Science as Co-Producer of Soviet Polity

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Abstract

The cultural authority of science reached its peak during the period of high modernity. Various countries and societies partook in this trend, but it found its ultimate expression within the communist, Soviet-type polity. This article discusses the cultural underpinnings of this characteristic feature of Soviet society and examines one of its major ramifications, the key role of scientific actors in creating and shaping the basic features of Soviet civilization. Examples illustrate this role in different time periods: from building the foundations of the Soviet state in the 1920s, through determining the major vectors of Stalinist economic expansion and industrialization, to designing some key priorities of post-Stalin reforms and the later perestroika. Different types of actors drew their power and inspiration from the cultural authority of science- "bourgeois specialists," amateur enthusiasts, engineers-turned-politicians, and nuclear physicists. Some of the important legacies they left behind continue to persist today, even if often misattributed, so that a historical analysis is required to uncover their original roots.

Key words: cultural authority, science and modernity, Soviet polity, experts and political advice

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In a 1936 letter to his Danish colleague Niels Bohr, the physicist and inventor Piotr Kapitza drew a figurative description of the relationship between science and politicians in the Soviet Union. The state, according to Kapitza, treated science like its most beloved pet or a hot-house plant, providing great amounts of attention, efforts, and resources otherwise scarcely available for the rest of society. At the same time, state officials often did not quite master the proper way of taking care of their darling, sometimes inflicting great pain.[1] Kapitza had personal reasons to complain about being wronged. Albeit a Soviet citizen, he had been developing an illustrious academic career in Great Britain until 1934, when the Soviet government abruptly and unexpectedly withdrew the permission to work abroad that he had enjoyed for thirteen years. Deprived of his newly built and richly equipped Cambridge laboratory, Kapitza was forced to remain within the Soviet Union, could no longer travel abroad, and had to restart his experimental research from scratch.

Yet Kapitza also felt that the personal injustice he suffered should not make him blind to the outlandish favors that the regime was granting science and its representatives, including himself. After all, a new modern institute was being built for him in Moscow

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[1] Piotr Kapitza to Niels Bohr, 20 October 1936 (Niels Bohr Archive, Copenhagen).

with exactly the same expensive equipment imported from Britain, and he started enjoying direct access to and the ear of powerful state officials, which he would manage to cultivate eventually to a degree unusual even for his Soviet colleagues, that included the rare privilege of personal correspondence with Stalin and other top political leaders.[2]

Both the high-level privilege and abuse were two sides of the same coin, namely, the extraordinary importance that Soviet culture and polity ascribed to science and scientists. This distinctive characteristic of Soviet civilization has been generally known and often taken for granted by both insiders and outsiders. Partly for this reason, and partly because of the lack of appropriate conceptual categories, it has not yet received adequate reflection and analysis in historical literature. In order to account for the special role and outsized influence of intellectuals in modern society, the French sociologist Pierre Bourdieu designed the category "cultural capital" (le capital culturel) as a way to characterize the excessive social resources and upward mobility available to members of the educated classes in disproportion to the relatively small share of material resources they commanded.[3] However tempting it is to apply the same category in the Soviet case, the underlying assumption behind it, attested by the very term "capital," presumes the kind of society in which the normative standard of influence and privilege granted to individuals is defined by their financial resources. Soviet society was founded precisely on the rejection of this premise and would not use monetary wealth as the basic standard against which to compare the intellectuals' relative prestige and privileges.[4]

A different kind of standard was often used by Soviet scientists themselves: the comparison between their status and that of their colleagues in major European and North American countries. They would typically understand that in absolute terms (although not necessarily in relative ones), the Soviet state could provide them with far fewer material resources for both research and personal consumption, than what was typically available to their Western colleagues. At the same time, they—especially those who, like Kapitza, experienced foreign realities firsthand—were able to acknowledge that scientists in Soviet society enjoyed much higher public prestige, visibility, and recognition, and also considerably more influence on important decision making. For the lack of a better term, or until a better term is found, let me call this characteristic "cultural authority," since authority in the Soviet conditions was a much more widely and commonly wielded resource than "capital."

As in situations described by Bourdieu, a major part of that authority derived from intellectuals' privileged relation to and command of a unique cultural resource, "scientific knowledge," with its ascribed unmatched degree of truthfulness and objectivity. A convergence of several historical trends allowed this resource to acquire significantly higher

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[2] Alexei Kojevnikov, "Scientist under Stalin's patronage: The case of Piotr Kapitza," Ch. 5 of *Stalin's Great Science: The Times and Adventures of Soviet Physicists* (London: Imperial College Press, 2004).

[3] Pierre Bourdieu and Jean Clause Passeron, *Reproduction in Education, Society and Culture* (London: Sage, 1977).

[4] A different meaningful connection between Soviet experiences and Bourdieu's concept can still be possible, as it can be argued that precisely the decoupling between wealth and education in modern society—introduced in a major way by making higher education free (in Soviet Russia in 1918 and spreading to the rest of Europe after WWII)—that allowed Bourdieu to develop his diagnosis of the cultural capital by the 1970s.

power in Soviet conditions as compared to other contemporary societies and cultures. From its main intellectual predecessors—the Enlightenment, classical Marxism, and the tradition of the 19th century Russian intelligentsia—the Soviet Marxism inherited a vision of science as a major force of progress, not only the economic and technical, but also the social one. In many European countries the relatively common 19th-century belief in progress and the related scientific/technological optimism took major hits after the destruction produced by WWI, but the Russian public drew the opposite lesson from the catastrophic experiences at the start of the twentieth century. The war disasters were more commonly attributed there to the relative lack of, rather than excess, of technological development, which only strengthened the existing cultural attachments to progress and the value of science.

The communist movement that came to govern as a result of the Russian revolution shared into this mood even more enthusiastically than other political forces of the century. Once they secured their power after the Civil War, the new leaders of Soviet Russia regarded science and technology as the sine qua non for achieving their primary economic objective—industrialization and modernization of the country—which they tended to identify with the building of socialism. The Soviet government allocated for research and development a significantly larger share of the national budget and resources then what was typical at the time for other countries with developed academic and research traditions.[5] Bolsheviks also hoped for the rational scientific worldview to unseat the power of religion and superstition in the minds of the people, especially the "backward" peasant masses. Their own unrestrained belief in the social power of science and reason often reached irrational, quasi-religious heights, and can be characterized as the cult of science and technology.

Science symbolized for Soviet communists not only the key engine of economic modernization, but also an important political and ideological ally. The general meaning of the word for "science" in Russian (*nauka*), as in German (*Wissenschaft*), embraced all fields of scholarship, including the humanities and social sciences. Even Marxism, according to the Bolshevik discourse, belonged to 'science' in this wider meaning and was labeled the "scientific ideology." Communists saw Marxism as methodologically modeled upon natural science, applying the naturalistic style of explanation to the study of human society and history, and therefore arriving at conclusions about the social world which were as certain and reliable as scientific truths about nature. The linguistically reinforced association between Marxism and science helped strengthen the perception about their close alliance shared strongly within the communist world.

Authors associated with or inspired by the communist movement formulated specific visions regarding science, which at the time encountered strong ideological opposition, even if today some of them, slightly rephrased, may be perceived as common sense. Once decried by anti-communists as dangerous, subversive, and distinctively ideological, these

[5] Large-scale government spending on research and development and systematical statistical data on it would become a major feature only in the post-WWII world. For the pre-war situation, the earliest significant estimates and international comparisons came from J. D. Bernal, the British communist who in the mid-1930s orchestrated the momentum to make the UK government increase its investment in research. On Bernal and "Bernalism" in science policy, see Brenda Swann and Francis Aprahamian, eds. *J. D. Bernal: A Life in Science and Politics* (London: Verso, 1999).

conceptions developed from the basic Marxist view that scientific thought, even at its most abstract, had originated from the practical, economic, activity of the people. The related conclusion that scientific research should develop in awareness of and in correlation with the needs of society stirred much outcry, since it contradicted the cherished ideology of the late 19th- early 20th century academics that proclaimed the ultimate value of "pure research," separated from the corrupting influence of "applied" interests and concerns. To communists, however, even the most fundamental science was worthy of its name only if it had potential useful applications, at least in the future perspective. The significant increase in public support for science, according to them, was conditioned upon the principle of "planning," or directing investigations towards satisfying social and economic goals formulated by the state (or "goal-oriented research," in today's parlance).

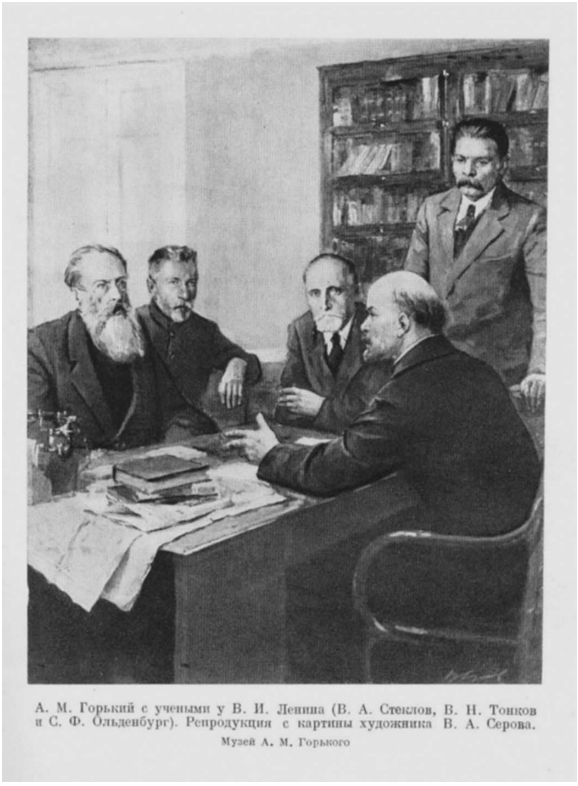
Guided by such ideas, communists did not see much value in the principle of the autonomy of the academic profession as a closed, self-governing corporation. Instead, they promoted the ideal of science as a public profession, supported by public funds, consciously guided by social needs, and oriented towards producing useful knowledge, with the distribution of resources over the main directions of research planned and managed "rationally" by appropriate institutions of the state. They also rejected the elitist concept of science as the privileged activity of individual "great minds" and independent free thinkers, driven by purely intellectual interests and curiosity. Instead, communist-inspired governments strove to open up scientific activities and occupations to non-elites and made higher education free and accessible to large numbers of representatives of once underprivileged classes and groups, including women and ethnic minorities.[6]

Earlier, in the paper just cited, I discussed in some detail the consequences that the Soviet vision of science entailed for the actual practice of research during the twentieth century. Some novel developments that eventually managed to spread internationally included the transformation of scientific research into a mass profession and full-time occupation, separate from the job of university teaching, the development of a network of government-funded R&D institutions of "big science," a set of educational and promotion practices similar to what is known today as "affirmative action," and the philosophical view on the nature of scientific knowledge as a social construction. In this essay I am focusing instead on the other side of the coin, namely on the formative impact that the unprecedented high cultural authority of science exerted on the development of the Soviet polity and society at large. To start approaching this question, let us consider several important encounters in which science and its representatives could be seen as agents shaping some of the fundamental social and political developments in Soviet history. Since the Soviet concept of science embraced applied R&D, engineers could also have a legitimate claim on representing "science" as such. They did, in fact, often appear in such roles (especially prior to WWII) and will be correspondingly included in some of the discussion that follows.

The first encounter on the list is in part symbolic-representational and in part real, represented by a socialist-realist painting of the 1930s.[7] In partial fulfillment of the "real-

[6] Alexei Kojevnikov, "The Phenomenon of Soviet Science," *Osiris*, vol. 23 (2008): 115–135.

[7] V. A. Serov, "A. M. Gorky and scientists meeting with V. I. Lenin," reproduced from *Gorky i Nauka: Stat'i, Rechi, Pis'ma, Vospominaniya* (Moscow: Nauka, 1964).



А. М. Горький с учеными у В. И. Ленина (В. А. Стеклов, В. Н. Тонков и С. Ф. Ольденбург). Репродукция с картины художника В. А. Серова.
Музей А. М. Горького

Figure 1

ist" genre specifications, it depicts real historical characters and the meeting that actually took place in January 1921 (Figure 1). Via the mediation of the famous writer Maxim Gorky, Lenin received at the Kremlin leading representatives of national science: the vice-president and the permanent secretary of the Russian Academy of Sciences, Vladimir Steklov and Sergei Oldenburg, and the director of the Military Medical Academy Vladimir Tonkov. The painter deliberately omitted one important aspect of the encounter: the academics came to deliver complaints and to plead on behalf of their Petrograd colleagues, college professors who had gone on strike in protest against miserable economic conditions in the city at the end of the Civil War and the heavy-handed tactics of government officials who were pushing through a radical reform of university education. The revolutionary government valued, but did not have too much sympathy for university professors, often treated them with contempt, as "bourgeois professoriate," and granted only minor concessions to their demands. In contrast, when Bolshevik state officials were approached by sometimes the very same individual academics, but acting in a different role—qua researchers representing science, rather than university professors—they were enormously sympathetic to the requests and suggestions. Quite a few scientists reported with amazement how certain research proposals and ideas, that under the old regime would have taken

years of bureaucratic deliberations and paper pushing, and then been tabled nevertheless, received prompt and enthusiastic approval from the new Soviet government acting in a "swift revolutionary manner."[8] Even some scientists who otherwise had very little respect for the general political program of the Bolsheviks could not help but admit that they were impressed by the new government attitude towards research. The propagandistic painting depicts this very aspect of the story and reaffirms the fundamentally communist vision of science: science and revolutionary politics, represented by their symbolic leaders, meet and talk as equals and understand each other as allies, united by overlapping values and worldviews.

The Russian Academy had already concluded a deal on such terms with the Bolshevik government at an earlier similar encounter in 1918. The new project both sides quickly agreed upon—the Commission for the Study of Natural Productive Forces (KEPS)—reflected the marked shift away from pure science towards prioritizing economically oriented research. For the Academy, this shift had originated during WWI out of concerns with wartime economic crisis, while the Bolsheviks wanted the same on the basis of their ideological vision of science. The crucial function of transforming scientists' agendas into government-sponsored and adopted projects was often performed by a facilitator, not necessarily the most visible or high-ranking participant, but capable of mediating between the academic and political circles. In the case of KEPS, this role fell to the relatively young geochemist Aleksandr Fersman (1883–1945).

Fersman studied mineralogy with Vladimir Vernadsky at Moscow University during the first decade of the 20th century. He belonged to the generation of researchers who were transforming traditional mineralogy into a new discipline of geochemistry by incorporating into it modern physical concepts (atoms, their spatial dimensions and mutual arrangements in crystals) and by studying the relative abundance of various chemical elements in segments of the Earth's crust. The war turned his interests decisively towards applied research, and like his teacher Vernadsky, Fersman saw the key towards economic modernization of Russia in the country's enormous, still largely unexplored territories and their yet-to-be-found rich natural resources. On Vernadsky's initiative, the Russian Academy launched KEPS as a modest initiative in 1915 and allocated start-up funds for its activities. Vernadsky, a political opponent of the Bolsheviks, left Petrograd after the fall of the Provisional Government in 1917 and did not return until the end of the Civil War in 1921. During his absence, Fersman ran KEPS as its secretary and oversaw the Commission's transformation into a huge enterprise, supported by the new Bolshevik government on a previously unimaginable scale. He was not a communist, and would never join the party—he was a typical "bourgeois expert" in the political terminology of the time—but succeeded like almost no one else in directing the energy and resources of the revolutionary state into the projects he and his academic colleagues deemed scientifically and economically worthy.[9]

[8] See, for example, characteristic recollections of an émigré scientist who had dealt with the Bolshevik government in both roles: as professor, opposing the communist reform of university education, and as researcher, collaborating with the same government in a responsible advisory position: M. M. Novikov, "Moscow University during the first years of the Bolshevik regime," in: Moskovskii Universitet, 1755–1930 (Paris, 1930): 156–192.

[9] A. I. Perel'man, *Aleksandr Evgenievich Fersman* (*1883–1945*) (Moscow: Nauka, 1983).

Figure 2

By the time of the revolution, scientists from the Geological Committee of the Imperial Department of Mining had nearly completed the comprehensive geological map of Russia's European part, where most of the country's demographic, transportation, and economic activities had been concentrated. They only started contemplating the intimidating task of exploring and mapping the vast, mostly uninhabited, almost inaccessible, and climatically hostile expanses of Siberia and the Arctic North.[10] Fersman's first Bolshevik-sponsored expedition of 1920 headed north from Petrograd, along the recently completed railroad to the White-Sea port Murmansk. In the Khibin Mountains beyond the Arctic Circle, his parties would eventually discover deposits of copper, nickel, and the world's richest source of apatite, phosphorus-containing ores (Figure 2). Fersman later expanded the main routes of his expeditions beyond the Urals, to Siberia, and Central Asia.

In decisions, choices, and proposals made by geologists during those formative years of the emerging Soviet polity we can find explanations for the main geographical vectors of the Soviet economic expansion from 1920 at least to the end of the Stalin period, and sometimes beyond. During the unprecedented upheaval and industrialization of that era, enormous efforts would be spent on daring and costly projects directed towards the Far

[10] I. L. Kleopov, *Geologicheskii Komitet, 1882–1929 gg. Istoriia Geologii v Rossii* (Moscow: Nauka, 1964).

North and North East, in contrast to the mostly Southern and South-Western vectors of Russian industrialization during the late Imperial period. The wisdom of prioritizing the search for resources in such remote and hard-to-survive territories over those that were located closer and were easier to develop could and was doubted by some cautious commentators. But the Bolshevik government did not count caution among its virtues, and it went along with the risky, at that time economically still uncertain, but heroic and inspiring proposals of its scientists.

The similarly overambitious project of electrification of Russia, GOELRO, started almost simultaneously, in 1920. Much discussed, it still needs to be mentioned briefly here for the point of interpretation. Huge efforts by state propaganda assigned the credit for this visionary enterprise to Lenin and the Bolshevik party, but this very intense propagandistic effort was required during the early stages of the project to quell the suspicions of many in the Bolshevik government that electrification was an adventurist program imposed upon the party by a team of mostly "bourgeois" specialists, in disregard of the much more pressing need to restart the damaged infrastructure that had already existed, but stopped working in the course of the Civil War. In contrast to this mundane, but desperately required job of at least partially restoring the prewar levels and types of economic productivity, the costly, long-term investment in GOELRO looked like a premature and misguided allocation of resources.

Yet Lenin decided to support this project, moved by its utopian futuristic appeal and by the authority of scientific experts, and he took the side of specialists despite the opposition from inside his own party. The key facilitator in this case—Georgy Krzhizhanovsky (1872–1959)—was actually a Bolshevik with an old prerevolutionary record, but after the failed first revolution of 1905 he withdrew from active conspiratorial politics. A railroad engineer by education and an aspiring poet, he took a legal job as an electrician in an upstart private company, because his reputation as "politically subversive" barred him from being employed by state-owned railroads. By 1917 he had risen through the company's ranks to the position of top manager and capitalist entrepreneur, while still politically and financially supporting the Bolsheviks.[11]

The company "Elektroperedacha" and its engineers were developing schemes for supplying power to Moscow from a region with abundant low-cost (but also low-quality) fuel. Their plans for building long-distance electrical networks with alternating currents and high-voltage generators ran counter to business competitors who favored simpler and safer low-voltage supply, which would have had to be local, based on many small generators of direct current located not far from the places of consumption. The basic technological choice between large-scale centers of power production with high-voltage AC transmission networks vs. small and independent, locally produced DC supply lines constituted the main dilemma of electrification in practically every country where the use of electric power was becoming widespread. Eventually, as Thomas Hughes has described in his classic study, the victory everywhere would go to long-distance AC networks connecting large power stations.[12] In Soviet Russia, this technological choice was enacted by a group of

[11] Vl. Kartzev, *Krzhizhanovsky* (Moscow: Molodaia Gvardiia, 1980).

[12] Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore:

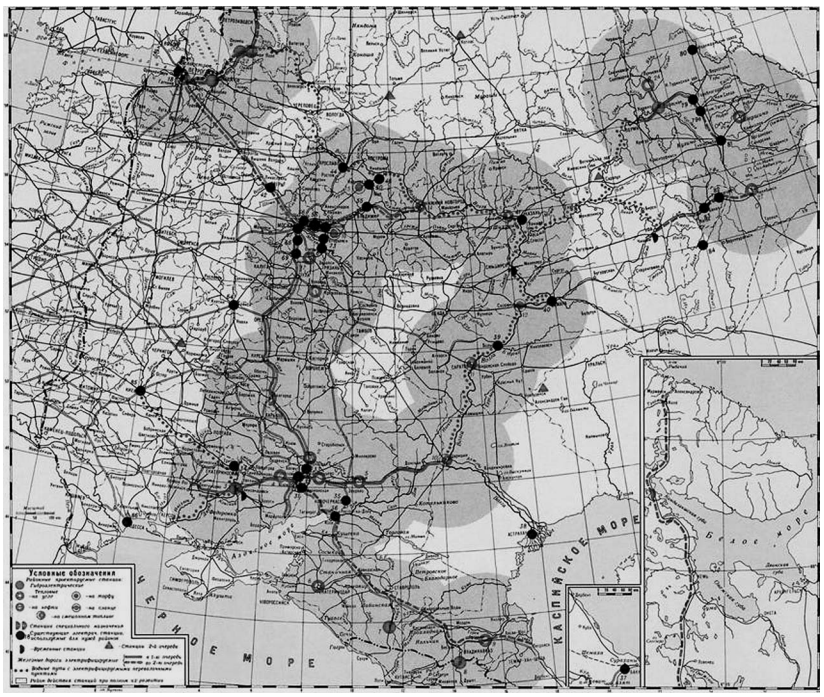


Figure 3

electrical engineers by way of successful lobbying of the new revolutionary government. It certainly helped that Krzhizhanovsky was personally acquainted with Lenin since the early conspiratorial years of Russian Marxism. His 1919 article with the proposal of electrification network caught Lenin's attention, and the latter pushed for its political approval at the 8th All-Russia Congress of Soviets in December 1920.

Krzhizhanovsky and his team designed the plan for building 27 large regional power stations with a high-voltage transmission network covering large parts of European Russia (Figure 3). They argued—with some reason—that this technological scheme was not only economically more efficient, but also intrinsically "socialist," meaning that it was more in tune and could be realized much easier within an economy based on state property and centralization of resources, rather than one influenced by private interests and local property concerns. With the exception of Krzhizhanovsky himself, the GOELRO Commission consisted of "bourgeois specialists," yet it provided the precedent and the model for what would eventually become the quintessential Soviet-style "planning": radically oriented towards the future, rejecting gradualism and skepticism, with ambitious propagandistic goals that tended to disregard the paucity of available resources and cautious economic calculations, and often requiring longer-than-projected time for actual completion. Out of the GOELRO case emerged not only the style, but also the central political

The Johns Hopkins University Press, 1993); Jonathan Coopersmith, *The Electrification of Russia, 1880–1926* (Ithaca: Cornell University Press, 1992).

organ for Soviet planning—GOSPLAN, or the State Planning Committee—for this is how the Krzhizhanovsky commission was renamed and continued to exist after it completed its first plan for electrification. In the later perception, it would have been hard to point to a political institution more quintessentially Soviet than GOSPLAN, the chief symbol of socialist economic planning. At its origin, however, GOSPLAN was the business of non-party scientists and engineers, which was somewhat extraneously and artificially attached to the main body of the Soviet government with its Commissariats.

Starting from the Civil War and until the end of NEP in 1928, "bourgeois" scientists and engineers enjoyed much stronger political influence with the Bolshevik government than they had had within the pre-revolutionary, Imperial polity. Non-party professionals not only provided much advice that was acted upon, but were personally involved in the everyday business of governing. They took responsible official positions and figured prominently in Soviet military, industrial, medical, agricultural, and educational commissariats, directly participated in making politically important decisions, including the metric reform, calendar and spelling reforms, the financial reform, the grand project of electrification, industrial planning and construction, and many other matters of state governance.

Some communist militants suspected all along that the arrangement gave specialists ample opportunities to exert their own political, and not necessarily communist-inspired, influences under the guise of scientific expertise. These worries prevailed in 1928, when the existing compromise with "bourgeois specialists" was declared a failure because of an alleged anti-Soviet conspiracy of engineers in the small mining town of Shachty. This event signaled the outbreak of the so-called Cultural Revolution, which in a couple of years made "bourgeois specialist" an obsolete term. Although non-party scientists and engineers with pre-revolutionary education continued to be employed in the fields of their professional expertise, they could no longer occupy responsible government offices simply on the grounds of their knowledge, unless they could also prove themselves as fully and reliably Soviet by their political outlook. And many were replaced in high administrative positions by representatives of the younger generation, so-called "red specialists," who received their professional education after the revolution and were expected to combine professional scientific training with properly Soviet political upbringings and values. Among this group we can find novel types of politically important actors who were able to use the authority of science as a cultural resource. The darlings of the Cultural Revolution—amateur enthusiasts, typically students, whose radical initiatives at times managed to garner enough popularity and social momentum—represented one such type.

Recent studies on the history of the Soviet space quest, especially by Asif Siddiqi, revealed the astonishing degree to which the latter was driven by grass-roots amateurs and popular, mass science media.[13] The Soviet culture of the 1920s generated a genuine popular obsession with interplanetary travel. Similar attitudes developed in several other countries contemporaneously, but in the Soviet Union they enjoyed a particularly strong appeal due to the resonance with other utopian temptations of the time, whether political,

[13] Asif A. Siddiqi, *The Red Rockets' Glare: Spaceflight and the Soviet Imagination, 1857–1957* (New York: Cambridge University Press, 2010).

Figure 4

social, or technological.[14] Popular science literature provided by far the most influential and effective way of spreading the idea and recruiting support for it. Dissemination of scientific knowledge to broad masses occupied a special place within the Soviet ideological vision of science, and publishing houses considered the production of such literature a very high priority.[15] Arguably no other writer of this genre could rival Yakov Perelman (1882–1942), who claimed his first major success with the 1913 publication of "Physics for Entertainment," and whose books sold 13 million copies over the next 60 years. Perelman embraced the dream of space exploration early on and published a book on this topic already in 1923 (Figure 4). Perhaps even more importantly, he used the idea to capture the imagination of young people in other books, including many subsequent editions of "Physics for Entertainment." He managed to convince his predominantly teenage audience that mathematics and physics were fun, thus succeeding spectacularly where most of to-

[14] Richard Stites, *Revolutionary Dreams: Utopian Vision and Experimental Life in the Russian Revolution* (New York: Oxford University Press, 1991).

[15] James T. Andrews, *Science for the Masses: The Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917–1934* (College Station: Texas A & M University Press, 2003).

day's educators fail. Moreover, for at least forty years before the official start of the space age, millions of his young readers learned to calculate the speed required by a spaceship to take off from the Earth as part of their initial acquaintance with the thrill of science.

A group of students and amateurs established the first voluntary society for the promotion of space travel in Moscow in 1924, following a media craze and the success of the pioneering science fiction movie, *Aelita*, featuring travel to Mars and contacts with an extraterrestrial civilization. Five years later, by the time of the cultural revolution, some of these students were not only dreaming and discussing, but tinkering and materializing primitive rocketry designs in wood and metal. They were assisted in these efforts by whatever little infrastructure and resources the Soviet educational establishment could provide for amateur youth activities in the field of technological creativity. Several local groups of engineering enthusiasts engaged in small-scale rocketry construction as an after-hours hobby, while occupied with more respectable and practical topics in their regular class assignments. Another thirty years later, several of these amateur pioneers would be working as leading designers of the official Soviet space project, including Valentin Glushko, Sergei Korolev, and Mikhail Tikhonravov.

In the meantime, they had to learn to constrain their space dreams for long and hard decades, due to the heavy political circumstances of the mid-century. In the 1930s, amateur rocketeers managed to impress high officials in the Soviet military sufficiently to be taken seriously as professionals and supported in a special design bureau. Of course, the Red Army had no interest in space travel, but was speeding up its preparations for the major war that was already threatening. Rocketry engineers abandoned ambitious futuristic projects and focused on more realistic and down to Earth designs for immediate military applications in WWII, and subsequently the Cold War, all the while also trying to survive the Stalinist purges of the military. Their star moment, literally, arrived only in January 1956, when the team headed by Korolev was preparing to test the world's first intercontinental missile.

At this juncture it became clear that at least some of the engineers did not entirely forget their youthful dream of space travel that decades earlier had brought them into the then amateur field of rocketry design. They still understood their chief mission to be about the strategic defense of the Soviet homeland, not cosmonautics. But the missile with a range of 7000 km they had just designed to carry a thermonuclear warhead was also perfectly capable of delivering a modest payload into the first space orbit. At an opportune moment when the new Soviet leader Nikita Khrushchev inspected and happened to be particularly pleased with their progress, Korolev requested permission to use one of the future missile tests for a sputnik launch. Khrushchev needed reassurances that such a distraction would not delay in any way the main priority of defense, but agreed to reward his scientists and engineers in their desire, even if it looked somewhat childish.[16] The space race became a major Cold War priority and a primary concern for political leaders only post factum—the morning after it had been effectively won by a team of engineers with their first Sputnik orbiting the Earth on 4 October 1957 and sending radio waves with funny beeping sounds.

[16] Sergei Khrushchev, *Nikita Khrushchev: Krizisy i rakety. Vzgliad iznutri* (Moscow: Novosti, 1994) vol. 1: 111.

Rocketry for space exploration was but one of many scientific-technological utopias that were gathering grass-roots momentum at the time of the cultural revolution, and not all of them were as harmless as Sputnik. Romantic enthusiasm for Northern exploration combined with lobbying efforts by activists from Siberia in the founding of another voluntary association, the Great Northern Way Society, which by 1930 established its central office in Moscow in proximity of the Kremlin. The Society bombarded state agencies with its ambitious proposal that paralleled, but should not be confused with a rival, subsequently pursued Northern Sea Route project that dispatched icebreakers and cargo ships along the Arctic coast in order to prove that the North-Eastern passage could be traversed within one navigation season. The Great Northern Way proposal envisioned instead a railroad almost 10.000 kilometers long, built from Leningrad on the Baltic Sea to Magadan on the Northern Pacific coast, running along the northern 60th parallel, through tundra, taiga, swamp, and permafrost, crossing the mighty Siberian rivers, along vast Arctic territory with only a handful of human settlements separated by thousand kilometers unsuited for habitation. The road's most ardent promoter, Professor Viktor Vobly (1877–1942), promised rich untapped resources and accelerated industrial development of the Far North, but was not as specific on the resources and human labor required for such an enterprise. Luckily, the ambitious project did not succeed in winning government's support.[17]

In the meantime, the Siberian geological committee had been sending its exploration parties all the way up to the Far North. The expeditions by Nikolai Urvantsev (1893–1985) in 1920–1921 and Georgy Ushakov (1901–1963) in 1930–1932 confirmed the existence of rich resources of coal near what is now Norilsk, at 69 degrees northern latitude, currently the second largest city above the Arctic Circle. Geologists were enthusiastic to report that they had managed to survive the long polar winter at such extreme latitude, thus proving the location suitable for human life (Figure 5).[18] They and other explorers of the North-East at the time probably did not anticipate that within a few years, the steps traversed by small geological parties driven by scientific enthusiasm and the thrill of exploration would be followed by convoys of GULAG prisoners. By the end of the 1930s, in the wake of Stalinist purges, thousands of convicts would be sent against their will to remote locations discovered by geologists, to years of hard labor, cold, hunger, and probable death, all for the sake of industrial development of precious resources in extremely inhospitable parts of the globe. Tens of thousands of frozen corpses buried around the gold mines of Kolyma and the nickel combine of Norilsk by 1950 were also part of the price paid for the unconstrained belief in scientific and technological progress. The terrible human suffering during Stalin's times developed the wealth in natural resources that is feeding the Russian economy today, and the Norilsk combine continues to turn huge profits as the world's largest source of nickel and rare metals.

Enthusiasts so common during the cultural revolution period, scientific and otherwise, often themselves became victims of the Stalinist purges, or, like the rocketry engineers discussed above, had to constrain and adapt their behavior to the more sober and desperate

[17] RGAE (Russian State Archive of Economics), Moscow. (Fond 4372, Opis' 28, Delo 464, 465, 469)

[18] N. N. Urvantsev, *Otkrytie Noril'ska* (Moscow: Nauka, 1981); E. M. Syziumov, *Pokoritel' nekhozhennykh zemel'* (Moscow: Mysl', 1967).

Figure 5

times. The Soviet polity of the period dominated by the threat, and then the outbreak of the terrible war, favored different types of actors and a different style of beliefs in the power of science and technology. In the culture of high Stalinism, the unity of science and politics was supposed to be achieved by the new generation of professional managers, experts, and politicians who tended to combine low class origin, strict communist upbringing, and engineering education. Typical Stalinist apparatchiks were usually recruited from among the graduates of engineering colleges, not those of law or politics. Many who received their technical education around 1930 went into political and economic management. Even if their scientific training was not always adequate for professional work as an engineer or researcher, it was still superior to that of a conventional politician. On this ground, their political and managerial skills were declared more suitable to the industrialization era than those of Old Bolsheviks—literarily eloquent but technically illiterate revolutionary conspirators and political agitators. The purges of old communists offered the new generation of Stalinist politicians some breathtaking career opportunities. Some of them by the late 1930s—while themselves in their thirties—rose to become heads of national corporations and state ministries. By the time of Stalin's death in 1953, this generation of engineers-turned-politicians constituted the bulk of cadres from which the new members of the Soviet Politburo were recruited, and they would remain in the majority within the Politburo until the very last years of the Soviet era.

Many of the late Soviet leaders—Khrushchev, Brezhnev, Kosygin, Podgorny, Ustinov, and others—all had at least a modicum of engineering education. Even if they had jumped into managerial careers immediately upon graduation and had little work experience as actual designers, they still retained certain ideals and ideas picked up in college in the 1930s. Many of their pet initiatives and favorite solutions to society's problems, well into the 1980s, focused on building large-scale dams and canals, hydroelectric stations with power networks, and railroads crisscrossing underdeveloped territories. Some other

officials from the same generation, while similarly trained, remained closer to the evolving practice of technology and invention even while serving in politically responsible offices. This experience appears to have provided them on occasion with important insights and innovation in political thinking and decision-making. The case in point is the engineer-cum-politician Viacheslav Malyshev (1902–1957), arguably one of the least known, but most underappreciated and understudied Soviet reformers (Figure 6).

Malyshev's early career provides an almost textbook example of a Stalinist apparatchik-in-the-making. Born to a family of a poor school teacher and growing up in a small provincial town, he joined the Communist Party and worked at a railroad depot. The cultural revolution recruited him, at the age of 27, from the factory bench onto a bench in an engineering college. He had served as a factory engineer for four years after graduation until another political upheaval—the wave of Stalinist purges—vacated so many positions in the ministerial ranks that someone like Malyshev, from the lower levels of administration and thus untainted by connections to the arrested high officers—could be called upon and promoted directly to a ministerial post. Malyshev was appointed the Commissar of Heavy Industry in 1939, when he was only 37 and just a few years after his engineering degree.

Figure 6

His most important service came with the Great Patriotic War of 1941–45, when Malyshev was responsible for the Soviet tank industry and managed to increase production from less than 10 to more than 100 tanks a day, thus ensuring a crucial source of the Soviet victory over German armies.[19]

Other ministerial appointments in industry followed, culminating with the supervision of nuclear weapons development after the fall of Lavrentii Beria in September 1953. As the overseer of projects dealing with new technologies, Malyshev-the-engineer had to continue learning gadgets: first locomotives, then tanks, and finally strategic weaponry. In the meantime, his political rank increased up to full membership in the Politburo in 1952, yet he did not seem to have much noticeable influence on Soviet policies en large. But during the subsequent period of great political fluidity and uncertainty—the interregnum following Stalin's death in 1953 until the full consolidation of power by Khrushchev in 1957 (and Malyshev's own death from leukemia the same year)—he and his immediate entourage of scientific advisers and experts appear to have initiated several highly important political changes in Soviet thinking about nuclear deterrence.

First came the decision to prioritize the development of intercontinental ballistic missiles (ICBMs) as the means of delivery. In the immediate postwar years, the development of rocketry in the Soviet Union proceeded gradually from the tasks of replicating the German V2's, improving their characteristics, and developing missiles for anti-aircraft defense. Although militarily important, missile technology did not share the highest prestige and priority ascribed to the atomic bomb. In the meantime, Soviet aircraft designers were developing strategic bombers with a similar flight distance and carrying capacity to those in the US arsenal. Yet the early Cold War strategic balance of threat was anything but symmetrical, and not merely with regard to the unequal number of atomic bombs but, most importantly, geopolitically. For delivery capability, the US could rely on more than a hundred airbases established across the globe, including countries close to the Soviet borders, from which bombers with nuclear payloads could quickly reach target cities deep inside Soviet territory. The USSR did not possess forward bases, which made bombers impractical as a means of retaliation against American territory, and thus its nuclear deterrence remained largely symbolic even with the possession of the atomic bomb.

Upon his appointment in 1953 as the head of the ministry in charge of nuclear technology, Malyshev questioned atomic scientists regarding the possible weight of the thermonuclear bomb, which was then still in the development stage. He received a somewhat deliberately overstated estimate of 3 tons, according to Andrei Sakharov's recollections.[20] When this parameter crossed the compartmentalization barriers erected around every top-secret project and was communicated to another classified team of researchers who worked on missiles, it pushed Korolev's group to leapfrog several incremental stages in the development of the first ICBM, called R7, by 1956. This machine was capable of flying to the American continent, for the first time making possible some retaliation and a different, non-symmetrical, deterrence against the nuclear bombers targeting Soviet cities.[21]

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[19] V. Chalmaev, *Malyshev* (Moscow: Molodaia Gvardiia, 1978).

[20] Andrei Sakharov, *Memoirs* (New York: Knopf, 1990): 180–181.

[21] This was still only a minimal deterrence, nothing even remotely resembling strategic parity, which would

In 1954 another commission of atomic experts headed by Malyshev came to the conclusion that would eventually become known as MAD, or mutually assured destruction. By then the Soviet atomic scientists had developed the design for a fully functional thermonuclear bomb and realized that it allowed for an increase in explosive power without any upper limit whatsoever (by contrast, the explosive power of the atomic bomb could not be enlarged significantly beyond what had already been achieved). The Malyshev commission reasoned that against such weapons, no practical defense was possible, and estimated that the explosion of about 100 large hydrogen bombs would create levels of radiation high enough to make impossible the continuation of all human life on Earth.[22] Their arguments eventually convinced Khrushchev to declare publicly in 1956, at the Twentieth Party Congress, that major wars had become avoidable and to announce the principle of "peaceful coexistence" with capitalism, which became the cornerstone of Soviet strategic doctrine until the very end of the Soviet-type polity under Gorbachev.

The intellectual path from Malyshev to Gorbachev was traversed by another Soviet scientist/engineer turned politician, Andrei Sakharov (1921–1989). Sakharov, of course, is better known as a political dissident and an opponent of the Soviet system. It is rarely understood that his very opposition to the regime developed gradually, by the end of the 1960s, out of his attachment to the profoundly Soviet system of values. A believer in the ideal goals of the socialist system, its morality and professed values, including the unrestricted cult of science and progress, Sakharov came to view the Soviet realities as not living up sufficiently close to these ideals. "The scientific method of directing policy, the economy, arts, education, and military affairs still has not become a reality," he complained, convinced that his scientific expertise, more than anything else, particularly on the strategic questions of nuclear security, entitled him to speak out on political matters even to the displeasure of higher authorities.[23]

Sakharov's major political essay of 1968 proceeded from the principle of peaceful coexistence, which he supported wholeheartedly. He insisted on the necessity of a common recognition that a nuclear war would destroy not just one adversary or both, but the entire civilization on Earth—a conclusion, he observed, that was still resisted by Maoists in the communist camp and by strategists of so-called "limited nuclear war" in the US. Throughout his life to the very end, he valued his contribution to the development of Soviet nuclear weapons as a way to establish a more symmetric strategic balance and prevent further Hiroshimas and Nagasakis. Sakharov strengthened his conclusions further in the 1970s, arguing that, in order to avoid a suicidal nuclear conflict, the two political systems would eventually need to undo their ideological opposition as well. Moving beyond the official Soviet understanding of peaceful coexistence as related primarily to military affairs, but not to the ideological rivalry, he started advocating "convergence," a gradual and peaceful rapprochement of socialist and capitalist principles, ideologies, and societies.

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only be achieved after another fifteen years of catching-up with the US in arms race.

[22] V. Malyshev, together with I. V. Kurchatov, A. I. Alikhanov, I. K. Kikoin, and A. P. Vinogradov, "Opasnosti atomnoi voiny i predlozhenie prezidenta Eizenkhauera," (April 1954). I am grateful to Vladislav Zubok for sharing with me a copy of this important archival document.

[23] Andrei Sakharov, *Reflection of Progress, Peaceful Coexistence, and Intellectual Freedom* (1968).

The basic ground for convergence, according to Sakharov, lay in the principle of human rights. The 1948 "Universal Declaration of Human Rights" by the United Nations combined the lofty goals of capitalism and socialism into a common ideal, including on the one hand political, intellectual, and religious freedoms, and on the other racial, ethnic, and gender equality, universal employment and healthcare, and other social rights. Even if neither social system was then prepared to realize the entire spectrum of human rights immediately and fully, their mutual acceptance of the overarching commitment in principle, as formulated by the internationally approved Declaration, opened, to Sakharov, the way towards the gradual removal of the main ideological divide of the 20th century. The opposing ideologies of capitalism and socialism, to him, were both undesirable and unviable in their radical versions, while their moderate modifications had more commonalities than differences.[24]

During the 1970s, Sakharov saw Western societies as doing more of their share of convergence via human rights, but was utterly frustrated by the failure of the Soviet regime to move beyond Khrushchev's limited de-Stalinization. Yet Sakharov's long held dreams came true with the start of Gorbachev's perestroika in 1985, when the Soviet Union started moving towards convergence at an incredibly fast pace. Much of the political agenda that Gorbachev famously promoted—the slogans of glasnost, democratization, the rule of law, and the priority of international commitments over internal legislation, in particularly with regard to human rights—had been formulated by Sakharov and other dissidents during the preceding decades. But Gorbachev, as a clever political tactician, advanced these initiatives

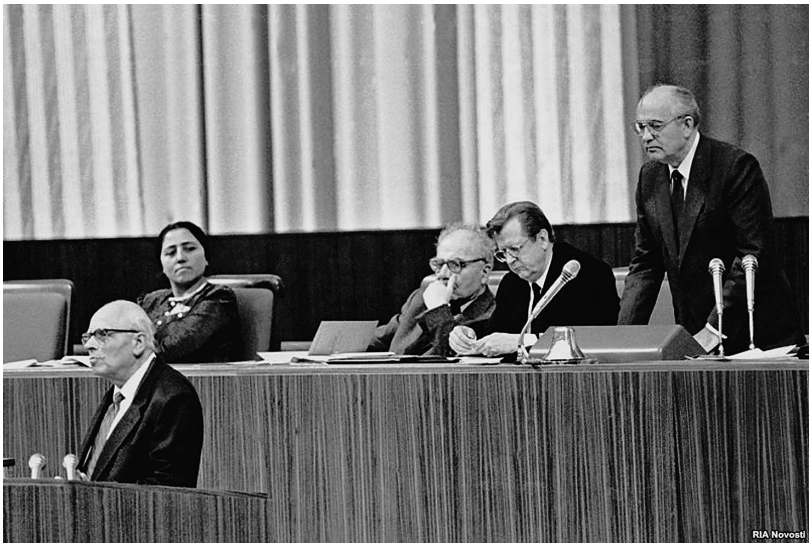

Figure 7

[24] Andrei Sakharov, "Dvizhenie za prava cheloveka v SSSR i Vostochnoi Evrope—tseli, znachenie, trudnosti" (1978) and "Konvergentsiia, Mirnoe Sosushchestvovanie" (1988) in *Sobranie Sochinenii: Trevoga i Nadezhda* (2006) 1: 487–510 and 2: 221–226.

one at a time, throwing his official power behind them only when he thought the time was ripe and he could assure adequate support for them. Sakharov's pronouncements, on the other hand, radicalized faster, and he was accustomed to arguing from a minority position for ideas which ran ahead of the changing limits of acceptable political discourse. Until Sakharov's death in 1989, their mutual dialogue and disagreements continued to push the reforms further, as the last major contribution of Soviet science towards the development of Soviet polity and political thought (Figure 7).

Conclusions

Power often subverts its own basis sooner or later. In 1960, at the time when the cultural authority of science in the Soviet Union stood at its highest, scientists used it to lobby for a political decision that in the long run proved detrimental to this very authority. Led by several nuclear experts who had done much to improve the country's strategic security, the Soviet Academy of Science decided that not only nuclear physicists, but the Academy as a whole, could be rewarded by disengaging from further applied work and concentrating primarily on "fundamental research." The Academy won permission to close its division of engineering sciences and transferred many applied institutes to other state agencies.[25] In the wake of hugely successful atomic and space projects, scientists felt secure enough to assume that their existing cultural authority could be taken for granted and would continue, without further proofs of practical importance, to ensure high levels of support by society and the state. In actuality, the authority of science after its separation from useful applications went into a slow but continuous decline during the remaining thirty years of the Soviet polity. Yet even at the very end of Soviet history, the social prestige of science still remained at a noticeably higher level in the USSR than in Western societies of the same time period, primarily because the other chief source of its decline—the 1960s cultural critiques of science and modernism—did not spread much into the Soviet Union.

The cultural authority of science collapsed abruptly and simultaneously with the Soviet Union itself, together with its' by that time rejected system of values. Almost overnight the prestige of science plunged down from a significantly higher into a much lower level than in the West. The most frequently used Russian saying of the 1990s, "If you are so intelligent, why aren't you rich?" reflected upon the problem in precisely Bourdieu's categories, only using plain words stripped of academic garb. It explicitly rejected Bourdieu's thesis that cultural capital could have any additional value besides economic one. The mentality of the time did not reflect upon the fact, that oil, metal, energy, and other national resources which were then being turned into enormous "real" capital, i.e. money, had been explored, developed, acquired, prospected, and built in the course of Soviet history through the cultural power of science. This important economic legacy of the Soviet polity, as well as many other pivotal decisions and politically important developments in the Soviet Union, cannot be properly understood without taking the effects of overblown scientific authority into account. Can one then characterize the Soviet polity as "technoc-

[25] Konstantin Ivanov, "Science after Stalin: Forging a New Image of Soviet Science," *Science in Context*, (2002), Vol. 15: 317–338.

racy"? In my view, not in the full sense of this ideal type, but it did come closer to this theoretical possibility than any other known society, past or present.

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