Introduction

The history of the Soviet Union and the history of space exploration share a paradoxical quality: each is a history of possible futures. At times, both the Soviet project and the space program were grounded in deep-rooted expectations for new possibilities, utopian and pragmatic in nature. The coincident nature of these two projects – one largely social and the other broadly technological – has reinforced the notion that the Soviet space program was the outcome of forces that were deeply consistent with the aims and ideologies of the state. As a result, our understanding of the Soviet space program has been encumbered with a tone of inevitability, as if the effort inexorably sprang from a massive state infrastructure driven only by ideological considerations.

This perceived intersection of ideology, state intervention, and technology was embodied most potently in *Sputnik*, the world's first artificial satellite. In the days and weeks after *Sputnik's* October 4, 1957 launch, these connections provided a forceful narrative for the Soviet and Western media, the former seeking to create a new history of its cosmic enthusiasm, and the latter eager to use that history to highlight the crisis of Western power at the height of the Cold War. This first satellite, whose name in Russian meant "fellow traveler," fell from the heavens within a few weeks of its launch. Despite its early demise, *Sputnik* has remained in our collective imagination not only as a potent symbol of the political, social, and cultural possibilities of the late twentieth century but also as a metaphor for human aspirations and expectations for an exhilarating future.

Within the Soviet Union, the satellite and its successors invested the rising hopes of a new postwar "Sputnik generation" with a powerful icon.[1] Given the often conflicting hopes and disappointments of the Khrushchev era, the project of spaceflight was one of the few state policies that united all in its utopianism, heroism, and iconography. By the time cosmonaut Iurii Gagarin returned to Moscow after his historic flight into the cosmos in 1961, more people assembled in Red Square to welcome him than had for the parades celebrating victory in the Great Patriotic War. *Sputnik*, like

[1] Donald. J. Raleigh, *Russia's Sputnik Generation: Soviet Baby Boomers Talk About Their Lives* (Bloomington: Indiana University Press, 2006).

Gagarin, represented a powerful symbol for restoring Soviet pride in the aftermath of the economic, social, and political shocks of late Stalinism.[2]

Sputnik also served as potent evidence of the country's arrival as a superpower on the international stage. Five days after the launch, the front page of *Pravda* distilled its import down to a single headline: "A Great Victory in the Global Competition with Capitalism."[3] Loudly and often crudely, Nikita Khrushchev used the early successes in the Soviet space program to emphasize the political, social, technological, and ideological power of the modern Soviet Union. *Sputnik* also ensured serious consideration of Soviet claims – whether about science, or military power, or the economy. For years, many Western observers had disregarded Soviet assertions as crude propaganda, but the clear trail of the *Sputnik* satellite above the night skies of the American Midwest denuded the dismissive tenor of Westerners of its power, making clear once and for all that Soviet claims for global preeminence in science and technology rested on inarguable truths. There was also the unmistakable military connotation of *Sputnik*; implied in the many communiqués about the first satellite was the notion that any country capable of lobbing a satellite overhead could also deliver a nuclear bomb to the other side of the world. "Missile diplomacy" during the Khrushchev years depended to a large degree on the highly publicized successes of the early sputniks; the perceived Soviet mastery with rockets and space exploration fueled international confrontations of the early 1960s such as the Berlin and the Cuban Missile Crises.[4]

In the United States, *Sputnik* shocked a seemingly complacent society, secure in their new suburbs, vast highways, color televisions, and the highest peacetime budget in history. Launched on the same night that *Leave it to Beaver* premiered, *Sputnik* awoke a nation. Walter McDougall noted that "[n]o [single] event since Pearl Harbor set off such repercussions in public

[2] E. Iu. Zubkova, *Russia After the War: Hopes, Illusions, and Disappointments, 1945–1957* (London: M. E. Sharpe, 1998); Donald Filtzer, *Soviet Workers and Late Stalinism: Labour and the Restoration of the Stalinist System After World War II* (Cambridge, UK: Cambridge University Press, 2002).

[3] "Velikaia pobeda v mirnom sorevnovanii s kapitalizmom," *Pravda*, October 9, 1957.

[4] For Soviet perceptions of the "missile gap," see Sergei Khrushchev, *Nikita Khrushchev: Creation of a Superpower* (University Park, PA: Pennsylvania State University Press, 2000); Vladislav Zubok and Constantine Pleshakov, *Inside The Kremlin's Cold War: From Stalin to Khrushchev* (Cambridge, MA: Harvard University Press, 1996); Vladislav M. Zubok, *A Failed Empire: The Soviet Union in the Cold War from Stalin to Gorbachev* (Chapel Hill: University of North Carolina Press, 2007). For U.S. views, see Peter J. Roman, *Eisenhower and the Missile Gap* (Ithaca, NY: Cornell University Press, 1995); Christopher A. Preble, *John F. Kennedy and the Missile Gap* (DeKalb, IL: Northern Illinois University Press, 2004); Max Frankel, *High Noon: Kennedy, Khrushchev, and the Missile Crisis* (New York: Ballantine Books, 2004).

life."[5] A crisis of confidence washed over most of American society. The Eisenhower Administration produced legislation to create several new agencies, including the National Aeronautics and Space Administration (NASA). By the early 1960s, government-funded projects to improve the scientific and engineering expertise of the country vastly expanded. Believing that better education in Soviet Russia contributed to *Sputnik*, huge amounts of money poured into the American higher education system, making it a key component in the battles of the Cold War. These policies – the creation of new government agencies, increases in state-sponsored research and development, and the expansion and restructuring of higher education – significantly influenced America's political, social, and cultural trajectory in the Cold War.[6]

Historians have repeated a common narrative about the origins of *Sputnik*. It begins with the "patriarch" of Soviet cosmonautics, Konstantin Tsiolkovskii, who in 1903 mathematically substantiated that spaceflight was possible with the aid of liquid-propellant rockets. According to this deeply ingrained story, the Bol'sheviks recognized the value of Tsiolkovskii's work after the Russian Revolution, honored him with many awards, and declared him a national treasure. Inspired by Tsiolkovskii, young enthusiasts came together to build rockets. The Soviet government supported them, and in 1933 it sponsored the creation of a Reactive Scientific-Research Institute to build rockets. The institute produced remarkable scientific and technical results, gradually moving in parallel with the Germans until the Great Terror decimated the leaders of the effort. Historians believed that the rocketry effort was dealt a near-fatal blow and did not rebound until after the war, when Soviet engineers scoured Germany for the detritus of the Nazi rocket program. German engineering jump-started the Soviet rocketry program, and soon, Soviet designers under the charismatic Sergei Korolev began methodically building more powerful rockets. The designers convinced the Soviet government to use the new R-7 intercontinental ballistic missile to launch a satellite into space. The missile successfully inserted the

[5] Walter McDougall, . . . *the Heavens and the Earth: A Political History of the Space Age* (New York: Basic Books, 1985), 142.

[6] For only a small sampling of the literature on Sputnik's ramifications in the American milieu, see McDougall, *Heavens and the Earth*; Roger D. Launius, John M. Logsdon, and Robert W. Smith, eds., *Reconsidering Sputnik: Forty Years Since the Soviet Satellite* (Amsterdam: Harwood, 2000); Paul Dickson, *Sputnik: Shock of the Century* (New York: Walker & Co., 2001); Robert A. Divine, *The Sputnik Challenge: Eisenhower's Response to the Soviet Satellite* (New York: Oxford University Press, 1993); Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Andrew Hartman, *Education and the Cold War: The Battle for the American School* (New York: Palgrave Macmillan, 2008); Zuoyue Wang, *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (New Brunswick, NJ: Rutgers University Press, 2008).

small metal ball known as *Sputnik* into orbit in late 1957, inaugurating the space era.

Most of the literature on *Sputnik* – which essentially replays this idealized narrative arc – has leaned on a number of unquestioned presuppositions. The most important of these is the conceit that the preamble to *Sputnik* was characterized by sustained symbolic and material support of cosmic ideas by the state, which began in the aftermath of the Russian Revolution of 1917. This assumption goes hand in hand with an understanding that the state's intervention into matters of rockets and space also took the form of indiscriminate violence during the Great Terror in the late 1930s as a result of which the Soviet drive to the cosmos was immeasurably hindered. The notion of the "noble" scientist runs through this story, particularly in the name of Sergei Pavlovich Korolev – the founder of the Soviet space program, whose dreams of the cosmos overcame the horrific injuries of Stalinism. The hagiographic trope of "triumph over adversity" has been a consistent thread in the narrative of the Soviet space program. By focusing on some key individuals such as Korolev and Nikita Khrushchev, the conventional histories obscure the contributions of hundreds of thousands who were as much responsible for *Sputnik* as the men at the apex.[7]

Scholars have revisited the history of the Soviet space program but none have situated the development of rocket technology in the broader context of Soviet social and cultural history.[8] Russian historians, although freed from Soviet-era constraints, have been mired in celebration and hagiography and have avoided critical contextual questions.[9] Social and cultural historians of the Soviet Union have, meanwhile, typically avoided the topic of space exploration, seeing in it fodder only for techno-buffs and unreconstructed Cold Warriors. Those who have studied this history have focused

[7] William Shelton, *Soviet Space Exploration: The First Decade* (New York: Washington Square Press, 1968); Michael Stoiko, *Soviet Rocketry: Past, Present, and Future* (New York: Holt, Rinehart & Winston, 1970); Nicholas Daniloff, *The Kremlin and the Cosmos* (New York: Knopf, 1972); Peter Smolders, *Soviets in Space* (New York: Taplinger, 1973); James E. Oberg, *Red Star in Orbit* (New York: Random House, 1981); James Harford, *Korolev: How One Man Masterminded the Soviet Drive to Beat America to the Moon* (New York: Wiley, 1997).

[8] Useful works include David Easton Potts, "Soviet Man in Space: Politics and Technology from Stalin to Gorbachev (Vols. I and II)," Georgetown University, PhD Dissertation, 1992; William P. Barry, "The Missile Design Bureaux and Soviet Piloted Space Policy, 1953–1974," University of Oxford, DPhil Dissertation, 1995; Asif A. Siddiqi, *Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974* (Washington, DC: NASA, 2000).

[9] Ia. K. Golovanov, *Korolev: fakty i mify* (Moscow: Nauka, 1994); G. S. Vetrov, *S. P. Korolev i kosmonavtika: perve shagi* (Moscow: Nauka, 1994); Iu. P. Semenov, ed., *Raketno-Kosmicheskaia Korporatsiia "Energiia" imeni S. P. Koroleva* (Korolev: RKK Energiia, 1996); B. E. Chertok, *Rakety i liudi*, vols. 1–4 (Moscow: Mashinostroenie, 1994–1999); Iu. M. Baturin, ed., *Mirovaia pilotiruemaia kosmonavtika: Istoriia. Tekhnika. Liudi* (Moscow: RTSoft, 2005).

only on the halcyon days of the 1960s rather than the origins of Soviet cosmic aspirations.[10] Perhaps the most limiting factor was the dearth of archival sources, which were opened to scholars only after the collapse of the Soviet Union. Without primary sources, which conveyed the voices of the main actors, historians were unable to ask or answer difficult and nuanced questions about the space program.

Many have written about the Bol'shevik state's love affair with science and technology. A measure of technological utopianism had already emerged in Tsarist Russia at the turn of the century, but after the Bol'sheviks came to power in 1917, this fascination embodied a millenarian mantra.[11] This obsession with the power of science and technology to remake society was partly rooted in crude Marxism but much of it derived from the Bol'sheviks' own vision to remake Russia into a modern state, one which would compare and compete with the leading capitalist nations in forging a new path to the future. Here, the tools of capitalism – Ford's mass production, Taylor's scientific management, and the Wright Brothers' airplane – were value-neutral systems that could be relocated into a socialist context without the exploitative costs of capitalism; science and technology could, in this way, be de-linked from one ideology and connected to another.

The Bol'sheviks never adhered to a singular and sustained vision of the role of science and technology in building the new Soviet Union; on the contrary, the Party's approach was neither monolithic nor consistent. For example, in the 1920s, during the time of the New Economic Policy (NEP), the Bol'sheviks reluctantly embraced the old pre-Revolutionary scientific elite, conceding that their skills might be of use during a period of reconstruction. But by the 1930s, after the Cultural Revolution, Stalinist imperatives resulted in a backlash against the old intelligentsia who were seen as being divorced from the "real" problems of socialist construction. Instead, Party directives embraced a more populist stance on science and technology, "technology for the masses," in the words of a popular adage of the day.[12]

[10] Cathleen Susan Lewis, "A History of the Public and Material Culture of Early Human Spaceflight in the U.S.S.R.," George Washington University, PhD Dissertation, 2008; Asif A. Siddiqi, "Privatising Memory: The Soviet Space Programme Through Museums and Memoirs," in *Showcasing Space*, eds. Martin Collins and Douglas Millard (London: The Science Museum, 2005), 98–115; Slava Gerovitch, " 'New Soviet Man' Inside Machine: Human Engineering, Spacecraft Design, and the Construction of Communism," *Osiris* 22 (2007): 135–157.

[11] Richard Stites, *Revolutionary Dreams: Utopian Vision and Experimental Life in the Russian Revolution* (New York: Oxford University Press, 1989).

[12] For important works on the place of science and technology in the Soviet Union during the interwar years, see Kendall E. Bailes, *Technology and Society Under Stalin: Origins of the Soviet Technical Intelligentsia, 1917–1941* (Princeton: Princeton University Press, 1978); Robert A. Lewis, *Science and Industrialisation in the USSR* (New York: Holmes & Meier, 1979); Nicholas Lampert, *The Technical Intelligentsia and the Soviet State: A Study of Soviet Managers and Technicians, 1928–1935* (New York: Holmes & Meier, 1980).

Historians of Soviet and Russian science have, however, largely avoided the space program.[13] Two disciplinary considerations have kept them away. First, their primary concern has been the natural and physical sciences and not technology. Second, their interests led them to problems that exposed ideological "interference" in science rather than cases such as the space program that seemed to support rather than be distorted by official state discourses. During the Cold War, pioneering scholars of Soviet science such as David Joravsky and Loren Graham underscored the important relationship between ideology and Soviet science.[14] Yet most laypeople typically understood this connection within the Soviet context as discrete and unidirectional. For example, the "failures" of Soviet science, including the disastrous case of Lysenko and the ban on genetics research from 1948 to 1964, represented stark examples of the negative influence of ideology on science. Meanwhile, the successes of Soviet science were seen as exceptions where Soviet scientists succeeded despite the draconic and limiting structures imposed upon them.[15] The past decade-and-a-half of scholarship on Soviet science has completely overturned such views.[16] Besides returning agency to the scientific community and investing our understanding of the role of scientific and engineering practice under Stalin with deeper complexity and nuance, the most important achievement of this new literature has been to dislodge the perception that the Lysenko affair was emblematic of Soviet science as a whole.[17]

[13] For canonical works on Soviet and Russian science, see Zhores Medvedev, *Soviet Science* (New York: Norton, 1978); Alexander Vucinich, *Empire of Knowledge: The Academy of Sciences of the USSR (1917–1970)* (Berkeley: University of California Press, 1984); Loren R. Graham, *Science in Russia and the Soviet Union: A Short History* (Cambridge, UK: Cambridge University Press, 1993).

[14] David Joravsky, *Soviet Marxism and Natural Science, 1917–1932* (New York: Columbia University Press, 1961); Loren R. Graham, *Science, Philosophy, and Human Behavior in the Soviet Union* (New York: Columbia University Press, 1987).

[15] See, for example, Medvedev, *Soviet Science*; Valery N. Soyfer, *Lysenko and the Tragedy of Soviet Science* (New Brunswick, NJ: Rutgers University Press, 1994); Paul R. Josephson, *Totalitarian Science and Technology* (Atlantic Highlands, NJ: Humanities Press, 1996).

[16] Michael D. Gordin, Karl Hall, and Alexei B. Kojevnikov, eds., *Osiris, 2nd Series, Vol. 23 (Intelligentsia Science: The Russian Century, 1860-1960)* (Chicago: University of Chicago Press, 2008); Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, MA: MIT Press, 2002); Alexei B. Kojevnikov, *Stalin's Great Science: The Times and Adventures of Soviet Physicists* (London: Imperial College Press, 2004); Ethan Pollock, *Stalin and the Soviet Science Wars* (Princeton: Princeton University Press, 2006). See also the special issue of *Science in Context* 15 no. 2 (2002).

[17] Although written partly with the aim of making Soviet scientists agents of their own fate, Nikolai Krementsov's *Stalinist Science* (Princeton: Princeton University Press, 1997) helped to reinforce the centrality of the Lysenko episode in our understanding of Soviet science. For an excellent critique of this earlier school of thought, see Michael D. Gordin, "Was There Ever a 'Stalinist Science'?," *Kritika: Explorations in Russian and European History* 9 no. 3 (Summer 2008) 625–639.

If the relationship between science and the Soviet state (and indeed the lack of delineation between the two) has been a subject of much fresh inquiry, mass engagement with science and technology during Soviet times, including popular (and populist) enthusiasm for science, has, until very recently, been a marginalized field. Mass campaigns involving science and technology were, however, part and parcel of prevailing Soviet culture, especially in the interwar years. James Andrews' recent work on public science has underscored the ways in which public enthusiasm was not simply a result of structured state directives but had significant foundation in genuine mass interest in the powers of science and technology.[18] Lewis Siegelbaum and Scott Palmer have also explored specific dimensions of public engagement with science and technology, deepening our understanding of how Soviet scientific enthusiasm was a peculiar combination of the mundanely practical and the grandiosely symbolic.[19] This new work has not been monolithic. Where Siegelbaum sees automobile users as appropriating automotive technology in ways unanticipated by the state, Palmer sees the state as a more powerful force that exploited fascination with aviation to distract the populace from the earthly realities of the day.

Mass enthusiasm for science and technology in Soviet times had their own peculiarities, but they can be best understood as part of broader (usually) state-sponsored campaigns to encourage large segments of the population to invest their work and life with the transformative spirit of the Bol'shevik project. The most obvious touchstones here include Stakhanovism but there were many others, such as the celebration of new secular holidays and festivals, popular campaigns focused on atheism, stratospheric and arctic exploration, literacy initiatives, and industry-related programs such as the shock worker movement.[20] Historians who have investigated these phenomena have contended that mass enthusiasm for these causes were not cynically fostered by a monolithic state exerting power over a passive populace; they were the result of earnest "bottom-up" zeal that often mutated into forms at odds with the original intention of the campaigns.

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

[19] Lewis H. Siegelbaum, *Cars for Comrades: The Life of the Soviet Automobile* (Ithaca, NY: Cornell University Press, 2008); Scott W. Palmer, *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia* (New York: Cambridge University Press, 2006).

[20] Lewis H. Siegelbaum, *Stakhanovism and the Politics of Productivity in the USSR, 1935–1941* (Cambridge, UK: Cambridge University Press, 1988); Daniel Peris, *Storming the Heavens: The Soviet League of the Militant Godless* (Ithaca, NY: Cornell University Press, 1998); John McCannon, *Red Arctic: Polar Exploration and the Myth of the North in the Soviet Union, 1932-1939* (New York: Oxford University Press, 1998); Karen Petrone, *'Life Has Become More Joyous, Comrades': Celebrations in the Time of Stalin* (Bloomington: Indiana University Press, 2000); William Husband, *'Godless Communists': Atheism and Society in Soviet Russia, 1917–1932* (DeKalb, IL: Northern Illinois University Press, 2000).

This book builds upon both the recent scholarship on Soviet science and technology and the new literature on mass campaigns in the Soviet milieu. It is the first to revisit *Sputnik* by locating its birth within Soviet and Russian social and cultural history. Grounded in archival research, it recovers an alternate history of the birth of the Soviet space program, giving voice to those who were at the center in action but were consigned to the periphery in recollection. It is a story of utopian ideals, expansive imagination, and popular mobilization.

I reframe the birth of the Soviet space program by bridging *imagination* with *engineering* – seeing them not as dialectic, discrete, and sequential but as mutable, intertwined, and concurrent. Both imagination and engineering were necessary to attain the reality of space exploration. Russian imagining of the cosmos dated back to the late nineteenth century, a time when the first seeds of cosmic enthusiasm were sown in the broader literate public. This curiosity percolated into a burst of utopian fascination in the 1920s that inspired and then intersected with the practical realities of rocket engineering a decade later. Imagination and engineering not only fed each other but were coproduced by key actors who maintained a delicate line between secret work on rockets (which interested the military) and public prognostications on the cosmos (which captivated the populace). *Sputnik* was the outcome of both large-scale state imperatives to harness science and technology and populist phenomena that frequently owed little to the whims and needs of the state apparatus.

This book is also one of the first *social* histories of Soviet science and technology, one that describes the popular mobilization for science and technology rather than simply a story of state directives and elite communities. It contests accepted notions about the origins of the Soviet space program, about the history of Soviet science and technology, and more broadly, about the spaces for local initiative in Soviet society. I argue that the primary state institution typically associated with the advancement and sponsorship of Soviet science, the Academy of Sciences, was only marginally involved in the genesis and creation of one of the greatest public advertisements for Soviet science, their space program. Instead, the century-long origin of the Soviet space program provides evidence of a kind of "science from below," which later intersected with the military imperative to build rockets in giving birth to the space program.

The first major theme of this study centers on the state's relationship to the cause of space exploration. Undoubtedly, the launch of *Sputnik* would have been impossible without the vast state commitment to develop the intercontinental ballistic missile that inserted the satellite into orbit. But though the development of the ICBM is a fundamental part of the story of *Sputnik's* birth, Party and government leaders considered it first and foremost a strategic weapon to deter the United States; without the intervention of a small group of missile designers who were also active space enthusiasts, the two

originating streams of utopian imagination and military engineering might not have intersected. In the received narrative of Soviet space history, the state appears as the central and indispensable agent in creating the Soviet space program, beginning with its grand and supposedly farsighted gestures in the 1920s and 1930s in elevating spaceflight as an important goal for the nation. In fact, Party and government officials had no interest in cosmic topics until the early 1950s.

That the state played an important role in every facet of Soviet life is inarguable, but as social and cultural historians have argued for decades now, agency also resided in the Soviet populace. All aspects of Soviet life at the height of Stalinism – such as work culture, urban life, family, mass campaigns, language, ritual, and aesthetics to name only a few – were defined by the outcome of negotiations between state actors and those outside the formal levers of power.[21] Not only did the state's attempt to legislate most public behavior frequently have unexpected outcomes, but the state could not intervene in all aspects of Soviet life, leaving key areas where the seemingly powerless were able to shape important phenomena.

During the Soviet era, the state also had a deep and abiding interest in the management of public opinion.[22] Mobilizing public attitudes in support of state imperatives was not, however, always easy or successful. In fact, as I show, at various times during the Soviet era – including at the height of Stalinism – it was possible for public opinion to mold state choices about science and technology, especially if those arguing on behalf of the public invoked the threat of foreign competition. For example, in the early 1950s, Soviet space enthusiast writers successfully elevated space exploration as a worthy goal for the Soviet Union in the backdrop of increasing American publications on the topic. In other words, the creation of a *popular* consensus about the place of science and technology in Soviet society was an important factor feeding state policy. Historians of Russian science, accustomed to focusing on elite scientific communities and their relationship to state ideologies, have largely missed these interactions, rendering invisible a key lever of influence on state science and technology policy.[23]

[21] For a few recent examples, see Wendy Goldman, *Women, the State, and Revolution: Soviet Family Policy and Social Life, 1917–1936* (Cambridge, UK: Cambridge University Press, 1993); David Hoffman, *Peasant Metropolis: Social Identities in Moscow, 1929–1941* (Ithaca, NY: Cornell University Press, 1994); Lewis Siegelbaum and William Rosenberg, eds., *Social Dimensions of Soviet Industrialization* (Bloomington: Indiana University Press, 1993); Stephen Kotkin, *Magic Mountain: Stalinism as Civilization* (Berkeley: University of California Press, 1995); Matthew E. Lenoe, *Closer the Masses: Stalinist Culture, Social Revolution, and Soviet Newspapers* (Cambridge, MA: Harvard University Press, 2004).

[22] See, for example, Sarah Davies, *Popular Opinion in Stalin's Russia: Terror, Propaganda, and Dissent, 1934–1941* (Cambridge, UK: Cambridge University Press, 1997).

[23] Andrews' *Science for the Masses* was the first major work on the topic of science as a public phenomenon, although he stopped short of mapping the public discourse with formal scientific and technical work at the institutional level.

The gaps in the standard social history of Soviet science led me to the second major theme of my work, the social factors – specifically people involved in self-motivated activity – in enabling the project of spaceflight. These included, but were not limited to, amateur individuals without any formal education, members of semigovernmental mass voluntary societies, and science popularizers and journalists. My goal is to relocate the development of rockets and the advocacy of spaceflight in broader Soviet social and cultural history. By this, I mean not just the upheavals generally associated with Soviet science, but also, for example, the cultural explorations of the period of New Economic Policy (NEP), the social forces that led to the Great Terror, and post–World War II visions of technological utopianism.[24]

Beginning in the 1920s, disparate men and women joined together in urban centers across the Soviet Union to establish informal networks to exchange ideas on the possibility of space exploration. Despite complete (and understandable) indifference from the Soviet government, these networks flourished, leading to the formation of early amateur societies, circles (*kruzhki*), and exhibitions that played key roles in fostering the first widespread interest in space exploration among the Soviet populace. Space and rocketry activists reframed their rhetoric to adjust to prevailing social and political conditions. For example, in the early 1930s, they worked through mass voluntary societies and touted the advantages of "stratospheric" exploration; in the 1940s, they established a powerful network of rocket designers in Soviet-occupied Germany; and in the 1950s, defense industry designers on the "inside" formed an effective alliance with journalists on the "outside" to mobilize public opinion in support of a space program, once again despite a lack of interest from the government. In each case, the nature of the discourse generated or the type of rocket produced was neither predetermined nor inevitable but resulted from a complex play of social, political, and military factors; it was "socially constructed," in the parlance of historians of technology.[25]

[24] For literature on NEP, see Sheila Fitzpatrick, Alexander Rabinowitch, and Richard Stites, eds., *Russia in the Era of NEP: Explorations in Soviet Society and Culture* (Bloomington: Indiana University Press, 1991); Stites, *Revolutionary Dreams*; and Abbott Gleason, Peter Kenez, and Richard Stites, eds., *Bolshevik Culture: Experiment and Order in the Russian Revolution* (Bloomington: Indiana University Press, 1985). For the Great Terror, see J. Arch Getty and Roberta T. Manning, eds., *Stalin's Terror: New Perspectives* (New York: Cambridge University Press, 1993); J. Arch Getty and Oleg V. Naumov, eds., *The Road to Terror: Stalin and the Self-Destruction of the Bolsheviks, 1932–1939* (New Haven: Yale University Press, 1999); Wendy Z. Goldman, *Terror and Democracy in the Age of Stalin: The Social Dynamics of Repression* (New York: Cambridge University Press, 2007).

[25] For important works on the social construction of technology, see Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: MIT Press, 1987); Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press, 1995); Donald Mackenzie,