Stalin's Rocket Designers' Leap into Space:
The Technical Intelligentsia Faces the Thaw

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ABSTRACT

This article explores the impact of the professional culture of rocket engineering in Stalin's Soviet Union on the engineering and organizational practices of the space program during the Khrushchev era. The Stalinist legacy and the dual military/civilian character of rocket engineers' work profoundly affected the identity of this elite part of Soviet technical intelligentsia. Focusing on such notions as control, authority, and responsibility, this article examines the role of engineering culture in shaping the Soviet approach to the automation of piloted spacecraft control. Through patronage and networking, rocket engineers were able to overcome the inefficiency of Soviet industrial management and to advance their agenda of space exploration.

INTRODUCTION

On September 25, 1938, Joseph Stalin signed a list of seventy-four military specialists and defense engineers, authorizing their execution by firing squad. The rest of the Politburo followed suit, huddling their signatures below Stalin's. This was a routine procedure; in 1937–1938, Stalin signed more than 350 such lists, condemning to death at least 39,000 people whose execution required his personal sanction. Number twenty-nine on the September 25 list was an engineer from a rocket research institute, one Sergei Korolev. He had been arrested in June 1938 on a trumped-up charge of wrecking and sabotage and tortured into confession.[1] Two days after Stalin's approval, a quick trial hearing was held. Fifty-nine people on the list were sentenced to death and immediately executed. Korolev was lucky: after retracting his

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[1] On the circumstances of Korolev's arrest, see Asif A. Siddiqi, "The Rockets' Red Glare: Technology, Conflict, and Terror in the Soviet Union," *Technology and Culture* 44 (2003): 470–501.

confession, he received only a ten-year sentence. Another engineer from the same institute, Valentin Glushko, had been arrested three months before Korolev, on the same charge, and was also sentenced to prison time. Glushko was sent to work at a *sharashka*, a prison design bureau. Korolev served the first several months at the notorious Kolyma labor camp, barely survived, and eventually ended up in the same sharashka as Glushko. Both were released in 1944, after successfully completing the design of a new airplane, but the charges against them were not formally dismissed for another ten years.[2]

The names of Korolev and Glushko are now associated with some of the most remarkable technological achievements of the twentieth century. Korolev, the chief designer of rocket technology, and Glushko, the chief designer of rocket engines, played crucial roles in the development of Soviet rocketry, building the first Soviet intercontinental ballistic missile, launching *Sputnik*, and sending the first man into space.[3]

The Stalinist oppressive policies also adversely affected many other rocket engineers. Boris Raushenbakh, a leading control systems engineer, was interned in a labor camp as an ethnic German during World War II.[4] Vasilii Mishin, Korolev's first deputy, who later succeeded Korolev as chief designer, lost his father in the Gulag.[5]

Nevertheless, the Stalin era has been held up as the golden age of rocketry in the historical mythology that permeates the Russian space industry. Space engineers often call the postwar years a "romantic" period, the time of optimism and enthusiasm.[6] I use the term "mythology" here without implying the truth or falsity of any particular historical claims but simply to stress the foundational, identity-shaping character of such claims.[7]

The Soviet space program achieved its greatest successes—*Sputnik*, the first man in space, the first group flight, the first woman's flight, the first multicrew mission—during the Khrushchev era. This was a tumultuous period, which combined many contradictory trends. Khrushchev's "secret speech" at the Twentieth Congress of the Communist Party condemned Stalin's "cult of personality" and opened the gates for de-Stalinization in wider society. Yet the violent Soviet suppression of the Hungarian uprising, the vociferous campaign against the Nobel laureate poet Boris Pasternak, and Khrushchev's public outbursts against liberal intellectuals testified not only to

[2] Konstantin Tomilin, "Stalin sanktsioniroval ubiistvo Koroleva," *Sarov* (June 2002); http://russcience.euro.ru/papers/korolev.htm (accessed 30 Oct. 2006). The list with Korolev's name is kept in f. 3, op. 24, d. 419, l. 170, Archive of the President of the Russian Federation, Moscow; http://www.memo.ru/history/vkvs/spiski/pg11170.htm (accessed 30 Oct. 2006).

[3] The most comprehensive history of the Soviet space program is Asif A. Siddiqi's thoroughly researched *Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974* (Washington, D.C., 2000), which includes an excellent bibliographic essay. For Korolev's well-researched biography, see Iaroslav Golovanov, *Korolev: Fakty i mify* (Moscow, 1994). For materials about Glushko, see V. F. Rakhmanin and L. E. Sternin, eds., *Odnazhdy i navsegda* (Moscow, 1998).

[4] Boris V. Raushenbakh, *Postskriptum* (Moscow, 2001).

[5] Deborah Cadbury, *Space Race* (New York, 2006), 95.

[6] E.g., see introductory remarks by Yurii Koptev, then the head of the Russian Aerospace Agency, in Yurii A. Mozzhorin, *Tak eto bylo* (Moscow, 2000); http://epizodsspace.testpilot.ru/bibl/mozjorin/tak/rka.html (accessed 30 Oct. 2006).

[7] On the selectivity of memories woven into various narratives of Soviet space history, see Asif A. Siddiqi, "Privatising Memory: The Soviet Space Programme through Museums and Memoirs," in *Showcasing Space*, ed. Martin Collins and Douglas Millard (London, 2005), 98–115; and Slava Gerovitch, "Creating Memories: Myth, Identity, and Culture in the Russian Space Age," in *Remembering the Space Age*, ed. Steven J. Dick and Roger D. Launius (forthcoming).

Khrushchev's oscillating personality but also to the uncertainty and instability that characterized this period's politics and culture. As the historian Polly Jones has noted, "Characteristic of the Khrushchev period were repeated swings in official policy, as the new leadership attempted to maintain a tense balance between enthusiasm for discarding the past, and uncontrolled iconoclasm, between mobilizing the energy of 'new forces', and giving in to anarchy, between maintaining the Soviet system, and causing its implosion."[8]

Among the confusions and contradictions of the Khrushchev era, the tremendous Soviet technological leap into space had a very specific symbolic meaning. In the public mind, it represented a daring breakthrough into the future—both into the technological utopia of interplanetary travel and into the political utopia of Communism. According to the 1963 poll by a popular youth-oriented Soviet newspaper, Yurii Gagarin's flight was viewed as the greatest human achievement of the century, and *Sputnik* the greatest technological feat.[9] In this sense, space exploration epitomized the thaw as a movement beyond Stalinism into a new and exciting political and cultural territory.[10]

This article attempts to look for the roots of the triumphs of the Khrushchev era in an earlier period by establishing the continuity of professional cultures of rocketry and space engineering. My focus is on two mutually shaping processes: the development of the space industry, and the formation of the identity and the professional culture of space engineers as a specific group of the Soviet technical intelligentsia in the late 1950s–1960s.

Historian Kendall Bailes stressed that the prewar Soviet "technostructure" did not simply follow orders issued by the "power structure." On the contrary, the technical intelligentsia played an active role in reshaping the Soviet social and cultural landscape.[11] Walter McDougall has noted a similar trend in the postwar period. In his study of the U.S. and Soviet space programs, he has emphasized the growing political influence during the cold war of the technocratic elites on both sides of the iron curtain.[12] Recent studies of the inner bureaucratic workings of the Soviet space program reveal a complex picture, in which different groups of space engineers competed for space projects and had to negotiate with multiple power brokers in the Communist Party and government apparatus, in the military, and in the defense industry.[13]

Focusing on the role of professional culture in rocket and space engineering, this

[8] Polly Jones, introduction to *The Dilemmas of De-Stalinization: Negotiating Cultural and Social Change in the Khrushchev Era*, ed. Polly Jones (London, 2006), 1–18, on 1. Jones's volume includes an excellent bibliography on the Khrushchev period. On de-Stalinization trends in Soviet science, see Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, Mass., 2002).

[9] Boris A. Grushin, *Chetyre zhizni Rossii v zerkale oprosov obshchestvennogo mneniia*, vol. 1, *Zhizn' 1-ia: Epokha Khrushcheva* (Moscow, 2001), 403.

[10] Slava Gerovitch, " 'New Soviet Man' Inside Machine: Human Engineering, Spacecraft Design, and the Construction of Communism," *The Self as Project: Politics and the Human Sciences in the Twentieth Century*, *Osiris* 22 (2007): 135–57.

[11] Kendall Bailes, *Technology and Society under Lenin and Stalin: Origins of the Soviet Technical Intelligentsia, 1917–1941* (Princeton, N.J., 1978).

[12] Walter A. McDougall, . . . *The Heavens and the Earth: A Political History of the Space Age* (New York, 1985).

[13] See Andrew John Aldrin, "Innovation, the Scientists, and the State: Programmatic Innovation and the Creation of the Soviet Space Program" (PhD diss., Univ. of California, Los Angeles, 1996); William Barry, "The Missile Design Bureaux and Soviet Piloted Space Policy, 1953–1974" (PhD diss., Oxford Univ., 1995); and Siddiqi, *Challenge to Apollo* (cit. n. 3).

essay draws on recent studies of patronage, networking, cultural norms, and social identity in Soviet society.[14] These studies have stressed the central role of personal networks in strengthening the Soviet state and at the same time helping individuals overcome bureaucratic bottlenecks. Sheila Fitzpatrick has argued that in Stalinist society "outward conformity to ideology and ritual mattered, but personal ties mattered even more."[15] Kiril Tomoff writes, "Born of inefficiency and encouraged by the Party's longstanding, self-proclaimed right to intervene to correct any bureaucratic shortcoming, unofficial networks permeated the bureaucratic system."[16] Gerald Easter and Jerry Hough have explored how cohesive groups of Soviet functionaries with close personal ties established and maintained the effectiveness and stability of the Soviet state.[17] Barbara Walker has suggested that "the Soviets were able to create such an inefficient means of redistribution at all precisely because effective prior networking and patronage relations mitigated and obscured the profound inadequacy of the bureaucratic system as it took shape."[18]

Professional networks played a particularly important role. Belonging to a professional network not only shaped the identity of engineers, scientists, and managers but also allowed them to consolidate their efforts in furthering their professional agenda. For example, according to Mark Adams, by using personal networks, the scientific community during the Khrushchev era proved "more resourceful at manipulating [the Soviet] system to serve its own agendas than even the most optimistic advocate of academic freedom might have hoped."[19]

Stressing the inconsistencies and uncertainties of ideological discourse and the shifting, unsettled nature of Soviet identities, these studies overturn the stereotypical picture of the Soviet citizen as either blindly supporting or passively resisting specific government policies. This perspective illuminates the complex dynamic of the technical intelligentsia's service to the state: the engineers constantly grappled with their problematic identity and tried to formulate their own technocratic agenda, while negotiating and reinterpreting government policies. Instead of positing an opposition between the technical intelligentsia and the state, it would be more productive to talk about the inner tensions that defined the intelligentsia's identity and about the intelligentsia's involvement in the formulation and implementation of government policies through both official and unofficial means.

[14] Major literature reviews in this field are Sheila Fitzpatrick, "Politics as Practice: Thoughts on a New Soviet Political History," *Kritika: Explorations in Russian and Eurasian History* 5 (2004): 27–54; Anna Krylova, "The Tenacious Liberal Subject in Soviet Studies," *Kritika* 1 (2000): 119–46; and Barbara Walker, "(Still) Searching for a Soviet Society: Personalized Political and Economic Ties in Recent Soviet Historiography: A Review Article," *Comparative Studies in Society and History* 433 (July 2001): 631–42.

[15] Sheila Fitzpatrick, *Everyday Stalinism: Ordinary Life in Extraordinary Times; Soviet Russia in the 1930s* (New York, 1999), 227.

[16] Kiril Tomoff, "'Most Respected Comrade . . .': Clients, Patrons, Brokers, and Unofficial Networks in the Stalinist Music World," *Contemporary European History* 11 (2002): 33–65, on 65.

[17] See Gerald M. Easter, *Reconstructing the State: Personal Networks and Elite Identity in Soviet Russia* (Cambridge, UK, 1999); and Jerry F. Hough, *The Soviet Prefects: The Local Party Organs in Industrial Decision-Making* (Cambridge, Mass., 1969).

[18] Walker, "(Still) Searching for a Soviet Society" (cit. n. 14), 635.

[19] Mark B. Adams, "Networks in Action: The Khrushchev Era, the Cold War, and the Transformation of Soviet Science," in *Science, History, and Social Activism: A Tribute to Everett Mendelsohn,* ed. Garland E. Allen and Roy MacLeod (Dordrecht, Netherlands, 2001), 255–76, on 271.

ORGANIZATIONAL PROBLEMS OF THE ROCKET AND SPACE INDUSTRY

The date of May 13, 1946, when Stalin signed a decree establishing a Special Committee for Reactive Technology, is still celebrated today as the birthday of the Russian rocket and space industry. The committee was headed by Stalin's chief lieutenant, Georgii Malenkov, and included several leading defense industry managers. The missile program was organized on the same principles as the atomic project, managed by the Special Committee No. 1: a crash program with direct political support from the top, vast funding, and enormous resources. Key institutions of rocketry development were created, including the Scientific Research Institute No. 88, which at that time included Korolev's design bureau.[20]

The story of Stalin's critical personal involvement in the launching of the Soviet rocket industry has been told many times and acquired mythic proportions. Some of it is clearly based on hearsay and has not been confirmed by documentary record.[21] Yet in the identity-shaping folklore of Soviet rocket designers, the truly significant support that the Soviet government gave to the highest priority missile program in the late Stalinist period is often personified in the figure of Stalin as a great benefactor of Soviet rocketry. After Stalin's death in March 1953, Korolev, clearly unaware of Stalin's personal role in his imprisonment, expressed genuine sorrow in a private letter to his wife: "Our Comrade Stalin passed away . . . My heart hurts so much, my throat is clogged, and there are no thoughts and no words to express the tragedy that befell all of us. This is truly a national, immeasurable tragedy—our beloved Comrade Stalin is no more."[22]

The launch of *Sputnik* in October 1957 on top of the R-7 intercontinental ballistic missile, designed by Korolev, became a highly visible sign of success of the missile program supervised by the Special Committee for Reactive Technology. The successful completion of the three major defense industry projects of late Stalinism—nuclear weapons, the ballistic missile, and radar—engendered a radical reorganization of the defense complex. Coupled with Khrushchev's far-reaching reform of the national system of economic management, this led to the complete dismantling of the old Stalinist system of defense industry management. In December 1957, the three special committees supervising the nuclear weapons, the ballistic missile, and the radar programs were abolished, and a new agency—the Commission on Military-Industrial Issues under the USSR Council of Ministers—was created instead to coordinate the work of the defense industry ministries.[23] That same year, another reform threatened the ministries themselves. Khrushchev proposed a radical management reform of the national economy, replacing the system of central ministries with a system of regional economic councils. Instead of a single ministry controlling all enterprises in a particular branch of industry across the entire Soviet Union, a regional

[20] For the full text of the 1946 decree, see Boris E. Chertok, *Rockets and People*, vol. 2, *Creating a Rocket Industry*, ed. Asif A. Siddiqi (Washington, D.C., 2006), 10–5.
[21] Asif A. Siddiqi, series introduction to Boris E. Chertok, *Rockets and People*, vol. 1 (Washington, D.C., 2005), ix–xix, on xvi.
[22] Nataliia Koroleva, *Otets*, 2 vols. (Moscow, 2002), 2:269.
[23] Chertok, *Rockets and People* (cit. n. 20), 2:23. On the Military-Industrial Commission, see Nikolai Stroev, "Voennaia aviatsia," in *Sovetskaia voennaia moshch' ot Stalina do Gorbacheva*, ed. Aleksandr Minaev (Moscow, 1999), 279–82.

economic council would supervise all the industries located on its territory. This threw the economy into chaos.[24]

The defense industry was not immune to the general economic disarray. In a letter to Khrushchev, a group of top managers tried to persuade him to exempt the defense industry from the management reform, but they failed.[25] Like other plants and factories, those producing missiles were transferred to the control of their regional councils. When Khrushchev famously proclaimed in the United Nations that Soviet plants were producing rockets “like sausage,” he was indeed correct. After the transfer, many of the problems that plagued the production of sausage now afflicted the production of missiles: broken supply chains across regional borders, poor coordination between central and regional agencies, and overlapping and conflicting spheres of authority among multiple supervising bodies.

The nascent space program had a particularly difficult time adapting to the new administrative regime. In the Soviet Union, there was no single central agency, like NASA, solely responsible for the funding and the supervision of space activities. Space projects were officially authorized by joint resolutions of the Party Central Committee and the Council of Ministers, but these decisions often came with no financial backing. In 1959, Korolev’s bureau received no funding for the development of the Vostok spacecraft and for the rockets it used to launch automatic lunar probes. By early 1960, the bureau had a deficit of 95 million rubles; by the end of February, it had exhausted all the funds allocated for the first quarter, and by March 1960, it had no cash at all. Korolev constantly petitioned his superiors for the 95 million rubles that the bureau had already spent fulfilling party and government resolutions. After a month of bureaucratic wrangling, Korolev received a 50 million ruble grant and a 22 million ruble loan, still far short of his needs.[26]

After Gagarin’s successful orbital flight on board *Vostok* in April 1961, a euphoric Khrushchev showered the space industry with medals and awards, and he became much more receptive to more ambitious plans of space travel to the Moon, Mars, and beyond. The new, larger projects, however, faced even greater organizational and financial problems than the Vostok program did. The growing complexity of rocket and spacecraft design and production required cooperation and coordination on an unprecedented scale. Korolev’s Experimental Design Bureau No. 1, which served as the rocket and space technology integrator, had to deal with 200 to 300 subcontractors. As a deputy chairman of the Military-Industrial Commission recalled, any broken deadline could lead to the “total disorganization of the entire project.”[27] Because the space program developed on the basis of ad hoc decisions of the party and the government, space projects often were not included in long-term economic planning. Their implementation required multiple adjustments of production plans for hundreds of enterprises across the Soviet Union. The cumbersome system of central planning had great difficulty managing such fast-paced large-scale technological projects.

[24] See Roy A. Medvedev and Zhores A. Medvedev, *Khrushchev: The Years in Power* (New York, 1978), 104–7.

[25] Irina V. Bystrova, *Voenno-promyshlennyi kompleks SSSR v gody kholodnoi voiny* (Moscow, 2000), 250.

[26] F. 4372, op. 79, d. 355, ll. 175–6, 216–7, Russian State Archive of the Economy (Rossiiskii Gosudarstvennyi Arkhiv Ekonomiki, hereafter cited as RGAE), Moscow.

[27] Georgii Pashkov, quoted in Aleksandr Ishlinskii, ed., *Akademik S. P. Korolev: Uchenyi, inzhener, chelovek* (Moscow, 1986), 318.

In July 1963, in an attempt to bring some order to the increasingly chaotic network of supply chains, the Council of Ministers established a system of monetary sanctions for undisciplined suppliers who did not fulfill their assignments on time. The reasons for delays, however, were often referred further and further down the supply chain, which made it nearly impossible to find and punish the "real" culprit. For example, in November 1965 a factory in Sverdlovsk was threatened with hefty fines for its failure to deliver a batch of launchers and missiles to the Ministry of Defense on time. By arguing that subcontractors had caused the delay in production, the factory officials obtained an exemption from the sanctions.[28]

The Soviet lunar program was besieged by inadequate funding and huge organizational problems. A rift between Korolev and Glushko resulted in Glushko's refusal to build engines for Korolev's N-1 lunar rocket and forced Korolev to collaborate with an engine contractor from another ministry. In the meantime, other leading missile designers, such as Vladimir Chelomey and Mikhail Yangel, actively promoted competing proposals for lunar missions. Korolev and his rivals cleverly used their political patronage ties with the top echelon of the Soviet government and lobbied for their own versions of government decrees. The ensuing compromise split the lunar program—including all the funds and resources—between Korolev and Chelomey. This resulted in an unprecedented duplication of effort in the design and production of lunar rockets and spacecraft.[29] The acute shortage of funds forced Korolev to cancel the construction of a ground testing facility for the entire cluster of first-stage engines for the N-1 rocket. This proved to be a fateful decision, one that spelled the ultimate failure of the entire program.[30]

The troubles with the organization of the rocket and space industry continued after Khrushchev's ouster from power in October 1964. In 1965, the Soviet government abolished the regional economic councils and restored the system of industrial branch ministries. The newly created Ministry of General Machine Building gathered under one administrative roof most of the bureaus and factories involved in rocket and space design and production. Korolev tried to seize this moment to transfer to the ministry as many of his subcontractors as possible. For example, in October 1965, he attempted to acquire control over the Balashikha plant that had been assigned the production of a fueling system for the N-1 rocket. He complained that the plant's performance was "exceptionally poor." Less than a year before the deadline, the plant had completed only 1 percent of the total amount of work. Korolev lost this round of bureaucratic power play: the plant was transferred to another ministry.[31]

The restoration of the ministry system did not solve the problem of component supply; in some ways, the system became even more complicated. Every contract between two organizations from different ministries now had to be approved by both ministries. Trying to reduce their overall load, various ministries often refused contracts for complex rocket and space equipment. For example, in February 1966, the Ministry of Electronic Industry flatly rejected a request to start production of ground control equipment for missiles and spacecraft. The head of the ministry declared that the proposal was "totally unrealistic and obviously impractical."[32] In August 1966,

[28] F. 4372, op. 81, d. 1249, ll. 139–40, RGAE.
[29] See Siddiqi, *Challenge to Apollo* (cit. n. 3), chaps. 9 and 11.
[30] Ibid., 392.
[31] F. 4372, op. 81, d. 1239, ll. 25–7, RGAE.
[32] F. 4372, op. 81, d. 1945, l. 16, RGAE.

the Ministry of Heavy Machinery refused to produce girders and support constructions for the N-1 assembly, even though the ministry had been assigned this task by the Party Central Committee, the Council of Ministers, and the Military-Industrial Commission.[33] "Having different ministries is like having different governments," one contemporary observed.[34]

In such circumstances, it was hardly surprising that the leaders of the rocket and space industry looked back at the Stalin years with a bit of nostalgia. In the folklore of Soviet rocketry, in the foundational myths that laid the narrative basis for rocket engineers' professional culture, even the fear and oppression of the Stalin era were often remembered fondly as productive mechanisms for instilling a strong sense of personal responsibility. For example, Yurii Mozzhorin, director of the Scientific Research Institute No. 88, wrote: "At that time, Joseph Stalin, who did not forgive any mistakes, was still in power, and our branch of industry was supervised by Lavrentii Beria, his henchman. For this reason, the development of technical-tactical specifications for rocket weaponry and its deployment had extraordinary significance and required a responsible approach."[35] Mozzhorin meaningfully pointed out that in the Stalin years no institutions, organizations, or individuals had been allowed to interfere with rocket research and production without special authorization from the Council of Ministers.[36]

Soviet rocket engineers' fond memories about Stalinism as the golden age of rocketry were quite selective. Lavrentii Beria was not, in fact, supervising Soviet rocketry (he was responsible for the atomic bomb), but his prominent presence in rocket engineers' folklore is indicative of their mythology of Stalinism. The perfect order and discipline of the Stalin era were a useful construct that helped the engineers to underscore their critique of the haphazard management of the space program under Khrushchev. In fact, in the late 1940s, top defense industry managers similarly complained of insufficient resources and petitioned to transfer factories from other ministries to their own control to ensure timely supplies.[37] Yet the image of the Stalinist era as the epitome of strong management, strict discipline, and personal responsibility formed the foundation for the professional culture of Soviet rocketry.

TAKING THE INITIATIVE

In May 1964, frustrated by the lack of action on the government resolutions authorizing the lunar program, Korolev decided to appeal to Leonid Brezhnev, then the secretary of the Central Committee for Defense Industry. "There are no firm deadlines, no essential organization, nor sufficient financial or material support," he wrote. "The initial sum of money set aside in 1964 for the Ministry of Defense to build preflight

[33] F. 4372, op. 81, d. 1944, l. 43, RGAE.

[34] V. Golovachev, "A Hercules Is Born," trans. Sharon Breit and Wade Holland, *Soviet Cybernetics: Recent News Items*, June 1967, no. 5:70–8, on 72.

[35] Mozzhorin, "Upravlenie raketnogo vooruzheniia GAU," chap. 2 in *Tak eto bylo* (cit. n. 6); http://epizodsspace.testpilot.ru/bibl/mozjorin/tak/02.html (accessed 30 Oct. 2006).

[36] Yurii A. Mozzhorin, "Rol' S.P. Koroleva v razvitii otechestvennoi raketnoi i kosmicheskoi tekhniki za 50 let (1946–1966 gg.)," *Iz istorii aviatsii i kosmonavtiki* 72 (1998); http://epizodsspace.testpilot.ru/bibl/iz-istorii/rol-kor.html (accessed 12 Oct. 2006). The Soviet government decree of May 13, 1946, stipulated, "No institutions, organizations, or individuals shall have the right to interfere with or ask for information concerning the work being conducted on reactive armaments without the special permission of the Council of Ministers." Chertok, *Rockets and People* (cit. n. 20), 2:11.

[37] Bystrova, *Voenno-promyshlennyi kompleks* (cit. n. 25), 244–6.

testing and launch facilities for the N-1, was 11 million rubles, but then the Ministry suddenly reduced this amount to 7 million, most recently to 4 million, and currently the Ministry refused any further financing of the N-1 construction despite the existing Party and Government resolution to this effect."[38] Korolev did not send the letter, perhaps realizing the futility of the effort. The customer—the Ministry of Defense—did not provide funds, subcontractors avoided contracts: Korolev was caught in the middle of a stalled economic and administrative structure.

The overly complicated system of Soviet defense industry management, which was supervised by several party and government agencies with overlapping authority and conflicting interests, relied on the Military-Industrial Commission to coordinate projects across agency lines. The commission, with its limited authority, could hardly manage large and complex space projects, and Korolev regularly complained about its poor performance. He suggested reorganizing the industry along the lines of the Stalin-era nuclear weapons and air defense programs, that is, placing a single central agency in charge.[39] Unable to effect such a radical administrative reform, he decided to facilitate government decision making and enforce the discipline of supply and production by other means. Korolev in effect established an alternative management mechanism, which complemented government structures and helped overcome bureaucratic barriers. He borrowed some of the proven management techniques of the Stalin era and adapted them for the new environment.

First, Korolev vastly expanded and strengthened his personal network. Like all chief designers, he attached special importance to the "vertical" patronage ties with Khrushchev and the chief patron of the defense industry, Dmitrii Ustinov. But his most effective tool was a "horizontal" network, linking top engineers and defense industry and military leaders. The hub of this network was the Council of Chief Designers. He organized this informal body in 1947 to coordinate the efforts of several key institutions involved in the design of the first Soviet ballistic missiles. The six original members of the council were Sergei Korolev (the entire rocket complex), Valentin Glushko (rocket engines), Mikhail Ryazanskii (ground-based guidance systems), Nikolai Pilyugin (onboard guidance systems), Viktor Kuznetsov (the chief designer of gyroscopes), and Vladimir Barmin (launch equipment). The original six were bound together by the ties of personal acquaintance and friendship going back to the 1930s' early rocketry studies or to the 1940s' prolonged joint mission to occupied Germany to collect rocketry artifacts and know-how.[40] The council tackled 90 percent of all engineering problems.[41]

While working on *Sputnik*, the first lunar probes, and the first piloted spacecraft, Korolev realized that a whole host of new problems had arisen—both technical and administrative—that went far beyond the area of expertise and influence of the original "rocketry caste." He invited at least fifteen new members, including leading mathematicians, ballistics specialists, designers of communications systems, new engine designers, ground tracking specialists, physicians, and air force officials.[42]

38 Boris V. Raushenbakh, ed., *S. P. Korolev i ego delo: Svet i teni v istorii kosmonavtiki* (Moscow, 1998), 449–50.

39 Ibid., 443.

40 Chertok, *Rockets and People*, (cit. n. 21), 1:5; Chertok, *Rockets and People* (cit. n. 20), 2:6.

41 Boris E. Chertok, *Fili—Podlipki—Tiuratam*, vol. 2 of *Rakety i liudi*, 3rd ed. (Moscow, 2002), 413.

42 Ibid., 413–5.

Figure 1. *The Council of Chief Designers. From right to left: Viktor Kuznetsov, Vladimir Barmin, Valentin Glushko, Sergei Korolev, Nikolai Pilyugin, Mikhail Ryazanskii, and Aleksei Bogomolov. The first six were the members of the original council, organized by Korolev in 1947. This photo was taken in 1959 during control of a Luna mission to the Moon. (NASA photo no. chiefdesigners1959.)*

The sphere of the council's authority spread from pure engineering to organizational issues. Achieving a consensus among the chief designers was crucial not only for resolving internal disputes but also for presenting a joint front to lobby the higher authorities.

Members of the council played a unique role: through personal contacts and alliances with multiple power structures within the party and government apparatus, they lobbied for their projects, obtained official approval, and were able to enforce the execution of government orders, which government officials often failed to do. As Korolev's first deputy, Vasilii Mishin, aptly put it, "Korolev was built into the space program like an engine into a rocket. He fitted into the existing social and economic system so well that he could, in fact, circumvent it."[43] Konstantin Feoktistov, the leading spacecraft designer, confirmed that "strategic decisions were made not by the Party Central Committee or by the Government but by Ustinov and Korolev, and often by Korolev alone. Only later, one way or another, did they manage to obtain an official endorsement of those decisions by the 'competent organs.' "[44]

Instead of hierarchical top-to-bottom decision making, the council practiced consensus-building negotiations. If the chief designers could not reach a decision on a complex issue, the council created a working group to hammer out a compromise.

[43] Vasilii Mishin, "My dolzhny spustit'sia s nebes na Zemliu," *Nezavisimaia gazeta*, 12 April 2001; http://www.astronaut.ru/bookcase/article/article22.htm (accessed 30 Oct. 2006).

[44] Konstantin Feoktistov, *Traektoriia zhizni* (Moscow, 2000), 36–7.

As one memoirist recalled, Korolev's working style was to "arbitrate disputes."[45] Korolev was not willing to postpone decisions indefinitely, however. If the council could not eventually reach a consensus, he would make a decision himself.[46]

In the 1960s, the Council of Chief Designers, an informal body whose decisions had no legal binding power, became a de facto steering committee for the Soviet missile and space program. The council often invited to its sessions a large group of defense industry managers, military officials, and academics. At those informal meetings, Korolev and other chief designers could frankly exchange opinions on crucial technical and organizational issues without generating a huge bureaucratic paper trail. For example, in September 1960, the council meeting included eighty-seven participants and discussed the design of the N-1 heavy booster and its potential military applications.[47] In January 1961, the council met again to discuss specifically the choice of fuel for the N-1, taking into account the efficiency, toxicity, and cost of various fuels.[48] At the June 1964 meeting, the council made a crucial decision to use liquid oxygen as the main fuel for the N-1 and to use the N-1 in the lunar landing program.[49] This decision was officially approved in the August 1964 joint decree of the Party Central Committee and the Soviet government, authorizing the Soviet lunar landing program.[50] The deterioration of Korolev's personal network after his death in early 1966 is often pointed to as a key factor in the Soviets' ultimate loss in the lunar race.

Another Stalin-era mechanism that Korolev adapted for the 1960s was the personal responsibility of chief designers for the failure-free operation of their systems. In September 1960, as the Vostok spacecraft for the first human flight was being built, Korolev's design bureau prepared *Basic Guidelines for the Development and Preparation of the Object 3KA* (3KA was the code name for Vostok), which all members of the Council of Chief Designers later signed. They realized that the reliability of Vostok was of paramount importance, but the scale and complexity of the project made efficient quality control exceedingly difficult. The total of 123 organizations from various ministries and agencies, including thirty-six factories subordinated to thirteen different regional economic councils, participated in the construction of the Vostok rocket and spacecraft. The rocket engines had thirty-three chambers, and the spacecraft carried on board 241 vacuum tubes, more than 600 transistors, fifty-six electric motors, nearly 800 relays and switches connected by 880 electric plugs, and almost fifteen kilometers of cables.[51] The *Guidelines* established "personal responsibility of chief designers, factory directors, and heads of services for the quality of technical documentation, for the correctness of design, for the testing and reliability of construction elements, and for the quality of production, assembly, and testing."[52] Korolev believed that to ensure the reliability of the entire system, one had to instill the sense of responsibility not only in the top management but also in every worker involved in the production of Vostok. Every step in the assembly and testing was documented, including the names of the workers responsible for that step. Quality

[45] Vladimir Syromiatnikov, interview by author, 25 May 2004, Moscow.
[46] Evgenii Shabanov [Shabarov], quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 259.
[47] Raushenbakh, *S. P. Korolev i ego delo* (cit. n. 38), 305–8.
[48] Ibid., 319–23.
[49] Ibid., 455–60.
[50] Asif A. Siddiqi, "A Secret Uncovered: The Soviet Decision to Land Cosmonauts on the Moon," *Spaceflight* 46 (2004): 205–13.
[51] Iurii V. Biriukov, ed., *Materialy po istorii kosmicheskogo korablia "Vostok"* (Moscow, 2001), 213.
[52] Ibid., 128.

control at major stages of assembly and testing was assigned to military specialists from the Ministry of Defense. All Vostok parts were branded by a special mark and documented as "acceptable for 3KA." Every worker knew that the life of a cosmonaut depended on the quality of that part.[53] It is worth stressing that the *Guidelines* were not imposed on the industry by any official authority. This document was spread around and enforced through the informal network coordinated by the Council of Chief Designers.

For chief designers, greater personal responsibility meant greater personal authority. Korolev "quite consciously sought such authority," remarked the space engineer Georgii Vetrov. "Such authority brought him power, which the Chief Designer needed as much as a military commander."[54] Other memoirists also compared Korolev to a military commander[55] or even to "an absolute dictator."[56] "The huge burden of personal responsibility, which Korolev could not share with any of his subordinates, sometimes made him exigent to the point of despotism, authoritative to the point of arrogance, and intensely focused to the point of alienation and seclusion," recalled Vetrov.[57] Korolev's idea of efficient management was to exercise personal control over every technical and organizational aspect of the space program. "As a leader, he believed he must extend his power over every single element of design," wrote Vetrov.[58] Korolev demanded, for example, "the right of the first information" about any failure during the testing phase.[59]

Korolev often began designing and even building rockets and spacecraft on his own initiative, without any official contract, using only the internal resources of his design bureau. This strategy of "design with anticipation" required "a tough character and strong nerves," for it relied on complete trust in the ultimate success of the pending proposal.[60] This strategy often paid off when Korolev faced a rival: he used to shore up his proposals with a hardware prototype, which, however imperfect, looked to the party and government leaders much more impressive than a stack of draft blueprints. For example, by hastily refurnishing the metal hulls of Soyuz orbital spacecraft for a circumlunar mission, he wrestled this mission's contract away from rival Vladimir Chelomey, whose design, however original and sophisticated, at that time had not progressed much beyond the paper stage.[61]

Although Korolev's formal administrative status in the space industry was not very high—he was just the head of a design bureau, with multiple layers of ministry bureaucracy above him—his fantastic energy and skill in manipulating the system allowed him to take up and win arguments with other chief designers, ministers, and party officials. Instead of focusing on what was possible within the allotted funding and the prescribed time frame, he started new projects, hoping to get funding and adjust the deadlines later. He stubbornly resisted the decisions he disagreed with, even if they came from the very top. For example, he alienated Khrushchev by bluntly

[53] Chertok, *Fili—Podlipki—Tiuratam* (cit. n. 41), 425.
[54] Georgii Vetrov, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 116.
[55] Boris Raushenbakh, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 375.
[56] Feoktistov, *Traektoriia zhizni* (cit. n. 44), 223.
[57] Vetrov, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 116.
[58] Ibid., 121.
[59] Georgii Vetrov, "O tvorcheskom stile Koroleva," 1975, f. 1546, op. 1, d. 50, l. 8, Russian Academy of Sciences Archive, Moscow.
[60] Igor' Erlikh, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 304.
[61] Siddiqi, *Challenge to Apollo* (cit. n. 3), 501.

refusing the Soviet leader's suggestion to use storable rocket fuel. Using this fuel would have shortened launch preparation time and greatly improved combat readiness of ballistic missiles, but Korolev's priorities lay elsewhere. He preferred dual-use rockets that could serve not just as military missiles but also as spacecraft boosters. For this reason he insisted on cryogenic fuels, which were non-toxic and more efficient and therefore more suitable for space launches, even though it took a day to prepare such a rocket for launch, rendering it useless as a practical weapon. The head of the Communist Party and the Soviet government could not persuade Korolev to change his position. Korolev designed his flagship lunar rocket, the N-1, for cryogenic fuels, even though he lost the support of the Ministry of Defense, which did not see any military purpose for this rocket.

Korolev's striving for greater authority also had its roots in the Stalin period. In the late 1940s, chief designers such as Korolev and Glushko reported directly to the deputy chairman of the Special Committee for Reactive Technology, Dmitrii Ustinov, while Ustinov personally reported to Stalin. Placing high-priority projects under his personal supervision, Stalin created a management structure that bypassed the multiple levels of bureaucracy separating him from the people directly involved in these projects. This shortcut to the supreme leader gave the chief designers a clear advantage over their immediate ministry superiors and helped them manage the pressures from various parts of the bureaucracy. The rocket engineers' memory of the Stalin era thus featured a phantom, an ideal supreme leader—omniscient, omnipresent, gracious, and infinitely powerful. In their perception, power resided in particular individuals, not in bureaucratic structures.

Korolev became convinced of the efficiency of this shortcut management structure, and he imitated it within his own design bureau. For every individual project, he appointed the so-called lead designer, who oversaw the production of all components and their integration, cutting across any departmental lines. The lead designer reported directly to Korolev and effectively served as his proxy. As one such designer recalled, "[Korolev] strengthened the authority of the lead designer, augmenting it with his own authority. The lead designer was often called 'the eyes and the ears of the Chief Designer' or 'the little Chief Designer.' It was a big trust, and to bear it was not easy. One had to work very hard, to know everything—what is being done, where, in what condition—down to the smallest detail."[62]

As the historian Susanne Schattenberg has shown, after Khrushchev's denunciation of the "cult of personality," the Stalinist authoritarian management style increasingly became a target of criticism from below. Stalin-era managers were often labeled "little Stalins" and denounced to the authorities. One such denunciation targeted Ustinov, then the minister of the armaments industry. His disgruntled subordinates reported:

> The Minister comrade D. F. Ustinov obviously considers despotism to be the best method of leadership. . . . The collective meeting room functions as a place of execution as under Ivan the Terrible. Cooperation is out of the question, because all members of the staff are frightened and used to voting for decisions made by HIMSELF. Everybody who falls out of Ustinov's favor, even the most talented employee, will be destroyed by him.[63]

[62] Oleg Ivanovskii, *Rakety i kosmos v SSSR* (Moscow, 2005), 51.

[63] Quoted in Susanne Schattenberg, " 'Democracy' or 'Despotism'? How the Secret Speech Was Translated into Everyday Life," in Jones, *Dilemmas of De-Stalinization* (cit. n. 8), 64–79, on 73.

However exaggerated, this characteristic captured Ustinov's direct and forceful style, aimed at cutting through the red tape and getting things done. Suspecting that midlevel managers might hide the truth from him, he used to enter factories from the back door and examine the shop floor by himself.[64] Korolev similarly often visited workshops with sudden inspections, swiftly assigning blame, dispatching reprimands, and issuing orders. His lead designers stayed on the shop floor practically around the clock, implementing his ideal of constant supervision. Like the notorious "little Stalins," Korolev's "little Chief Designers" embodied the idea of omniscient, omnipresent authority, which rocket engineers associated with the Stalin era.

In the words of Polly Jones, during the Khrushchev period "the very ideas of stability, control and authority were thrown into question."[65] It was precisely the notions of control and authority that had shaped the professional culture of rocket engineers in the Stalin era. They found these values challenged by the instability and haphazard reforms under Khrushchev, and they resorted to the proven management techniques of the past: professional networking, personal responsibility, and shortcut direct control.

In preparation for launching the first piloted Vostok, however, there was one element in the entire system that lay beyond the effective control of space engineers. This element was the cosmonaut himself.

A TINY SCREW IN A GIANT MECHANISM

A key decision shaping the future of the Vostok spacecraft was made by the Council of Chief Designers in November 1958. The council discussed three alternative proposals for a new spacecraft: an automatic reconnaissance satellite, a piloted spacecraft for a ballistic flight, and a piloted spacecraft for an orbital flight. All three proposals emerged from Korolev's Experimental Design Bureau No. 1; he always preferred to hedge his bets by developing variants for future projects. The spy satellite designers promoted their proposal, stressing its primary importance for defense. This clearly had an appeal to the military, the main customers of Korolev's bureau. The proponents of a piloted ballistic flight offered a quick result and a guaranteed win in the race to get a human into space. The group that designed a more complex orbital piloted mission, led by the integration designer Konstantin Feoktistov, decided to strengthen their proposal by performing what he called a "tactical maneuver." They claimed that their piloted spaceship could easily be converted into a fully automatic spacecraft and used as a reconnaissance satellite, which would be able to return to Earth not just a small container with film but also a large capsule with the entire camera set. This dual-purpose design promised great savings of time and money. The council supported Feoktistov's scheme, and he drafted a formal proposal to the Military-Industrial Commission for an automatic spy satellite, disguising its second function as a piloted spacecraft. Some officials became suspicious when they noticed, for example, that the presumably automatic satellite was equipped with a set of communication devices. "Who is going to talk over this radio?" they inquired. "The photo cameras?"[66] In May 1959, the Soviet government adopted a secret decree au-

[64] Ivanovskii, *Rakety i kosmos* (cit. n. 62), 197–8.
[65] Jones, introduction to *Dilemmas of De-Stalinization* (cit. n. 8), 4.
[66] Feoktistov, *Traektoriia zhizni* (cit. n. 44), 62.

thorizing the construction of an automatic reconnaissance satellite. Through personal connections, Korolev was able to add seven words to the text of the decree: ". . . and also a sputnik for human flight."[67]

The forced unification of two totally different projects—automatic reconnaissance and human flight—in one decree resulted in a peculiar design for the final spacecraft. The piloted Vostok had to be constructed in such a way as to be easily convertible into a spy satellite named Zenit by simply replacing the cosmonaut's couch with a set of photo cameras. Because the Zenit had to be fully automatic, the Vostok turned out to be fully automatic as well. The entire Vostok piloted mission could be flown without the cosmonaut's touching any controls on board the spaceship.

Having a fully automatic spacecraft at hand, the spacecraft designers began carving out a role for the cosmonaut to play. By early 1960, the Experimental Design Bureau No. 1 had completed the design of an automatic control system; only then did they begin working on manual control. Unlike with classical automation, which presumes a transfer of certain functions from a human to a machine, Vostok designers had to work out how to transfer functions from an existing automatic system to a human pilot. What needs to be explained here is not why the Vostok was automated but why it had a manual control system at all. The purposes of the manual control were to back up the automatic system in case of malfunction, to expand the window for controlled descent, and most important, to provide psychological support to the cosmonaut. As the designer of the manual control system, Boris Raushenbakh, put it, "The cosmonaut must be convinced that even if ground control equipment and the onboard automatic system fail, he would be able to ensure his own safety."[68] The engineers assigned the cosmonaut only two manual control functions—attitude control and retrorocket firing—to be used in an emergency as a backup for failed automatics.[69]

The first spacecraft—the Soviet Vostok and the American Mercury—were both fully automated and were flight-tested first in the unpiloted mode. Yet there was one important difference: the range of manual control functions available to and actually performed by Mercury astronauts was much wider than those on Vostok. Astronauts could manually perform such essential tasks as separating the spacecraft from the booster, activating the emergency rescue system, releasing the parachute, dropping the main parachute in case of failure and activating the second parachute, and correcting the onboard control system. Those and many other functions were not available to Soviet cosmonauts.[70] This can be illustrated by a simple comparison of the control panels of Vostok and Mercury. The Vostok instrument panel had only four switches and thirty-five indicators, while the Mercury panel had fifty-six switches and seventy-six indicators.[71]

[67] Chertok, *Fili—Podlipki—Tiuratam* (cit. n. 41), 423.

[68] Quoted in Aleksei Eliseev, *Zhizn'—kaplia v more* (Moscow, 1998), 15.

[69] Valentina Ponomareva, "Osobennosti razvitiia pilotiruemoi kosmonavtiki na nachal'nom etape," in *Iz istorii raketno-kosmicheskoi nauki i tekhniki*, no. 3, ed. V. S. Avduevskii et al. (Moscow, 1999), 132–67; Siddiqi, *Challenge to Apollo* (cit. n. 3), 196.

[70] Loyd S. Swenson Jr., James M. Grimwood, and Charles C. Alexander, *This New Ocean: A History of Project Mercury* (Washington, D.C., 1989); Robert B. Voas, "A Description of the Astronaut's Task in Project Mercury," *Human Factors* 3 (Sept. 1961): 149–65.

[71] For a comparison of the technical parameters of manual control panels on American and Soviet spacecraft, see Georgii T. Beregovoi et al., *Eksperimental'no-psikhologicheskie issledovaniia v aviatsii i kosmonavtike* (Moscow, 1978), 62–3.

One reason the American astronauts had a greater role than their Soviet counterparts: while secrecy kept Soviet cosmonaut trainees out of the spotlight, American astronauts enjoyed celebrity status even before their flights. Capitalizing on their prominent public image, they were able to influence the design of control systems. They renegotiated the role of passenger/observer initially assigned to them and gained a greater share in spacecraft control.

On the Soviet side, however, the engineers and designers saw the potential expansion of the number of manual control functions as a threat to the well-organized scheme of ensuring the quality and reliability of every system component. Space engineers plainly did not trust the cosmonaut's untested ability to operate onboard equipment while in orbit, in the unusual conditions of zero gravity and psychological stress. Feoktistov openly told the cosmonauts that "in principle, all work will be done by automatic systems in order to avoid any accidental human errors."[72] Korolev strongly believed that automation produced much more reliable results, and he pressured his subordinates and subcontractors to automate every possible step in the production and operation of space equipment.[73] He trusted a ground operator no more than he trusted a cosmonaut. His discovery that employees at an automatic ground control station performed one of the procedures manually enraged him.[74]

Manual control also undermined the space engineers' efforts to maintain maximum control over every element of the space system. Boris Chertok, who was responsible for the Vostok's entire control system, has formulated Korolev's approach to system engineering as follows: "The properties of every element, every device, every unit, even the human being and his activity must be subordinated to the common interest of system synthesis."[75] As the historian Asif Siddiqi has argued, Vostok designers "not only did not trust a pilot's capability to function adequately, but they also wanted to design the craft, fly it, and land it all on their own."[76]

The division of control functions between the human and the machine on board also reflected, as well as affected, the relative influence of the institutions responsible, respectively, for the training of cosmonauts and for the design of automatics. Under Korolev's leadership, Experimental Design Bureau No. 1 acquired unprecedented control over multiple aspects of the space program. The air force, which supervised cosmonaut selection and training, tried to acquire greater say in mission programming, but Korolev and his bureau did not yield decision-making power to any outside agency. Korolev, in particular, played a central role in decision making on a whole range of issues going far beyond engineering, such as spacecraft procurement, crew selection, cosmonaut training curriculum, mission planning, and ground flight control. His own role as the unquestionable leader within the Experimental Design Bureau No. 1 mirrored the central role of his bureau in the entire space industry.[77]

The automation of Vostok set a trend that dominated the Soviet piloted space program for decades. Despite the expansion of manual control functions on the Soyuz ships, the role of the cosmonaut as an emergency backup for automatics did not fun-

[72] Vladimir Komarov, workbook no. 39, 1961, Gagarin Memorial Museum Archive, Gagarin, Smolensk, Russia; http://web.mit.edu/slava/space/documents.htm (accessed 28 Aug. 2006).
[73] Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 449.
[74] Feliks Meshchanskii, *Obratnaia storona* (Boston, 2001), 69.
[75] Boris Chertok, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 462.
[76] Siddiqi, *Challenge to Apollo* (cit. n. 3), 198.
[77] Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 292.

Figure 2. *Three female cosmonauts at the cosmodrome prior to the launch of* Vostok 6 *on June 16, 1963. Left to right are second backup Valentina Ponomareva, first backup Irina Solov'eva, and prime crewmember Valentina Tereshkova. Behind the women are (from left) Sergei Korolev, the State Commission chairman Georgii Tyulin, and the Strategic Missile Forces commander in chief Sergei Biryuzov. Tereshkova was the first woman in space, spending three days aboard* Vostok 6. *(NASA photo no. womencosmonauts.)*

damentally change. Although Gemini and Apollo astronauts routinely performed manual rendezvous, Soyuz cosmonauts only occasionally had an opportunity to try a manual procedure. Such efforts often failed because engineers' main efforts were aimed at the perfection of automatics and the cosmonauts were not fully equipped, properly trained, or authorized to dock manually in difficult conditions.[78]

The cosmonauts resented this general trend toward automation. Some of them saw its origins in the ideological foundations of the Soviet system. For example, the former cosmonaut candidate Valentina Ponomareva, who served as a backup for Valentina Tereshkova, wrote in her memoirs:

> "The emphasis on automation" is the result and inherent part of the total mistrust of the individual, the mistrust peculiar to our ideology. . . . Propaganda tried to impose on people's minds the idea that technology decided everything. From this it directly followed that the individual was small and insignificant, and that he was only a tiny "screw" in a giant mechanism.[79]

In my view, this sentiment against Soviet ideology is misplaced. It was not the party or the government that encouraged automation; it was the space engineers' mindset of control, which they developed in an attempt to reduce uncertainty and risk while they dealt with the inadequacies of the overall organization of the space program.

[78] Slava Gerovitch, "Human-Machine Issues in the Soviet Space Program," in *Critical Issues in the History of Spaceflight*, ed. Steven J. Dick and Roger D. Launius (Washington, D.C., 2006), 107–40.
[79] Valentina Ponomareva, *Zhenskoe litso kosmosa* (Moscow, 2002), 207.

There is historical irony here. Spacecraft designers—some of the most talented, innovative engineers in the country, the cream of the crop of the Soviet technical intelligentsia—at the height of the cultural thaw built a spacecraft that embodied the notions of control and authority derived from their idealization of the Stalin era. The Vostok spacecraft became the technological analog of the totalitarian myth, an omniscient panopticon that monitored the cosmonaut's every move. Like any other technological artifact, the Vostok spacecraft reflected the professional culture of its designers. To the extent that this culture bore an imprint of the Stalin era, one could argue that the Vostok, the most celebrated artifact of the thaw, was a flying example of mythologized Stalinism.

DUAL USE, DUAL IDENTITY

The dual controls of the Vostok spaceship—automatic and manual—reflected the dual use of this spacecraft for military and civilian purposes. As a highly publicized project carried out in closed defense institutions, the space program represented an anomaly, a centaurlike creature. This fostered an unusual split identity of space engineers working at organizations such as Korolev's Experimental Design Bureau No. 1, which developed new types of military missiles alongside space rockets and spaceships. Their original professional identity as secret rocket designers, working in isolation from the rest of the world, clashed with their newly found sense of being (though anonymously) in the spotlight.

Space engineers were excited to see huge popular enthusiasm over *Sputnik* and the first human space flights. As Boris Chertok has recalled:

> [T]he effect produced by Sputnik proved totally unexpected. Workers, engineers, and scientific researchers from numerous institutes, design bureaus, and the cosmodrome had believed that they had been doing very important but ordinary work. Suddenly they realized that it was quite extraordinary. Every participant in the design, production, preparation, and launch [of Sputnik] felt connection with a scientific feat, with a lustrous day in the history of humankind.[80]

Yet the Soviet leadership decided not to reveal the identity of Korolev or any other leading space engineer, on the grounds that all of them were involved in top secret missile work. The spotlight focused squarely on the young, photogenic, smiling cosmonauts, while the chief designers were prominently absent from public ceremonies. Other individuals, often not involved in the space program at all, traveled abroad, gave speeches, and received honors. Korolev was designated in the press only as "the Chief Designer" and remained anonymous until his death in 1966. In September 1963, well after *Sputnik* and Gagarin's flight, Korolev was vacationing on the Black Sea and decided to attend a public lecture about Soviet triumphs in space. Nobody in the audience, including the lecturer, had any idea who he was.[81] Even the prospect of receiving the Nobel Prize for *Sputnik* and later for Gagarin's flight did not move the Soviet leadership to reveal Korolev's identity. In response to an inquiry from the Nobel Committee, Khrushchev reportedly said that "the creator of Sputnik is the Soviet

[80] Chertok, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 461.
[81] Ivanovskii, *Rakety i kosmos* (cit. n. 62), 140–1.

people."[82] Once Korolev bitterly remarked to an old friend, "I have no public identity. And will probably never have one."[83]

The cultural thaw opened new exciting opportunities for academic scientists to establish contacts with foreign colleagues, travel to international conferences, and publish abroad. But rocket engineers, despite their direct contribution to a research enterprise of huge international significance, remained isolated from the West. Chertok has recalled that in the wake of World War II Korolev and his team

> dreamed that instead of the confrontation that had begun to emerge, the interaction of the scientists from the victorious countries would be a natural continuation of the military alliance. In late 1946, Korolev, who had returned from some meeting in Berlin, [told] me, "Get ready to fly across the ocean." Alas! Until the very day he died, neither Korolev, nor any one of his closest associates was ever "across the ocean."[84]

Joint work on classified projects, which had to be kept secret even from family members, the specific lifestyle during prolonged stays in the harsh climate and primitive conditions of the cosmodrome, the sense of pride for internationally recognized achievements, and the bitterness about the lack of public recognition—all this strongly reinforced the group identity of rocket engineers. Shared lives bred identical values and interests. One engineer, returning to Moscow from the cosmodrome, picked up the wrong suitcase at the airport and discovered, to his astonishment, that the contents of the suitcase were nearly identical to those of his: "A shaving set, just like mine, lay in a box; next to it, a few issues of a literary magazine, the same ones I had; the same gloves, helmet, pilot's pants, underwear, and toiletry. Several recently purchased books were almost the same as the ones I had bought while staying at the cosmodrome."[85] The owner of the suitcase was soon found; naturally, he turned out to be another space engineer.

Boris Chertok stressed that rocket engineers often lacked the cultural sophistication usually associated with the intelligentsia: "To act, not to chat; to take risks; to make a decisive impact on the course of events—such was our work style. Those who did not care left very quickly. Many in our group lacked such intelligentsia traits as cultured conversation, tactfulness, or politeness. But we appreciated the sense of humor and were attentive to each other's work, trying to help if necessary."[86] Indeed, as another memoirist remarked, the manners of original Council of Chief Designers member Mikhail Ryazanskii, who was "overtly intelligentsia-like, invariably polite, courteous, and friendly," were an exception to the prevailing pattern among the council members.[87] Chief designers—tough negotiators and strict administrators—often regarded refined manners as a sign of weakness. For example, Korolev at first distrusted the communication systems designer Yurii Bykov. Korolev was "suspicious of Bykov's overt politeness, of his inner and outer intelligentsia-like traits," recalled Chertok. "Would Bykov falter at a difficult, decisive moment, when a cosmonaut's

[82] Golovanov, *Korolev* (cit. n. 3), 585–6.
[83] Mark Gallai, quoted in Ishlinskii, *Akademik S. P. Korolev* (cit. n. 27), 64.
[84] Chertok, *Rockets and People* (cit. n. 20), 2:27.
[85] Meshchanskii, *Obratnaia storona* (cit. n. 74), 75.
[86] Boris E. Chertok, *Lunnaia gonka*, vol. 4 of *Rakety i liudi* (Moscow, 2002), 356.
[87] Meshchanskii, *Obratnaia storona* (cit. n. 74), 61.

life and the nation's prestige are at stake?"[88] Eventually, Korolev overcame his suspicions, but his initial doubts are telling.

Civilian engineers were always surrounded by military personnel: by detachments servicing the launch facility, by military specialists testing rocket and spacecraft equipment, and by the military's top brass supervising launches. In the intermingling of the military and civilians in the rocket and space industry, a curious transitional category of "civilian military personnel" emerged: such was the nickname for military engineers assigned to civilian engineering groups to facilitate the development of rocket technology.[89] Several key positions in the leadership of the rocketry sector of the defense industry were occupied by military officers, for whom an exception was made that allowed them to work at civilian institutions while remaining on active duty.[90] The professional culture of rocket engineers became permeated with the spirit and values of military service. Yet their identities remained split: the commitment to the construction of missiles for the defense of the socialist fatherland clashed with the aspiration to explore space. And they often viewed the former as merely the means for the latter.

CONCLUSION

Writing his memoirs in the post-Soviet era, Boris Chertok has formulated several traits, which, in his view, described typical Soviet rocket engineers: they found the meaning of life in creative engineering work; combined technical work with organizational activity; bore personal responsibility for project results; worked in isolation from their Western counterparts and relied exclusively on domestic technologies; worked in cooperation with researchers from other fields; and identified themselves as members of a "gigantic technocratic system closely associated with the state and with the ideology of a socialist society."[91]

The engineers' belief in a technological utopia fitted well with the Marxist view of scientific and technological progress as a foundation for building a better society. Unlike many writers, artists, and scientists, space engineers kept a safe distance from any sensitive political issues. As one spacecraft designer admitted, "There were no dissidents among us."[92] Space engineers needed the regime to implement their ambitious space plans, while the regime needed their help in strengthening the defense and raising the nation's prestige. The top engineers were gradually integrated into the country's political elite. The chief designers Korolev, Glushko, Yangel, and Chelomey became delegates at party congresses, and Glushko and Yangel joined the ruling Areopagus, the Central Committee of the Communist Party.

In his landmark study, *Technology and Society under Lenin and Stalin*, Kendall Bailes remarked on the following "paradoxical relationship" between the technical intelligentsia and the Soviet state:

[88] Chertok, *Fili—Podlipki—Tiuratam* (cit. n. 41), 420.
[89] Meshchanskii, *Obratnaia storona* (cit. n. 74), 8.
[90] Bystrova, *Voenno-promyshlennyi kompleks* (cit. n. 25), 214–28.
[91] Chertok, *Rockets and People* (cit. n. 21), 1:8.
[92] Vladimir S. Syromiatnikov, *100 rasskazov o stykovke i o drugikh prikliucheniiakh v kosmose i na Zemle*, vol. 1, *20 let nazad* (Moscow, 2003), 423.

> Just as the Russian nobility staffed the upper levels of the Tsarist bureaucracy before 1917, and provided the core of the "critically-thinking" intelligentsia during the nineteenth century, since Stalin's death, the Soviet technical intelligentsia has emerged as the single largest element from which the ruling elite has been recruited, and also has been a large segment of the new, critically-minded intelligentsia.[93]

This statement appears as a paradox only if one assumes that the ruling elite was monolithic and lacked a critical attitude. The case of the space engineers suggests, however, that this most privileged group of the Soviet technical intelligentsia had a torn identity: the secretive world of postwar rocketry reinforced their affinity with the military, while working on cutting-edge technologies nurtured their sense of belonging to the international technoscientific elite. Continuous disputes over military and academic priorities of space missions reflected this deep-seated tension in the space engineers' identity. The chief designers constantly argued over space policy issues both with party and government leaders and among themselves.

Korolev and other chief designers did not simply use their personal networks to execute government orders more efficiently. They used these networks to recruit allies in the pursuit of their own visions of space exploration. Korolev designed and build rockets that nominally had a dual use but in fact were much better suited for space exploration than for combat. Chelomey, by contrast, built rockets on storable fuels, won support of the military, and tried to leverage this support to advance his own space projects.

The rocket engineers manipulated the system at least as much as the system manipulated them. In 1966, trying to curb independent activity on the part of the chief designers, the Military-Industrial Commission set up a formal procedure by which the chief designers could no longer bypass the commission in their lobbying efforts and had to clear their proposals with the commission and the Ministry of Defense before appealing to the political leadership. As a former deputy chairman of the commission admitted, "Naturally, this procedure was not always thoroughly followed."[94]

The professional networks of rocket engineers did not merely facilitate the work of Soviet defense industry. They became channels through which Soviet space policy was formulated, debated, and reshaped. By working often in parallel with, and sometimes in opposition to, the established administrative hierarchies, the chief designers were able to develop and promote their own policy initiatives. It was their proposals, reluctantly approved by the Soviet government, that produced *Sputnik*, Gagarin's flight, and the ambitious interplanetary and lunar programs. It was their technocratic vision of the future as a technological utopia that captured the public imagination in the early 1960s. Ironically, just as Soviet society tried to shed the political legacy of Stalinism, it was inspired by products of the engineering culture of the Stalin era.

[93] Bailes, *Technology and Society* (cit. n. 11), 3.
[94] Stroev, "Voennaia aviatsia" (cit. n. 23), 280.