2

Key players

INTRODUCTION

Any great enterprise is the product of people. It is people who make things happen. Institutions are the means by which great enterprises are realized, but it is the people in these institutions, and in particular the leaders of these institutions, that drive the mechanisms to create great products. And so it is in the space exploration enterprise. We begin the story of the Soviet Union's space exploration program in the 20th Century with a description of the people who led the development of this great enterprise. While there were many administrators, engineers and scientists who were essential, we have room here only to describe those at the top of the enterprise, those whose personal and institutional power created the USSR's space program. At the top are the Communist Party leaders and government ministers who had control over selecting and funding national projects; second, and most particularly, the individual Chief Designers of the space program who proposed the projects; third the directors of the design bureaus which were responsible for building rockets and spacecraft for the projects; and finally the President of the Soviet Academy of Sciences, who besides his own leadership of the space program provided academic resources via the directors of the Academy's research institutes where space mission goals were developed using the rockets and spacecraft built by the design bureaus.

The single most important individual in the development of the Soviet space program after WW-II was Sergey Pavlovich Korolev. After Joseph Stalin decided to make rocket development a national priority at the end of the war, Korolev was retrieved from exile in a labor camp, together with others from his small band of engineers that built research rockets before the war. They started with the V-2 and a group of captured German engineers, just as occurred in the US. During the 1940s and 1950s Korolev's design bureau developed the USSR's first long range rockets using the German rocket engineers' expertise to build their own design skills. By the mid-1950s the German engineers had been generally dismissed, and the enterprise was entirely Russian. Korolev began testing his R-7 ICBM in the spring of 1957, the rocket that would launch not only Sputnik and other early Earth satellites, but

W.T. Huntress and M.Y. Marov, *Soviet Robots in the Solar System: Mission Technologies and Discoveries*, Springer Praxis Books 1, DOI 10.1007/978-1-4419-7898-1_2,

almost all of the Soviet lunar and planetary missions throughout the 1960s and all Soviet cosmonauts. In upgraded and modified versions, this venerable rocket has become the core of the Soyuz launcher that is used commercially today for both manned and unmanned missions.

Korolev was an excellent engineer and designer, with considerable leadership and political skills. These qualities and his mission successes made him the darling of the Soviet space program. His identity was kept secret and he became known as 'Chief Designer', a term invented for the titular head of the Soviet space program. There were only two others that followed him after his death in 1966, but neither man had the full measure of qualities possessed by Korolev and the program seemed to lose much of its driving force. Had Korolev remained in charge, the USSR may have landed a cosmonaut on the Moon – even if later than planned and after the Americans. The Chief Designer of the Soviet space program, the de-facto leader inside Kremlin circles, was at the same time a director of one of the implementing design bureaus. There was no equivalent in the US: Wernher von Braun had a similar leadership role but was not at the same time the Administrator of NASA. In the USSR, there was no equivalent of NASA. The space enterprise was only a portion of the government's Ministry of General Machine Building, which had wide control over all of Soviet space industry and the design bureaus that implemented the policies of the ministry.

The design bureaus and research institutes were the places where all the hardware

Figure 2.1 Korolev's Council of Chief Designers in 1959. Left to right: A.F. Bogomolov, M.S. Ryazansky, N.A. Pilyugin, S.P. Korolev, V.P. Glushko, V.P. Barmin, V.I. Kuznetsov.

was developed and built to execute the Soviet space program, except for the science instruments supplied by the Soviet Academy of Sciences. The directors, also known as 'Chief Designers', of the several design bureaus and research institutes were the key 'movers and shakers' of the program. At the beginning of the Soviet rocket and space enterprise, Korolev established a Council of Chief Designers to coordinate all efforts in rocket development and space exploration. The members of the Council are shown in Figure 2.1. Council member Academician Valentin Petrovich Glushko (1908–1989) was an early colleague of Korolev's before WW-II and supplied the rocket engines for the R-7, but later he became a dedicated rival to Korolev. He was one of the most important figures in the history of the Soviet program, and his role following Korolev's death is described later in this chapter. Academician Nikolay Alexeevich Pilyugin (1908–1982) was Chief Designer of NIIP and responsible for autonomous control systems (avionics) for rockets and spacecraft. Pilyugin was one of Korolev's closest colleagues and pioneered the development of flight computers and precision avionics for autonomous navigation. Corresponding member Mikhail Sergeevich Ryazansky (1909–1987) was Director and Chief Designer of NII-885 and developed radio systems including on board transmitters, receivers, radio command links and terrestrial antennas for rockets and deep space missions. In particular, he pioneered the study of radio systems to facilitate autonomous navigation by vehicles in deep space and the development of imaging systems for spacecraft. Academician Alexey Fedorovich Bogomolov (1913–2009) was Director of Design Bureau OKB MEI (until 1989) and principally responsible for the development of on board radio telemetry and trajectory tracking, in addition to terrestrial antennas for rockets and spacecraft. He also greatly contributed to radar remote-sensing techniques including the instrument for mapping of Venus by Venera 15 and 16. Academician Vladimir Pavlovich Barmin (1909–1993) was Chief Designer of all ground complexes for ballistic missiles and space launchers. He also contributed to the development of soil-sample devices for Luna and Venera missions. Academician Victor Ivanovich Kuznetsov (1913–1991) was Chief Designer and Director of NII-10, and as such he developed gyroscopes for rockets and spacecraft and pioneered inertial navigation systems in the USSR.

The design bureaus were all in competition with one another. One or the other of the directors, such as Korolev, was by force of personality and political connection the 'Chief Designer' of the whole space program. With no dedicated governmental space administration to marshal the competition between design bureaus, the Soviet space program was rife with rivalry, animosity and political intrigue. The resulting inefficiencies were wasteful of resources and a cause for much delay and many a failure. After Korolev died, there was no one with all the personal skills necessary to hold it all in check.

Almost equivalent in stature to Korolev was Mstislav Vsevolodovich Keldysh, head of the Institute of Applied Mathematics and after 1961 President of the Soviet Academy of Sciences. While Korolev was the 'Chief Designer' of the Soviet space program, Keldysh was 'Chief Theoretician'. They worked together both to advocate and implement the space exploration program. From 1956 until his death in 1978, Keldysh was the Chair of the highly recognized Inter-Departmental Scientific and

Figure 2.2 Sergey Pavlovich Korolev (left) and Mstislav Vsevolodovich Keldysh (right).

Technical Council on Space Research (MNTS KI; Mezhduvedomstvennyi Nauchno-Tekhnicheskii Soviet po Kosmicheskim Issledovaniyam) which was responsible for space science and technology development in the Soviet Union. The Council and the Academy determined the objectives for the space program, advised the government and recommended individual projects, provided expertise in space navigation, and supplied scientific investigations for flight missions. Acting together, Korolev and Keldysh were responsible for many of the achievements of the space program.

The final highly influential group were the directors of research institutes of the Soviet Academy of Sciences. The two leading space science organizations were the Vernadsky Institute of Geochemistry and Analytical Chemistry established in 1947 and the Institute for Space Research set up in 1965. The Academy's science institutes devised the science objectives and instruments for space missions. The leading design bureau and science institute directors were strong individuals who advised Korolev and Keldysh on which missions to fly and determined what science investigations would be carried.

MINISTER

Afanasyev, Sergey Aleksandrovich
1918–2001
First Minister of General Machine Building
1965–1983


Afanasyev

Sergey Afanasyev's organization managed the institutions and workforce that built ballistic missiles and satellites vital to the defense of the Soviet Union, as well as the spacecraft and launch vehicles for their politically important space exploration program. Leonid Brezhnev once told him, "We believe in you, but if you fail we will put you against a brick wall and shoot you." Known as "the big hammer", he could be a very rude and intimidating man but he had a talent for orchestrating immense projects. He was among the most powerful people involved in the USSR's space program, which included Korolev and his rival Glushko. His criticism of Korolev's management of the manned space program resulted in the separation of the robotic program from Korolev's bailiwick to that of Georgi Babakin in 1965. He oversaw the Soviet Union's response to the Apollo project and was ultimately responsible for canceling it after many setbacks.

FOUNDER AND CHIEF DESIGNER OF THE SOVIET SPACE PROGRAM

Korolev, Sergey Pavlovich
1907–1966
Founder of the Soviet Space Program
Chief Designer OKB-1 1946–1966


Korolev

Chief Designer Sergey Korolev (this common spelling is not phonetically correct, Korolyov is proper) was the behind-the-scenes Soviet equivalent of von Braun in the US. His Experimental Design Bureau No.1 (OKB-1) led the development of first military and, shortly thereafter, peaceful applications of rocketry in the USSR. His identity was a state secret known only to an inner circle; to others he was simply the 'Chief Designer'. While von Braun was openly engaged with the public and served as an enthusiastic communicator on the American civilian space program, Korolev worked under heavy state security. He was not even allowed to wear his medals. His identity was not made public until after his death.

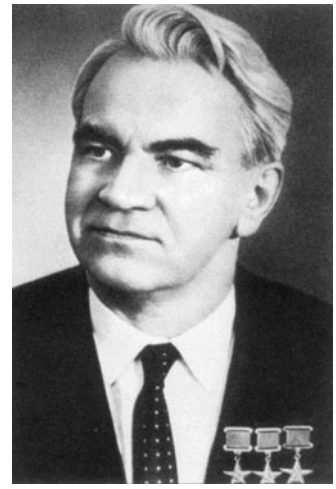
A passionate advocate of space exploration, Korolev began as a young engineer leading a research group, GIRD, that built small rockets in the 1930s at the same time as Robert Goddard was making his rockets in the US. Korolev became a victim of one of Stalin's purges in the late 1930s, confessing to trumped up charges under duress. He was sent initially to a gulag before being transferred to the 'sharashkas', slave labor camps for scientists and engineers, where he could continue to work on rockets in exile for the military. As a result of the considerable hardship he endured, he developed health issues that would persist for the rest of his life. He was released near the end of WW-II to evaluate the captured German V-2 missile and build a Soviet rocket capability.

In 1946 Korolev was appointed Chief Designer of a new department in Scientific Research Institute No.88 (NII-88) to develop long-range missiles. The R-1, which was basically a Soviet-built V-2, led to a succession of ever more powerful rockets named R-2, R-3 and R-5. He proved himself to be a very talented technical designer and manager, and in 1950 his department was upgraded to a design bureau, and then in 1956 was separated from NII-88 to become OKB-1. He began work in 1953 on an ICBM to deliver the heavy 5-ton nuclear warhead. This would require a rocket of unprecedented size and power. The resulting massive multi-stage R-7 (which NATO referred to as the SS-6 Sapwood) was first tested in the spring of 1957, long after technology had reduced the size of the warheads. It was overly large and awkward as a weapon, taking 20 hours to prepare for launch, and only a few were deployed before more practical delivery systems were produced by competing organizations. However, the R-7's lifting power allowed Korolev to adapt it for space exploration purposes, including Sputnik, which proved to a reluctant Kremlin the political value of non-military uses for large missiles. Like von Braun, Korolev's passion was the exploration of space, but he needed the military business to build his rockets. Thus his designs owed as much to his dreams as to hard military requirements. Korolev's lobbying to use the R-7 for space exploration, and his insistence on the large and militarily impractical cryogenic rockets best suited to this role, drew impatience from the military, which reacted by placing contracts with competitors, in particular Mikhail Yangel's OKB-586 and Vladimir Chelomey's OKB-52.

Korolev was a charismatic man who through sheer perseverance, political savvy, technical expertise, and talent for leadership established the Soviet space exploration program on the backs of the military, with consequent resentment. Nevertheless, he triumphed because his space spectaculars won him the support of the Soviet political hierarchy and in particular Nikita Khrushchev. The R-7 in its various incarnations became the most reliable and most used space exploration launch vehicle in the 20th Century. The Soyuz version continues in use today to launch cosmonauts into low Earth orbit. The Molniya version launched all of the early Soviet lunar and planetary missions until the more powerful Proton developed by Chelomey became available, and later versions are still used for this purpose. His sudden death in January 1966 was a severe shock, and without his leadership the Soviet lunar program devolved into rivalry between factions, impeding progress and dashing any chance the Soviet Union may have had after their late start.

PRESIDENT OF THE SOVIET ACADEMY OF SCIENCES

Keldysh, Mstislav Vsevolodovich
1911–1978
President, Soviet Academy of Sciences 1961–75



Keldysh

While Sergey Korolev was the engineering genius behind the Soviet space program, Mstislav Keldysh was its scientific genius and his eager partner. There was no single person equivalent to Keldysh in the US space program. As a brilliant and elegant mathematician, he was particularly adept at applying mathematics to complex practical problems, with a special interest in aerodynamic engineering. From 1946 to 1961 he was head of the research organization NII-1, which is now the Keldysh Research Center. NII-1 was originally Korolev and Glushko's rocket research group prior to their arrest in the purges. In 1953 Keldysh was named head of the Division of Steklov's Mathematical Institute which in 1966 became the Institute of Applied Mathematics and now bears his own name. In 1961 he was elected President of the Soviet Academy of Sciences.

Keldysh's involvement in space research began in 1954 when he co-chaired with Korolev the committee that designed the scientific spacecraft that ultimately became Sputnik 3. Beginning in 1956 he chaired the Academy's powerful MNTS committee and was regarded as the 'Chief Theoretician' of the space program, in charge of the scientific aspect of space including military applications in computers and nuclear weapons design. He and the Academy's science institutions provided the theoretical basis for space exploration, rocket design, mission design and navigation in space. Unlike in the US, the Soviet Academy of Sciences was charged with developing the mathematical and scientific tools, including instruments, for space exploration, and as head of the Academy Keldysh was a major force in the development of lunar and planetary exploration in the USSR. The government often had the Academy assess the merits of projects proposed by the various design bureaus. Also, the government presented Keldysh to the international community as the face of the Soviet space exploration program, representing it abroad and to the media. His prominence went hand in glove with Korolev's obscurity.

CHIEF DESIGNERS AND DIRECTORS OF THE DESIGN BUREAUS

Tikhonravov, Mikhail Klavdievich
1900–1974
Deputy Chief Designer OKB-1 1956–1974

Tikhonravov

Although not chief of a design bureau, Mikhail Tikhonravov was a key member of Korolev's team in the early days of OKB-1, and one of the pioneers of the Soviet space program. He was an early glider enthusiast and worked with N.N. Polikarpov in the 1920s developing aircraft. In 1932 he joined GIRD and became interested in the theory of rocket flight and space technology, working with Korolev to build the first Soviet liquid propellant rocket. Tikhonravov escaped the terror of the late 1930s and during WW-II worked on Katyusha rockets and a rocket-powered fighter. After the war, he was fascinated with the German V-2 rocket and designed his own high-altitude rocket for carrying a pilot into space. In late 1946 he became Deputy Chief of NII-4 in Moscow to manage research into ballistic missile development. There he began a pioneering study into multistage rockets and orbital flight that would later be applied in launch vehicle and spacecraft development. Following Tsiolkovsky, he originated the concept of 'packet' design for multistage rockets adopted by Korolev for the R-7. On November 1, 1956, he was transferred to OKB-1 where he worked hand-in-hand with Korolev in developing robotic spacecraft for flights to the Moon, Venus and Mars, and spacecraft for OKB-1's manned spaceflight program.

Mishin, Vasily Pavlovich
1917–2001
Chief Designer OKB-1 1966–1974

Mishin

As Korolev's deputy and protégé, Vasily Mishin took over management of OKB-1 after his mentor's unfortunate death during surgery in 1966. It was during Mishin's tenure that OKB-1 attempted to develop Korolev's giant N-1 Moon rocket and the Soyuz spacecraft to send cosmonauts to the Moon. When he took over, the project was plagued with technical problems and unrealistic schedules. Mishin was a well-regarded engineer and a kindly man, but did not possess Korolev's leadership talent, nor the charisma and connections that Korolev used to mobilize the massive Soviet political and industrial

machine and to thwart his enemies. While NASA succeeded with Apollo, Mishin oversaw four disastrous N-1 launch attempts, failures in lunar Soyuz test flights, failures in three space station missions, and the deaths of the pilot of Soyuz 1 in 1967 and the three-man crew of Soyuz 11 in 1971. He was deposed in 1974 by a coup orchestrated by Korolev's bitter rival, Valentin Glushko. Two years later any further attempts to send cosmonauts to the Moon were terminated.

Mishin was exiled to the Moscow Aviation Institute and blamed as "the man who lost the Moon race". He was unfortunate to have been the man in charge when the ambitious technological challenges began to crumble in the face of the relentless American Apollo juggernaut; he just didn't have the 'right stuff' to overcome them. Although many in the West thought that he had been executed, Mishin resurfaced in the late 1980s and published a number of controversial accounts of the history of the Soviet space program.

Glushko, Valentin Petrovich
1908–1989
Chief Designer OKB-456 1946–1974
Chief Designer NPO-Energiya 1974–1989

Glushko

A contemporary of Korolev, Valentin Glushko began working on rocket engines in the 1920s and became head of the Gas Dynamics Laboratory. The military merged it with Korolev's GIRD rocket research group in the 1930s. Like Korolev, Glushko was a victim of the purges. After WW-II he was made head of Design Bureau OKB-456 to develop rocket engines for missiles designed by Korolev's OKB-1, Chelomey's OKB-52 and Yangel's OKB-586. When Korolev began to design a successor to the R-7 and ignored Glushko's advice to use hypergolic propellants they became bitter enemies. In fact, the animosity between the two harked back to the purges. Korolev was convinced that Glushko was responsible for his internment. Glushko was arrested first, and there is a story that under duress he denounced Korolev for undermining progress by preferring liquid rather than solid fuel rockets, and shortly thereafter Korolev was arrested. Glushko criticized Korolev's plans for the Moon program and impeded Korolev's progress by refusing to build the engines for the N-1, forcing Korolev to resort to an inexperienced supplier.

In 1974, with the N-1 suffering spectacular failures, OKB-1's enemies, including Glushko and Chelomey, convinced Brezhnev to fire Mishin. Glushko was appointed in Mishin's place. His first act was to precipitously cancel the N-1 program. He then absorbed OKB-1 into his own design bureau OKB-456. On gaining membership of the Central Committee of the Communist Party he also absorbed Chelomey's design bureau to create a massive rocket engineering empire named NPO-Energiya. Then,

having defeated the legacy of Korolev, Glushko focused on building a new rocket and reusable spacecraft system in his own image – the Energiya and Buran – to replace the Soyuz system and compete with the US Space Shuttle. The Energiya rocket flew twice in the late 1980s and Buran once, unmanned, and were promptly canceled as unaffordable. They are now only silent monuments to a man described by his critics as vain, stubborn, petty and manipulative. Nevertheless, the Energiya-Buran project is a monument to the skilled people in the Soviet Union who made this ambitious and complex project possible. By supreme irony, today Korolev's Soyuz rocket and spacecraft are still in front line service and the conglomerate that Glushko built bears Korolev's name as the S.P. Korolev Rocket and Space Corporation Energiya.

Glushko was a superb engineer and designer of rocket engines and his OKB-456 created some of the most efficient engines ever produced. He managed to build closed-cycle engines that eluded the skills of American rocket engine makers. At the same time he was a stubborn critic of cryogenics, even though he built engines using liquid oxygen, and insisted that hydrogen was not a suitable rocket fuel while the US was using it for the upper stages of its most powerful launch vehicle, the Saturn V. Unable to eliminate combustion instability in large single-chamber engines, Glushko devised an ingenious solution using four smaller combustion chamber/nozzles which shared a common fuel/oxidizer feed. The four-chamber RD-107 and 108 engines he built for the R-7 are still in use today with the Soyuz launcher. In one of the ironies of the Cold War, the very powerful four-chamber RD-170 engine that he made for the Energiya rocket was split in two and the two-chamber variant, the RD-180, is now in service powering the latest model of the US Atlas launch vehicle!

Chelomey, Vladimir Nikolaevich
1914–1984
Chief Designer OKB-52 1955–1984

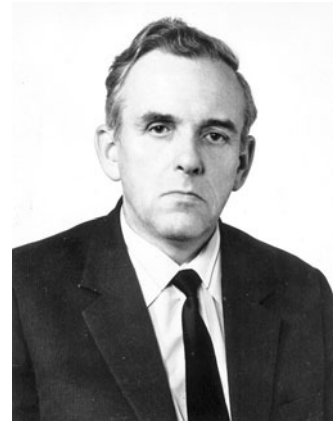
Chelomey

Vladimir Chelomey, a mathematician dealing with non-linear wave dynamics, began his career working on cruise missiles. In 1955 he became head of OKB-52, and in 1958 began work on his first ICBM, the UR-100 (NATO designation SS-11), which became the Soviet Union's answer to the US Minuteman. While Korolev never lost his preference for cryogenics, both Chelomey and Mikhail Yangel opted for storable propellants and their missiles were better suited to military requirements. This led Korolev to focus on the politically-supported lunar cosmonaut program. Chelomey's attention to military requirements gained him respect in the military establishment and access to far greater resources than Korolev.

In the early 1960s, Chelomey began development of the UR-500 Proton rocket intended to be a heavy lift ICBM. When the military canceled it, Chelomey, with

Keldysh's support, used his political connections to save it for the Moon program. Chelomey had a rival plan to Korolev's for development of rockets and spacecraft to take cosmonauts to the Moon. He proposed his plan in competition to Korolev when the USSR finally made its decision in 1964 to compete with the US Apollo program. Khrushchev (whose son was an engineer at OKB-52) was indebted to Chelomey for providing practical and vital military ICBMs, and so Chelomey managed to have his UR-500 chosen in preference to Korolev's new design for the test and circumlunar phases of the manned lunar program. However, the spacecraft would be the lunar Soyuz that Korolev proposed, and Korolev's massive N-1 Moon rocket was selected over Chelomey's even larger UR-700 for the lunar landing missions. The Chelomey-Korolev rivalry continued as both programs were separately managed and funded by Khrushchev and later by Brezhnev in a process that divided the backing required for an efficient and timely outcome. After a long run of early failures, the Proton was used to launch an automated Soyuz test spacecraft under the cover name of Zond on flights which looped around the Moon and returned to Earth. It went on to launch heavy satellites and modules for the Salyut and Mir space stations. Georgi Babakin at the Lavochkin Design Bureau, who had inherited Korolev's robotic exploration program, recognized that the Proton was well suited to launch the heavy spacecraft that he was designing and, with upper stage modifications which included using one of the stages from Korolev's N-1 rocket, the Proton became the launcher of choice for the Soviet lunar and planetary spacecraft of the 1970s and beyond. It is today a world standard for commercial heavy launch services.

Babakin, Georgi Nikolayevich
1914–1971
General Designer NPO-Lavochkin 1965–1971



Babakin

As a self-taught engineer, Georgi Babakin did not gain a college degree until the age of forty-three. He worked on rocket control systems at NII-88 from 1949 to 1951, where he first met Korolev, and then designed military missile systems at OKB-301 for Chief Designer Semyon A. Lavochkin, where he rose to become a deputy chief designer and then General Designer (Director) of OKB-301, now renamed NPO-Lavochkin. Meanwhile, OKB-1 had become overwhelmed with responsibility for both manned and unmanned programs, and was suffering a run of failures. Trusting Babakin implicitly, Korolev transferred all robotic lunar and planetary space probes to Lavochkin. Subsequently, Babakin solved the quality control problems plaguing the Luna Ye-6 and 3MV planetary spacecraft, leading to a long run of successes at the Moon and Venus. The heavy Proton-launched spacecraft were developed under his direction and he experienced their initial success with the Luna 16 sample return and Luna 17 rover.

He was a worthy successor to Korolev, but died suddenly at the early age of fifty-seven in August 1971 before his new Mars spacecraft reached their destinations.

Kryukov, Sergey Sergeyevich
1918–2005
General Designer NPO-Lavochkin 1971–1977

Kryukov

Sergey Kryukov worked with Korolev, Tikhonravov and Mishin on the development of the R series of rockets, and rose to deputy chief designer to Korolev along with Mishin and others at OKB-1. He had a falling out with Mishin over development of the Block D upper stage for the N-1 (also used on the Proton) and transferred to Lavochkin. After less than a year, he became General Designer when Babakin died. He inherited the problems that would plague the Mars program and the successes that would come in the Venus program. After the 1973 Mars fleet disaster, he was tasked by Afanasyev to design new and even larger Mars missions to send rovers to the surface and to return samples. These missions turned out to be too complex and costly for the traumatized post-Apollo Soviet space program and were canceled in 1977 in favor of the rather less ambitious Phobos mission. Kryukov was replaced by Vyacheslav Kovtunenko and transferred to Glushko's organization, where he worked until retirement in 1982.

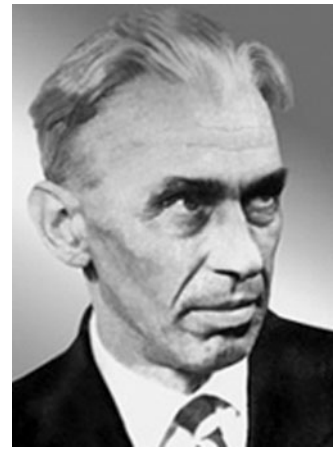
Kovtunenko, Vyacheslav Mikhailovich
1921–1995
General Designer NPO-Lavochkin 1977–1995

Kovtunenko

While working for Yangel's design bureau, Vyacheslav Kovtunenko designed the Cosmos and Tsyklon rockets and was responsible for the Intercosmos series of small science satellites. On succeeding Kryukov as Director of Lavochkin, he developed the new generation Universal Mars Venus Luna spacecraft, which was essentially a renovation and upgrade of the heavy Venera spacecraft. He encountered obstacles to funding, not faring well against industry heavyweights such as Glushko, and the first of the new spacecraft was unable to be launched until 1988, as the Phobos mission. Kovtunenko would guide Lavochkin through the successes of Venera 11 to 16 and Vega 1 and 2, and the partial failures of Phobos 1 and 2, and the transition from the USSR to Russia leading up to the final Mars-96 debacle. He died in office in 1995.

DIRECTORS OF THE SCIENCE INSTITUTIONS

Petrov, Georgi Ivanovich
1912–1987
Director of the Institute for Space Research (IKI) 1965–1973



Petrov

A brilliant aerodynamics engineer having contributed significantly to ICBM design, Georgi Petrov was selected in 1965 by Keldysh to be the first Director of the newly formed Institute for Space Research. Petrov worked hard to establish his institute in the panoply of scientific communities, all of which were scrambling for funding in the new scientific space program. It was several years before IKI developed into a world-class institute for space research and the building of scientific instruments for space science missions. He established highly capable teams of space scientists and engineers and successfully motivated them to explore near-Earth space, the Moon, and the planets. IKI benefited immensely from his leadership, and mirrored his style of creativity and open discussion.

Sagdeev, Roald Zinnurovich
1932–present
Director of the Institute for Space Research 1973–1988

Sagdeev

Roald Sagdeev was a nuclear physicist working in the remote 'science city' of Akademgorodok when, at the advice of the distinguished physicist Leo Artsimovich, he was tapped by Keldysh to replace Petrov at IKI. He took leadership of IKI as the second generation of heavy Venus spacecraft was being introduced by Lavochkin, and shared in its success. He reassigned planetary geology to the Vernadsky Institute and focused his own institute's scientific efforts on planetary atmospheres and space plasma. These two institutes became dominant and competitive centers for planetary science. IKI remained the center for space astronomy.

A hallmark of Sagdeev's experience in a 'science city' far from the Kremlin was a culture of open, questioning discussion with promotion on the basis of merit rather than on political connection. Although upon becoming Director and a member of the Communist Party he initially conformed to the Soviet system, he later imported the Akademgorodok attitudes to IKI, bringing *perestroika* (transformation) and

glasnost (openness) to his institute before Mikhail Gorbachov introduced it to the USSR. His most remarkable and enduring achievement was the opening of the Soviet planetary exploration program to international participation, leading his country into an era of scientific mission cooperation with the West as *perestroika* was driving the Soviet Union. Succeeding through charm, patience and shrewd political judgment, first the Vega Venus-Halley mission and then the Phobos Mars mission were approved as progressively more open to international scientific participation. He was aided by the mass and size of Soviet spacecraft, which were able to accommodate a large number of foreign instruments to undertake comprehensive scientific missions. The new policy was highly successful at the outset, catching the US in the doldrums after its successes of the 1970s, and the Soviets overtook the US as international leader of planetary exploration in the 1980s.

After the success of the Vega missions in 1986, Sagdeev became a local hero and international celebrity. But the joy was short lived. The loss of the Phobos missions in 1988 raised an international furor in the space science community. This was not a comfortable situation for Sagdeev and he left IKI in 1988, married the daughter of Dwight Eisenhower, and moved to the US to become a Professor at the University of Maryland. He remained a force in international space science and exploration for a time, but his influence on space policy decreased as he focused his efforts more on East-West relations. The high level of international participation in the Vega and Phobos missions, and the ensuing Mars-96 mission, has never been equaled.

Vinogradov, Aleksander Pavlovich
1895–1975
Director of the Vernadsky Institute of Geochemical and Analytical Chemistry 1947–1975

Vinogradov

Alexander Vinogradov was the Soviet Union's leading geochemist, head of the Vernadsky Institute and Vice President of the Soviet Academy of Sciences at the opening of the 'space age', and Chairman of the Moon and Planets Section of the Space Council MNTS KI. He was a pioneer in using chemical and isotope analysis to study the formation of minerals in Earth and meteoritic materials. He developed the use of gamma-ray spectroscopy to study the composition of planetary surfaces, and analyzed samples returned from the Moon. Under his leadership, the Vernadsky Institute developed many of the geochemistry instruments flown on missions to the Moon, Venus and Mars.

Barsukov, Valery Leonidovich
1928–1992
Director of the Vernadsky Institute 1976–1992

Barsukov

Valery Barsukov was a geologist experienced in field work. After taking over the Vernadsky Institute and its new role in planetary geology in 1976, he promoted missions and flight experiments with geochemical goals. He assumed leadership at a time when Mars exploration was in decline and Venus exploration was dominating the planetary program. He was an effective lobbyist for planetary geology missions and proved an effective rival to the Institute for Space Research led by Sagdeev. Both Barsukov and Sagdeev were well connected and fought, sometimes bitterly, to establish their own space science missions.

With Sagdeev's departure in 1988, Barsukov and the Vernadsky Institute assumed effective leadership of the Soviet planetary exploration program. Until his death in 1992, Barsukov pursued a complex Mars exploration plan even more international in scope than Sagdeev's Phobos mission, with a particular focus on US involvement. Under the joint leadership of Barsukov from Vernadsky and Professor James Head from Brown University, the Vernadsky-Brown Symposium on Cosmochemistry was organized. This continues to function as a forum for Russian-American cooperative research in lunar and planetary science.

http://www.springer.com/978-1-4419-7897-4

Soviet Robots in the Solar System
Mission Technologies and Discoveries
Huntress, JR., W.T.; Marov, M.Y.
2011, XX, 453 p. 232 illus., 29 illus. in color., Softcover
ISBN: 978-1-4419-7897-4