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The Man Behind [★] The Curtain

ALTHOUGH SPACE CZAR SERGEI KOROLEV WON FAME FOR THE LAUNCH OF SPUTNIK, A MORE MODEST GENIUS DESERVES THE CREDIT. by Asif Siddiqi

Over the past few years, I have tried to reconstruct the life of Mikhail Tikhonravov, one of the most puzzling figures in the Soviet space program. Although few Westerners have heard of him, it is quite likely that without him, the Soviet Union would not have inaugurated the Space Age 50 years ago this October. Tikhonravov (pronounced "Tee-kun-RAFF-off") had a hand in most of the critical events in the history of his country's space program. He designed the first Soviet liquid-propellant rocket, he proposed the clustered-booster idea for the famous R-7 rocket, he oversaw the design of Yuri Gagarin's Vostok rocket, and he supervised the development of the first Soviet moon probes. He even coined the word "cosmonaut."

Throughout his life, Soviet space designer Mikhail Tikhonravov (opposite, left) never got the credit or acclaim accorded to Sergei Korolev, his friend. Ten years before they launched the world's first satellite, the two paused in front of a bust of Konstantin Tsiolkovsky, considered the father of cosmonautics.

But perhaps his greatest triumph was Sputnik, the world's first artificial satellite, which was launched on October 4, 1957. Over the years, much of the credit—some might say too much—has gone to Sergei Korolev, Tikhonravov's friend and the

chief designer of the rocket that lofted Sputnik into orbit. But Korolev couldn't have created Sputnik. He "needed a visionary like Tikhonravov," Sergei Khrushchev, whose father, Nikita, led the Soviet Union during that time, once wrote in an essay. "Together they constituted the 'critical mass' that shook the world."

How did a man manage to contribute so much yet remain hidden? His shy nature and an aversion to taking credit all but ensured that his achievements in the Soviet space program would be often overlooked by history. His own office diary, which I was allowed to read, indicates that he was a workaholic, often forgoing vacation time to work. Much of the diary is cryptic or in code since everything he was doing was top secret; Tikhonravov may have been afraid to

write too much down. But his words express a strong fealty to Korolev; almost every entry mentions him, and it is clear from the tone that Tikhonravov held Korolev in extremely high regard. One of the few times Tikhonravov shows any emotion in his diary is on the day of Korolev's death in 1966.

Tikhonravov had lived and worked for many years in the Moscow suburb of Yubileiny. For decades during the cold war, Yubileiny was a closed area. The town was so secret it did not appear on any maps and few Muscovites even knew it existed. It was the site of the most sensitive space organizations in the former Soviet Union. One of those was the 4th Scientific Research Institute of the Ministry of Defense, where Tikhonravov worked among grim military personnel devising strategies for the Soviet nuclear and space programs. There in the 1950s, he organized a group of young men and women—known as the Tikhonravov Group—who worked in secret on the R-7 rocket and Sputnik itself.

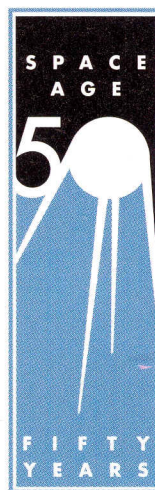
Few members of the group are alive today, but one of the brightest members still lives in Yubileiny. Oleg Viktorovich Gurko and his wife Larisa welcomed me last winter into their small, third floor

apartment with a warmth that put me at ease. Gurko was wearing a cardigan and tie, giving him a look of formality. Their modest living room was cluttered with mementos from the Space Age: books, models, and souvenirs.

Our conversation soon turned to how Gurko first met Tikhonravov. World War II had just ended, and Gurko was eager to expand the space study group he had organized as a teenager, but he needed an outsider experienced in space science to guide it. Having heard of Tikhonravov's work, Gurko sought him out in hopes of persuading him to offer his support. Because

Tikhonravov worked in a classified military institute, it was not easy to visit him, but Gurko was persistent.

Gurko still vividly remembers their first meeting. He and a friend were shown into an office with two military officers, one a stocky



Korolev (standing, far left) led the team of rocket enthusiasts and engineers that launched the first Soviet liquid-fueled rocket, called the O9, which Tikhonravov had designed. Tikhonravov missed the 1933 launch from a wooded suburb of Moscow, but the other enthusiasts watched it fly for about 18 seconds, reaching an altitude of about 1,300 feet.

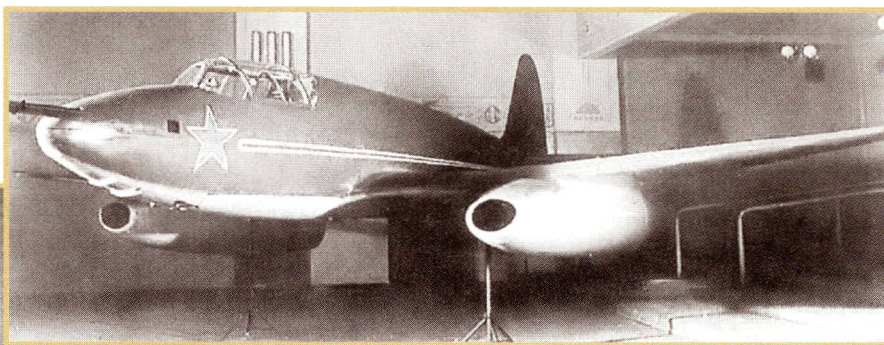


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The 302P rocket-plane (right), which Tikhonravov designed in 1943, was never produced. Below, he greets Oleg Gurko (left) and Igor Yatsunsky during a 1966 reunion of the Tikhonravov Group.



OLEG GURKO



ASIF SIDDIQI

man with an imposing presence, the other a shy, thin man of medium height with clear, lively eyes. Thinking that the heavier officer was Tikhonravov, Gurko turned to him and explained at length the work of the student group. Only after the meeting did Gurko discover that it was the other man—the one who had seemed unimportant—who was Tikhonravov.

TIKHONRAVOV WAS BORN in 1900 in Vladimir, one of the oldest cities in Russia, located a little more than 100 miles east of Moscow. His parents were teachers, and as a boy, he mastered Latin and ancient Greek. After finishing in the first class to graduate from the prestigious Zhukovsky Military Air Academy (his classmates included future airplane designers Sergei Ilyushin, Artem Mikoyan, and Alexander Yakovlev), he worked in the late 1920s as an aeronautical engineer. In his spare time, he studied gliders. At a 1927 regional glider competition, Tikhonravov met a 20-year-old aviation enthusiast named Sergei Korolev. In an apt metaphor for their later relationship, Tikhonravov designed a glider named *Firebird* that Korolev flew to gain his pilot license, thus bringing Korolev's name to prominence within the glider com-

munity. Besides holding a day job and working on gliders, Tikhonravov was a prolific writer. He wrote frequently on bird and insect flight. In the hope of replicating the flight of a bird, he spent years crunching numbers and doing experiments. Though he decided that human muscles, even augmented by wings, were simply incapable of flight, "Tikhonravov never gave up studying how birds fly," Gurko told me.

More than airplanes and other flying things, Tikhonravov's greatest passion was space exploration. He was an early convert to the cause, molded by the space and science fiction craze that raged in Russia in the 1920s (see "Russia's Long Love Affair With Space," June/July 2007). Tikhonravov believed that the first step to space flight would be to build a liquid-propellant rocket engine. In 1931, he heard through acquaintances that his old friend Korolev had joined up with another older enthusiast, Friedrich Tsander, in an attempt to mount a crude rocket engine on a glider. With a few others, they formed the Group for the Study of Reactive Motion (GIRD in its Russian acronym), a team with no official standing but a desire to do more than just talk about rockets.

Though GIRD existed for less than two

years, its accomplishments were impressive. The late Russian space historian Yaroslav Golovanov characterized the team as an "apprenticeship" for Sputnik. By early 1933, the group had attracted the attention of the Soviet military but it had also had a number of setbacks, including the failure of an engine and Tsander's death from typhoid fever. Korolev, the leader of the group and the most practically inclined, desperately needed a success to show the military that the group was serious and to win government funding. Tikhonravov's experiments with a rocket known as 09 provided a glimpse of hope. A simple design that used a combination of liquid oxygen and jellied gasoline, the rocket weighed about 42 pounds. This was seat-of-the-pants rocketry: To launch the 09, the young engineers would put the rocket in the back of a rented truck and rush to their "launch base," a wooded area in the Nakhabino suburb of Moscow; they had to hurry so they could launch the rocket before the liquid oxygen in the fuel tanks evaporated.

Success came on August 17, 1933, when Tikhonravov's rocket reached about 1,300 feet. It was the first launch of a Soviet rocket that used liquid propellants, and came seven years after American Robert Goddard had accomplished the same feat in Auburn, Massachusetts. Ironically, Tikhonravov missed the big moment; before the launch, he had driven himself to such exhaustion that Korolev sent him off on a sailing and fishing trip on the Khooper River. A cryptic telegram from the team—"Examination passed"—was the only indication to Tikhonravov that the rocket had lifted off. Korolev, though, was careful to credit his friend with the actual design of the rocket. Years later, in the 1960s, an obelisk was erected in the same woods to mark this birthplace of Soviet rocketry. Tikhonravov always felt embarrassed that

the monument was inscribed with only his name; according to Gurko, he felt the launch was a team effort.

GIRD's successes led to the formation of a rocket research institution in the early 1930s, sponsored by the Soviet government, yet the institute (known as RNII) was mired in infighting. When engineers clashed over technical options—particularly the selection of rocket propellants—they were unwilling to compromise, which created a poisonous atmosphere. Tikhonravov, who by then had moved on to less sensitive projects, largely avoided the disputes within RNII. Creative work was stalled, and the institute—as well as the rest of the country—then suffered Josef Stalin's purges. Many of those on the "wrong" side of a technical issue ended up in prison; some were shot. Tikhonravov's wife, Olga, told friends that her husband always kept a suitcase packed. Gurko refused to speculate why Tikhonravov was never included in Stalin's purges, but others I spoke with believe that he was saved by his natural shyness and avoidance of confrontation.

During World War II, Tikhonravov moved from project to project: He worked on the famous Katyusha rocket launchers, a rocket airplane, and even a manned high-altitude research rocket. He was on the first Soviet team to study the wreckage of the famous German V-2 rocket, a mission that completely changed the trajectory of Soviet rocket development. By the time he met Gurko, he was in his late 40s and a deputy director at the 4th Scientific Research Institute. The institute, a Soviet-style think tank much like the U.S. RAND Corporation, did not build rockets, but it generated ideas on how to use them in battle.

Tikhonravov recruited young engineers to design—on paper—a rocket that could fly across the world. He was well aware that such a rocket could also deliver a satellite to orbit. But the technical limitations seemed insurmountable: How to design a rocket engine that could fire at very high altitudes? In search of a solution, he decided to focus on an alternate path: Why not have all the engines fire on the ground at liftoff? He and his team developed an innovative design, a vehicle that clustered several single-stage rockets with engines that would fire simultaneously at launch. He called the new

design a "packet."

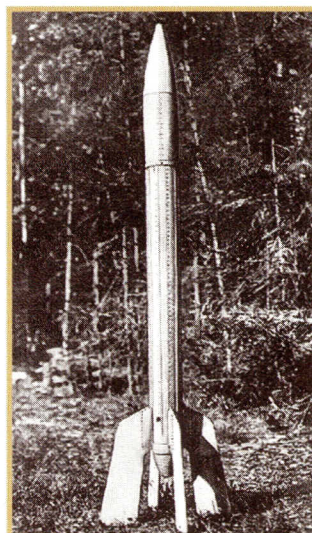
Tikhonravov gave lectures on the idea at several high-level scientific conferences, culminating in a talk in 1950 in which he argued that with current Soviet technology, the country could launch a satellite using the cluster design. A few like-minded rocket scientists—including Korolev—were easily persuaded, but most were appalled that the institute had, as one critic fumed, "decided to switch to the realm of fantasy." So serious was the fallout that Tikhonravov was demoted and ordered not to meddle in spacecraft design.

He did not give up easily. With Korolev's quiet support, Tikhonravov regrouped his team of young engineers, adding fresh new university graduates, including the 24-year-old Gurko. The group was small, and most members were in their mid-20s. Together, between 1951 and 1953, the Tikhonravov Group worked intensively on a number of mathematical studies of the packet concept for an intercontinental ballistic missile. Besides Gurko, who worked on thermal equations, the brain trust included Igor Yatsunsky, who shared Tikhonravov's calm disposition and acted as his deputy; Anatoly Brykov, who studied how to connect missiles into a cluster; Grigory Moskalenko, who explored the mass characteristics of various rocket clusters; and Igor Bazhinov and Gleb Maksimov, who analyzed the motion of missiles through the upper atmosphere. The only woman in the group, Lidya Soldatova, worked with Brykov on making the strap-on booster rockets detach from the core booster.

The packet-design studies that these



Korolev (far left) watches as a rocket club member fills the O9 rocket's oxidizer tank. Fueled by liquid oxygen and jellied gasoline, the O9 (below) was launched more than seven years after Robert Goddard's first liquid-fueled rocket.



ASIF SIDDIQI (2)

young scientists produced profoundly influenced Korolev's thinking on an intercontinental ballistic missile. When Korolev's design bureau finally settled on an ICBM design, they chose Tikhonravov's cluster. The idea went through a number of major redesigns before the final version emerged as the R-7 rocket for Sputnik. In spirit, this majestic booster, whose descendants today launch cosmonauts to the International Space Station, owes its birth to Tikhonravov and his team.

There was more creative work to come. Tikhonravov obtained support to redi-

rect his group of young scientists to start studying satellite design. In late 1953, at Tikhonravov's initiative, his bosses approved "Theme 72," the first serious study of satellites conducted in the Soviet Union, similar to the satellite studies RAND conducted at the time in the United States. The Tikhonravov Group explored a variety of engineering problems, with each member taking on a specific topic, such as placing a satellite in orbit, returning the launcher to Earth, and optically tracking the satellite.

Tikhonravov's study was groundbreaking, but it would have languished had it not been for Korolev's enthusiasm for it. In May 1954, Korolev sent a letter to the Soviet government asking for approval to design and build a satellite. He attached a summary of Tikhonravov's work, which showed not only that a satellite could be built, but that the Soviets could beat the Americans into space. It took a year for the request to get through the Soviet bureaucracy and win approval. Tikhonravov's office diary provides a glimpse of the frustrations of this critical period. In one passage, he laments that after explaining satellites to an audience, "[t]here were no questions. Don't they get it? Or are they not interested?"

Armed with government approval, Korolev's engineers began building the first Soviet satellite, a nearly 3,000-pound observatory to study geophysical phenom-

ena. The project proved to be overly ambitious. Korolev and Tikhonravov had to depend on a great number of subcontractors who rarely made their delivery deadlines. The two were also well aware of the United States' satellite project, Vanguard. In late 1956, both men were becoming worried that all of this complicated equipment would delay the primary goal: to get to space first. The historian Golovanov, who interviewed Tikhonravov, wrote about a crucial exchange between the two friends. Once, while Korolev was complaining about the delays, Tikhonravov suddenly piped up: "What if we make the satellite a little lighter and a little simpler? Thirty kilograms or so, even lighter." This single question, unassumingly raised, was the key to Soviet leadership in the Space Age.

In typical fashion, Korolev went into action, marshaled a handful of engineers, and ordered them to work on a "simple satellite." It would be a metal sphere (Korolev thought a sphere was the most elegant design) carrying a battery, a radio transmitter, a heat regulation system, some antennas, and not much else. There would be no subcontractors who could disappoint the program at a critical moment. Tikhonravov, who had by now transferred from the military institute to work directly under Korolev, oversaw the production of the 184-pound satellite.

In the weeks before launch, Tikhonravov spent days and nights next to the satellite, overseeing all the preparations. He took a break only to attend celebrations for the 100th birthday of Soviet space pioneer Konstantin Tsiolkovsky. The ceremonies were held in Moscow and in Tsiolkovsky's hometown, Kaluga, just two weeks before Sputnik's launch. A rare photo of Korolev and Tikhonravov in Kaluga shows both uncharacteristically smiling—they were on the cusp of their greatest achievement. Both men soon flew back to Tyuratam (later named the Baikonur Cosmodrome) to oversee work on the satellite. Remarkably, though Tikhonravov is acknowledged as the godfather of Sputnik, few remember him spending much time at the launch pad. Shy and unaccustomed to the hectic life at the launch range, he stayed out of the spotlight while Korolev directed all the preparations.

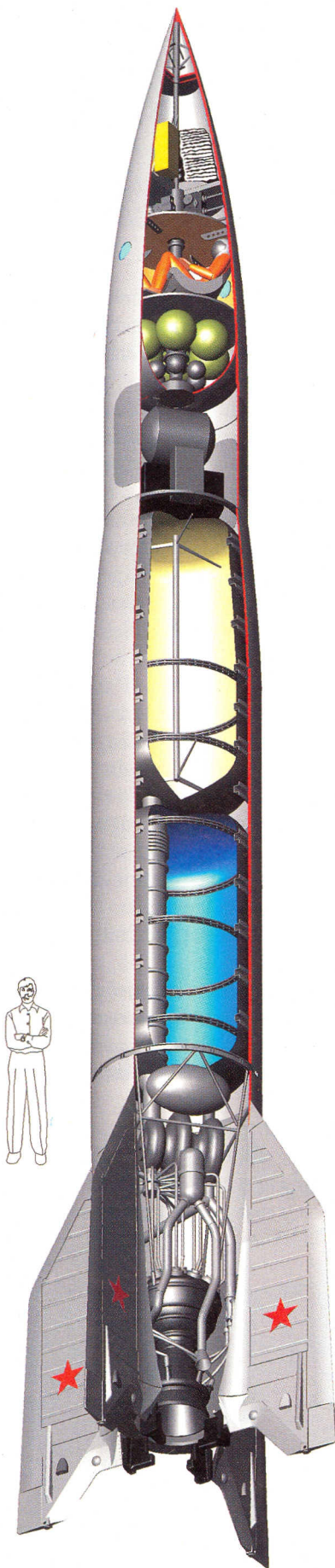
On the night of October 4, 1957, Tikhonravov's "simple satellite" took off in a burst



Tikhonravov is buried in Moscow. Below: The designer with granddaughter Olechka and scientist Lidya Soldatova.



OLEG GURKO (2)



The VR-10 (left), which Tikhonravov designed in 1946, was a two-seat suborbital spaceship. Its technologies ended up on the later Vostok and Soyuz spacecraft. Right: Gurko keeps a model of a spaceplane he proposed in the 1970s; the Buran was built instead.



ASIF SIDDIQI

of thunder and flames and headed for the heavens, opening up the Space Age. Ecstatic and exhausted, Korolev and Tikhonravov were awake the whole night. The next day, Tikhonravov had only this to say in his diary: "Newspapers write about the Sputnik launch!"

After Sputnik, Tikhonravov directed all space projects under Korolev. Unlike his boss, who had become the monarch of the Soviet space program, Tikhonravov wielded little decision-making influence, although he guided the design of many spacecraft. Why was Tikhonravov in the shadows? Gurko believes that excessive modesty kept Tikhonravov from having a higher-profile career. "Tikhonravov was unusually intelligent, but he also avoided publicity," Gurko says. "He didn't care for awards or positions or influence."

Those who knew them say Korolev and Tikhonravov were completely different in character. Korolev was impulsive and had a volatile temper, and was feared by all. Tikhonravov, by contrast, always seemed approachable. Former cosmonaut Vitaly Sevastyanov, who worked under Tikhonravov, recalls that the man was "unhurried, thorough in his judgments, [and] capable of reflection. He never imposed his ideas on anyone else, and never raised his voice." Sevastyanov remembers that while Korolev would rage over the smallest trifle with others, with Tikhonravov he would always calm down.

Yet there was occasional friction between the two. For example, although he led the design team that created Yuri Gagarin's Vostok spacecraft, Tikhonravov was absent at Baikonur on April 12, 1961, when Gagarin was launched into orbit. Korolev hadn't bothered to invite him for

the historic launch—a slight that, according to former Korolev deputy Boris Chertok, "very deeply upset" Tikhonravov.

Design work under Korolev may not have been easy but it was rewarding. Tikhonravov's last major contribution to the Soviet space program was designing the Luna probes, which in 1966 made the first soft landing on the moon.

By that time, Korolev was dead. Tikhonravov left the space business soon after, unable to get along with Korolev's successor, the irascible Vasily Mishin. Tikhonravov continued teaching at the Moscow Aviation Institute, but spent more time with Olga, whom he had met when both were young rocket enthusiasts in the amateur group GIRD and who shared his deep interest in space travel. In his spare time, he wrote and painted.

By the time Gurko last saw him in late 1973, Tikhonravov had cancer. He fell gravely ill soon after and died at the age of 73 on March 4, 1974. Olga died 19 years later. Their daughter, Nataliya, does not grant interviews. But others, like Gurko, are eager to promote Tikhonravov's legacy. In the history of the Soviet space program, "Tikhonravov's name should be right up there with that of Korolev!" Gurko said as I said goodbye.

Back in Moscow, I stopped by Novodevichy Cemetery, where some of Russia's most famous sons and daughters are buried. There, an imposing bust of Tikhonravov stands over his grave. An inscription describes him simply as the designer of the "first Soviet rocket." There is no mention of Sputnik, the R-7, Vostok, or Luna. In death as in life, Tikhonravov remains a modest figure, overshadowed by others who were more charismatic. —

A. SHIYADINSKY AND I. AFANASYEV