History of Sputnik Project Recounted

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[Article by Yaroslav Golovanov: "The Beginning of the Space Era"]

[Text] Mikhail Klavdiyevich Tikhonravov was a man of unusual curiosity. The mathematics and the many engineering disciplines he mastered in the Academy imeni N.Ye. Zhukovskiy did not dry up his romantic enthusiasm and bent for flights of fancy. He painted landscapes in oil, assembled a collection of wood-eating beetles, and studied the dynamics of flight in insects, hoping secretly to discover in the beating of their tiny wings some new principle for the design of an improbable flying machine. He liked to mathematical-ize his dreams, and he drew as much pleasure, as it were, from his calculations demonstrating their reality as he did from their doing the opposite—leading to the absurd: he simply loved learning. Once, Tikhonravov decided to design an artificial earth satellite. He read Tsiolkovskiy, of course, and knew that a single-stage rocket could not place a satellite into orbit. He carefully studied works of Tsiolkovskiy's such as "Space Rocket Trains" [Kosmicheskiye raketnyye poyezda] and "Achieving the Greatest Rocket Velocity" [Naibolshuyu skorost rakety], in which the theoretical basis for the idea of a multistage rocket was presented for the first time. But he wanted to try different variations for the combination of these stages and to see how it would all balance out. In short, he wanted to determine how feasible the idea itself was of achieving the orbital velocity necessary for a satellite launched with today's level of rocket technology. He began to calculate and became seriously absorbed in the matter. The Defense Scientific Research Institute in which Mikhail Klavdiyevich worked was studying things incomparably more serious than an artificial earth satellite, but to the credit of his chief—Aleksey Ivanovich Nesterenko—all this extracurricular, half-fantastic work in the institute was not only not persecuted—just the opposite, it was encouraged and supported by Nesterenko, although he did not make a display of it, so as to avoid accusations that he was involved in wild schemes. In 1947-48, without the aid of any sort of computer, Tikhonravov and a small group of his equally enthusiastic colleagues performed a colossal feat of calculation and proved that there did indeed exist a feasible configuration of a rocket package that in theory could accelerate a cargo to orbital velocity.

In June 1948, the Academy of Artillery Sciences was prepared to conduct a scientific session, and a paper arrived at the institute where Tikhonravov was working and inquired about what kinds of reports the research institute could present. Tikhonravov decided to report the results of his calculations on the artificial earth satellite. No one actively objected, but the topic nevertheless sounded so strange, if not wild, that they decided to consult with the president of the artillery academy, Anatoliy Arkadiyevich Blagonravov.

In the company of several of his closest associates, this completely gray-haired 54-year-old, handsome, refined, courteous academician in the uniform of a lieutenant general of the artillery listened very attentively to the small delegation from the research institute. He understood that the calculations of Mikhail Klavdiyevich were accurate, that all of this was not something out of Jules Verne or Herbert Wells. But he also understood something else: that this report would not embellish a scientific session of the artillery academy.

"The topic is interesting," Anatoliy Arkadiyevich said with a fatigued, colorless voice. "But we cannot include your report. Nobody would understand why....They would accuse us of getting involved in things we do not need to get involved in..."

The high-ranking officers sitting around the president began to nod in agreement...

When the small delegation from the research institute left, Blagonravov felt a bit disturbed. He had worked much with the military and had, by and large, adopted their useful principle of not re-examining decisions once they were made. But he kept returning again and again to Tikhonravov's report, and at home that night he again thought about it. There was no way he could escape the thought that this ridiculous report was in fact not very ridiculous at all.

Tikhonravov was a true researcher and a good engineer, but he was not a fighter. The artillery academy president's refusal upset him. His young associates at the institute, who had held their tongues in the president's office, were now in an uproar, which resulted in, however, new, serious arguments in favor of their report.

"Why did you not say something then?" Mikhail Klavdiyevich asked angrily.

"We must talk with the general again," the youth decided.

And on the next day, they went again to see the general. They got the impression that Blagonravov was almost happy at their arrival. He was smiling, and he listened to the new arguments carefully. Then he said, "All right. we will include the report in the session's agenda. Be prepared—we will blush together..."

The report was given, and afterwards, just as Blagonravov had expected, one very serious individual of no small rank asked as if in passing, as he looked somewhere above Anatoliy Arkadiyevich's head, "The institute must not have much to do and decided to switch to the realm of fantasy?..."

Ironic smiles were more than plentiful. But there were not just smiles. Sergey Korolev went up to Tikhonravov without a smile and, knitting his brow severely, as was his manner, said, "We have some serious things to talk about..."

They had been introduced in the summer of 1927 on Mt. Uzyn-Syrt, near Koktebel, during the Fourth All-Union Meeting of Glider Pilots, and they became friends at GIRD [Group for Study of Reactive Motion], in the basement at Sadovo-Spasskaya. Then their paths diverged. Tikhonravov had been lucky in 1938: he had kept his freedom. And now this new meeting...

Korolev understood the importance of what Tikhonravov had done, and within a year his own work, "Principles and Methods of Designing Long-Range Rockets," would come out. In it he also analyzed the different possibilities of multistage "packaging." But Korolev was a great realist and psychologist. He knew that the technical difficulties of creating a space package of rockets would be great, although surmountable. But he also knew something else: he would have to begin working at once—the difficulties would grow a hundred-fold and would become insurmountable, since we were not prepared psychologically for a satellite. The "cold war" would freeze such a project to the core. One could not talk about a satellite until there was a rocket capable of stopping the nuclear blackmail of the Americans. He began work on the R-3 rocket, which had a range of 3,000 kilometers. That was quite a distance, but still not enough...

Things were worked out with Tikhonravov quickly: he would continue his work. Soon afterward, Mikhail Klavdiyevich conducted an analysis of a two-stage package and proved that it could lift a fairly heavy satellite into orbit. Korolev liked the design: the engine did not have to be started in a vacuum—that had not yet been mastered.

In February 1953, the decision was made to develop an intercontinental ballistic missile. Speculative designs of a huge machine were awash in mathematics, and, just as some kind of contrast appears on a white sheet of photographic paper in a bath with developer, the formulae revealed the contrasts of these designs, their merits, and their flaws. By May, the principal design had been chosen from the two most promising designs—a two-stage ballistic missile and a two-stage missile with a winged second stage. Korolev set to work on the most important business of his life.

A gigantic rocket capable of reaching any point on the globe was needed to defend the country. But Korolev also understood immediately that that very rocket would lift a satellite into space. Tikhonravov was extremely excited: this was a specific rocket, and he knew its specific parameters. If one were to substitute its warhead partly with fuel and partly with the satellite, the rocket would put it into orbit!

On 26 May 1954, Korolev wrote to the USSR Council of Ministers: "The current development of a new product with an ultimate speed of nearly 7,000 meters a second makes it possible for us to speak of the possibility of developing in the near future an artificial earth satellite. By reducing the weight of the payload somewhat, we will be able to achieve the ultimate speed of 8,000 m/sec that a satellite needs..." On 16 July, M.K. Tikhonravov relayed to Korolev a brief report that had been written with I.V. Lavrov: the satellite could weigh between 1,000 and 1,400 kilograms! Two weeks later, on 29 July 1955 [as published], President Dwight Eisenhower published a special communique in the White House that said the United States would begin preparing for the launch of an artificial earth satellite.

The communique created a sensation. Although the Americans had been writing about an artificial earth satellite since 1946, "Eisenhower's Moon," as the journalists dubbed the project, was to once again remind the world of the inaccessible primacy of American technology. The "Bird," as specialists had named the project, was to be the generous gift of a great country to the International Geophysical Year (IGY), which began in July 1957, and would strengthen in the consciousness of millions of people the notion of the indisputable leadership of the United States in the world community. Then, after the launch of our satellite, FORTUNE magazine wrote: "We did not expect the Soviet satellite, and thus it had the effect of a new, technological Pearl Harbor on Eisenhower's America."

But why did they "not expect" it? Did they not know? Why, literally several days after the White House communique, Academician L.I. Sedov, at the Sixth Congress of the International Astronautical Federation in Copenhagen, told journalists that the Soviet Union intended to launch a satellite during the IGY—in fact, several satellites. "It is possible that our satellites will be finished before the American satellites and will be heavier," the academician told them. The president of the USSR Academy of Sciences, A.N. Nesmeyanov, confirmed that, theoretically, the problem of launching a satellite into orbit had been solved. The magazine RADIO published approximate frequencies on which the satellite's transmitter would be operating. S.P. Korolev, in his own report at a gathering celebrating the 100th anniversary of the birth of K. Tsiolkovskiy, came right out and said that Soviet scientists intended to launch a satellite in the near future. Why, much was being written abroad about Soviet satellites. The progressive French science writer Michel Ruze [Mishel Ruze] soberly sized up the situation: "By no means can it be implied that Eisenhower's Moon will be the first to the finish line in the race against its Soviet, and maybe even its English, rivals," he wrote in September 1955.

So why did they "not expect" it? They knew about it and were hearing about it. It was for another reason—they did not want to know, they did not wish to hear. Here once again appeared the long-time American illness that,

alas, remains uncured to this day: for it to admit the possibility of the launch of a Soviet satellite would have been to take a step toward comprehending the actual forces that existed in the world, would have meant admitting that its own assessments of other nations were outdated and were in need of reevaluation. That was something that was beyond the developers of Eisenhower's Moon.

Meanwhile, time passed, and the business of our satellite distressed and alarmed Korolev. At first everything went well. On 30 August 1955, there was a gathering in the office of Academician A.V. Topchiyev, the main scientific secretary of the presidium of the USSR Academy of Sciences: S.P. Korolev, M.K. Tikhonravov, M.V. Keldysh, and, among other specialists, V.P. Glushko. Korolev reported on the status of the operations involving the rocket and suggested that a commission be formed to develop a program for launching a satellite and that the leading scientists of the academy be enlisted to develop the equipment.

"I support the suggestion of Sergey Pavlovich," Keldysh said. "We need to appoint a chairman..."

"You should be the chairman," Korolev replied immediately.

An approximate date was set for the launch—the summer of 1957, the beginning of the IGY. That left 2 years to develop and build equipment, power sources, a temperature-regulation system, a radiotelemetry system with omnidirectional antennae, a system for controlling the operation of the on-board gear, and much more. Korolev immediately recognized the biggest danger: dozens of people were working to solve a single problem. A failure in one link would break the entire chain. Korolev's design office was responsible for the most important thing—the booster, and there still was no rocket. But for the time being that bothered Sergey Pavlovich less than the coordination of all the other operations. Korolev was probably the first to encounter an undertaking of such scale, whose solution required not only his will, experience, and energy, but also the enthusiasm of many other people. It was unrealistic to expect from everyone the enthusiasm he needed and one equal to his. Keldysh consulted with the "atmospheric specialists" S.N. Vernov, L.V. Kurnosovaya, and V.I. Krasovskiy; enlisted his own "apprentice" specialists for trajectory measurements—D.Ye. Okhotsimskiy, T.M. Eneyev, V.A. Yegorov,and M.L. Lidov; got the solar-battery expert N.S. Lidorenko on the job; and advised and consulted with the brightest minds of the academy—P.L. Kapitsa, A.F. Ioffe, B.P. Konstantinov, V.A. Kotelnikov, L.A. Artsimovich, and, among others, V.L. Ginzburg. After the launch of the satellite, Keldysh would say, "Every kilogram of scientific gear was considerably more expensive than gold—it took golden intellects..." But now—and Korolev saw this clearly—they needed fast builders as well as brainy consultants. The schedule for building and testing the equipment was constantly being disrupted. Finding the guilty parties was difficult: many scientists and many people with higher degrees—creative and original thinkers—turn into downright children when it comes to production. As he spoke with them, Korolev saw that we had little experience when it came to science interacting with industry, that deadlines would continue to be disrupted, and he was nervous about it. He sometimes shared his alarms with Tikhonravov. Mikhail Klavdiyevich would silently nod his head. Korolev interpreted Tikhonravov's placidness to be indifference toward his concerns and was, in any case, completely surprised when, in late 1956, Tikhonravov suddenly suggested this: "What if we make the satellite a little lighter and a little simpler? Thirty kilograms or so, or even lighter?"

Korolev quickly assessed the situation: without dampening the Academy of Science's ardor, and using a few smezhniki [suppliers of components] as possible—mainly, Nikolay Stepanovich Lidorenko would provide the power sources, and Mikhail Sergeyevich Ryazanskiy would provide the radio gear—he could use his own resources to build a small, simpler satellite (in the documentation, it is called the PS [original Russian initials for term "simple satellite"]). On 5 January 1957, he sent the government a report which spoke of the preparation of two satellites—one weighing 40-50 kilograms (it would be the first) and one weighing 1,200 kilograms (it would be the third)—and proposed preparing a rocket for launch between April and June of 1957. He got the OK, and on 25 January he signed off on the initial data for the PS.

But there was still no rocket. Or more precisely, there was a rocket, but it had not flown yet. There were many difficulties, but Korolev did not hide them, and in the report to the government he wrote frankly: "The preparatory operations for the first launches of the rocket are proceeding with significant difficulties and behind schedule..." He set the first launch for March. It did not go off. Nor did the launch go off in April. On the 10th of the month, Korolev and the chief control equipment designer, N.A. Pilyugin, went to the cosmodrome. On the way, he said to Pilyugin that he would not return to Moscow until the rocket had flown. The first launch of the R-7 (which is how it is referred to in the documentation concerning intercontinental missiles) took place on 15 May 1957. The rocket did not fly for long: it broke up on the active leg of the trajectory. Pilyugin, the chief launch-complex designer V.P. Barmin, and other specialists left for Moscow. Korolev's favorite—Lenya Voskres (the deputy for testing Leonid Aleksandrovich Voskresenskiy) became ill: his face swelled up horribly, and Korolev sent him to Moscow. Sergey Pavlovich himself was not well. He had a bad sore throat, and they gave him penicillin shots. He never troubled his wife with his worries, but now he was writing Nina Ivanovna letters that were very unlike himself: "When things are going badly, I have fewer 'friends'....My frame of mind is bad. I will not hide it, it is very difficult to get through our failures....There is a state of alarm and worry....It is

a hot 55 degrees here." In mid-June he wrote: "Things are not going very well again!" But he would not have been Korolev if he had not added: "Here, right here and now, we must strive for the solution we need!" On 24 June, his assistant K.D. Bushuyev called from Moscow and said that he had signed off on the drawing of the final configuration of the PS. The satellite weighed 83.6 kilograms. But the rocket still had not flown... In a letter to Nina Ivanovna dated 8 July, Korolev wrote, "We are working hard..." In a letter dated 13 July: "Things are very, very bad..." In all the postwar years, no days were more painful, difficult, or tense for Sergey Pavlovich Korolev than those of that hot summer of 1957. Indeed, he weathered it all with his own "No 7": on 21 August, the R-7 flew! After the launch, he did not go to bed until 3 in the morning, talking about future work and, of course, the satellite. Korolev knew that now No 7 would fly—it had exhausted the inventory of possible failures, such as those that had occurred with the other vehicles, and now it would definitely fly! And it would lift a satellite into space!

Ten days later, on 31 August, after returning from Moscow, Korolev would conduct testing of the PS together with the booster, and in early September he and his designers and testers would send the satellite to the cosmodrome. To the rocket testing site that he would have to rename a cosmodrome.

I had the opportunity to speak with many of those who worked in Korolev's design bureau and with specialists from subcontracting industries about our first satellite. Strangely enough, they do not remember it well. Working on the rocket was so immense and so tense that it pushed that little ball with a "mustache" of antennas into the background of human memory. An assistant of Tikhonravov, Yevgeniy Fedorovich Ryazanov, recalled how the first sketches of the PS were shown to Korolev. Korolev did not like any of them. Ryazanov asked him gingerly, "Why not, Sergey Pavlovich?"

"Because they are not round!" Korolev answered mysteriously.

It was not just that the sphere is an ideal form containing the most volume for the least amount of surface. Perhaps instinctively, intuitively, Sergey Pavlovich was striving for the maximum laconicism and expressiveness of form in this historical device, and in fact now it is hard to imagine an emblem more capacious than this for symbolizing the space age.

Vyacheslav Ivanovich Lappo—the designer of the PS's radio transmitter—recalls how Korolev came to him in the laboratory one night and asked Lappo if we would let him listen to the satellite signals. Lappo explained that the pressure and temperature inside the satellite are monitored by the change in the length of the radio pulses. "Understand, right before it dies, it will squeak a little differently," Lappo said. Korolev liked this very much. He listened to the "beep-beep" signals with pleasure for a bit, and then he cautiously, even a bit timidly, asked, "There is no way you could make it squeak some sort of word?"

The industrial people who had worked in the experimental plant also remembered more about the rocket than about the PS.

"For us, from the standpoint of manufacturing, it was something truly simple," recalled chief engineer Victor Mikhaylovich Klyucharev. "In fact, all our attention at that time was concentrated on finishing the booster. But for the satellite itself, it was hard to get a shiny surface that reflected the sun's rays: at that time there was no special technology for making the aluminum alloy from which the hull of the first satellite was made. But we mastered that. All who came into contact with the 'little ball' began to literally carry it with their hands, in white gloves, and the stand on which it was assembled was covered with velvet. Korolev, overseeing all the operations involving the satellite, demanded special treatment for that piece."

Yes, fearing that it would be overheated by the sun's rays, Korolev required that the globe of the satellite be polished. He had no idea just how much would be reflected in his mirror on 4 October 1957.

The order for flight testing of the PS was signed at the cosmodrome on 2 October. Leonid Aleksandrovich Voskresenskiy, from the design bureau, and Aleksandr Ivanovich Nosov, from the missile forces, were appointed as heads of the test crews. Early in the morning on 3 October, the rocket was taken to the pad. Operations were going according to schedule, without any hitches.

"Nobody will hurry us," Korolev said. "If you have even the tiniest doubt, we will stop the testing and make the corrections on the satellite. There is still time..."

Did Sergey Pavlovich understand that during these hours the future moral and ethical principles of cosmonautics, unwritten, unnoted in any kind of instructions, were being formed? "No, nobody back then was thinking about the magnitude of what was going on: everyone did his own job, living through its disappointments and joys," Oleg Genrikhovich Ivanovskiy, the assistant to the head designer of the PS, wrote years later in his book, "The First Stages" [Pervyye stupeni].

On the next day, after the rocket had been fueled, Korolev called Khomyakov and told him to go up to the service platform and re-check everything carefully. According to witnesses, the chief designer [Korolev] was reserved and silent during all those prelaunch days, rarely smiling. He continually asked questions of himself for which he could find no answers. He did not know whether the correct trajectory had been chosen, where in fact the atmosphere ended, where its boundaries were.

He did not know if the radio transmitter's signals would pass through the ionosphere. He did not know whether the micrometeorites would spare the polished globe. He did not know whether the seal would keep the vacuum in space. He did not know whether the ventilation system could cope with exhausting the heat. Often now, sometimes without any reason, people use an expression that has practically grown wings—"flight into the unknown." But that was truly a flight into the absolutely unknown, and there has never been anything more unknown in the entire history of man.

It was in the dead of that autumn night, and the launch pad was illuminated by spotlights. It was as if their burning beams made the rocket smoke lightly—the liquid oxygen was steaming. Those on the observation deck saw the white smoke suddenly disappear: the drain valves had been closed, and the tanks were now being pressurized. The "firer" ["strelyayushchiy"] Yevgeniy Ilich Ostashov was giving commands without removing his face from the black rubber that lined the eyepiece of the periscope. Two operators sat at the command console with its buttons during those very minutes: Lt Boris Semenovich Chekunov and senior technician Anatoliy Ivanovich Kornev. And then the darkness shook, and somewhere below a flame hammered down, and it flashed for an instant from a concrete channel. Columns of smoke and dust engulfed the fire-breathing tail of the rocket for a second, but then the rocket broke away from this hot cloud and lifted upward, flooding the nighttime steppe with light. The satellite was launched on 4 October 1957, at 10:28 p.m. Moscow time.

"We were as happy as kids, laughing and kissing one another," recalled K.D. Bushuyev.

The radio station was set up in a van that was positioned about 800 meters from the pad. A huge crowd of people packed into the van, everyone wanting to hear the voice from space. Slava Lappo sat at the receivers and recorders and waited for the signal. And suddenly he heard something that was at first distant and weak but that became increasingly louder and clearer: "Beep-beep-beep..." A hearty "Hurrah!" arose, drowning out the happy voice of Ryazanskiy, who was yelling over the telephone to Korolev, who was in the command bunker: "We have it! We have a signal!"

On its first revolution (it lasted 92 days in all), the ballistics specialists established that the satellite was losing little altitude, but to be safe the State Commission chairman Vasiliy Mikhaylovich Ryabikov decided to wait until the second revolution to call Moscow with a report. Seeing as it was in the middle of the night in Moscow, everyone was asleep...

No one noticed that it was already daylight. The first morning of the space era had come to the planet Earth.

Thousands of articles, entire libraries of books will be written about that night. The launch of the first satellite will be analyzed from every angle: the scientific, the technical, the historical, the social, the political. It will force us to look at many of the problems of our age in another light.

But to speak today only of the political significance of that launch as it applies to events 30 years old would be to belittle the event. Is it not symbolic that the most horrible of all the weapons that existed at that time—the intercontinental ballistic missile capable of carrying an atomic warhead—barely out of the womb, was transformed, in a matter of literally just a few weeks, into the most powerful instrument for science? The NEW YORK HERALD TRIBUNE, as if with surprise, wrote then that "in spite of the obvious psychological victory of the Soviet Union, this will not lead to an intensified threat of the outbreak of war." The launch of 4 October 1957, was not only the most graphic, convincing demonstration of the scientific and technical potential of the Soviet Union, but also new evidence of its peace-loving policy.

The satellite delighted the specialists—that is understandable. But it also brought delight to people who had absolutely nothing to do with science and technology. They saw the marvel of human thought and effort in this man-made object that was hurled upward and did not fall back to earth. The Soviet satellite forced all the inhabitants of earth to be proud of themselves—that is the principal result of its triumphant flight above the planet.

Thirty years have passed. Already 30 years. Just look at how time flies! But it is still just 30 years! And look how far we have already traveled along the highway in space! But no matter how far we go, no matter how small that shiny globe seems to us in the distance of years gone by, it will always shine to all those who are traveling to the stars, because we endowed it with a greatness that can never be surpassed by anyone: it was the very first!

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