Soviet Effort to Develop Rocket for Manned Lunar Mission Revealed

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[Article by Sergey Leskov: "Hcw We Didn't Fly to the Moon"]

[Text] A couple of years ago K. Gatland's "Space Technology" encyclopedia was offered in a Moscow book fair. The encyclopedia created a sensation in scientific circles. Many scientists, and precisely the most qualified and knowledgeable at that, came specially to the fair in order to leaf through the encyclopedia.

It would of course be naive to suggest that Soviet specialists in space technology must supplement their store of knowledge by such an undependable means. Interest in the copy at the exhibition was elicited for entirely different reasons. Besides the huge American Saturn-5 launch vehicle that took the Apollo spacecraft into Lunar orbit, the ecyclopedia contained information on a similar Soviet rocket, the N1, development of which was treated as one of the deepest secrets of our space sector, and which was naturally never mentioned in our literature. However, in the century of spy satellites, many secrets, no matter how hard you try to keep them, still surface. And so it was with the N1: Hiding it from foreign eyes was not any easier than, let us say, hiding a giraffe in a chicken coop. Several times in the 1960s-1970s the giant cigar-shaped N1 was conveyed to the launch pads of Baykonur, where it was photographed by all-seeing space vehicles.

By the way, "Space Technology" was republished with the "necessary" abridgements in the USSR, and all mention of the N1 was banished from the text. Why such a cautious attitude toward the N1? Why the desire to lower a curtain of secrecy over its history, when it is clear from a single glance at the parameters of the rocket to even the least knowledgeable specialists what its purpose might be? Could it be that the N1 was guilty of something, and they decided to punish it with oblivion, striking it from the history of cosmonautics? That guess is right in part. According to official propaganda cosmonautics developed in our country to the sound of kettle drums, to the tune of victory marches. The N1 rocket just didn't fit into this glorious chronicle.

The N1 is called Korolev's "last love." From the many biographies on the chief designer of space systems, we know that he dreamed not only of mankind's emergence into space, but also flight to other planets. We also know that in contrast to the multitudes of science fiction writers, Korolev was able to bring his plans to life. He was able to accomplish the former. But what about the latter? Could Sergey Pavlovich really have overlooked the planet closest to Earth, modestly limiting himself to the launching of unmanned spacecraft?

Moreover the creator of the world's first spacecraft was doubtlessly ambitious. His ambition consisted not of acquiring titles and awards. The circumstances themselves would not allow this: Being strictly "classified" all his life, even in Kremlin receptions Korolev was compelled to remove his Hero of Socialist Labor decorations, and in the newspapers he signed his articles with a pseudonym. Korolev's vanity took the form of a passionate desire to be indisputably the first to create a unique machine, and to accomplish an unprecedented project before anyone else. Once Sergey Pavlovich was shown a schedule bearing the optimum dates for launches to the Moon, Venus, Mars and other planets. Korolev said: "It would be nice to traverse this entire front, and be first everywhere." But the Americans did not make a secret of their preparations for a Lunar landing. That meant that....

That didn't mean anything yet. Because space accomplishments are achieved not in laboratories. Success requires money, and a great deal at that. This is not an appropriate moment to return to today's favorite topic of discussion—conversion, the turnover of money invested into cosmonautics. All of this is valid, but the money still has to come from somewhere initially. And the military is a primary source. It is an evil irony that all significant scientific and technical projects of the 20th century—from Popov's inoffensive radio to utilization of the energy of fission of the atomic nucleus—received support and the right of practical realization only in the event that they were "betrothed" to the military industrial complex. Nor was this fate to be avoided by rocket technology creator Korolev, whose interests were far removed from all military applications. One of the first major assignments received by Korolev was associated namely with military technology—he was sent to Germany together with a group of specialists in 1945 to study German developments of the V-2.

Sergey Pavlovich lived in Bleicherode, in the villa abandoned by SS Sturmbanfuhrer Werner von Braun, a talented German engineer, the creator of the first long-range military missiles, and simultaneously the organizer of the extermination of concentration camp captives servicing his secret proving ground. Making his way across the ocean, von Braun took charge of many American space projects. He and Korolev never met, but it was apparent that they perpetually maintained invisible competition. I would hardly be trampling the truth if I were to say that prior to Saturn and Apollo, Korolev's vehicles were invariably superior to von Braun's in their technical characteristics.

So where was Korolev to get his money? Calculations showed that a manned flight to the Moon would require a launch vehicle capable of inserting a payload of 100 tons into a near-Earth reference orbit. But the capacity that had already been attained was fully sufficient to maintain parity in weaponry in the foreseeable future. Various modifications of Korolev's legendary "No 7" are still the principal means of transportation in cosmonautics, inserting from 5 to 7 tons of payload into orbit. But even then it was clear to Korolev that the future of cosmonautics lay in vehicles of even greater power. This

was obviously not an easy thing to prove. Korolev was forced to work a step at a time toward his cherished 100 tons, cautiously increasing the rocket's power. But he kept constant sight of his goal. That the intentions were serious is revealed by the fact that a special group of cosmonauts under the leadership of A. Leonov was preparing for a flight to the Moon.

On 25 May 1961 U.S. President J. Kennedy sent an historic message to Congress posing the high goal of a Moon landing before the "American nation." The USA, which had yielded its primacy to the Soviet Union in initiating the space age, thirsted for persuasive revenge, and in the minds of Americans it was associated with conquering Earth's satellite. Hundreds of companies and private and state-run corporations worked harmoniously on the Apollo project, tens of billions of dollars were allocated, and all of the work was coordinated by a single brain center—NASA.

No, we had absolutely no desire to lose our priority in space. But we had nothing like a real analysis of the situation, or the ability to create a single work plan for dozens of enterprises and institutes, to concentrate the necessary efforts on the most important task, and to provide precise economic justifications. On the contrary each space design office sweated over its own project. It took a long time to get going on a lunar expedition, and to make a final decision, as a result of which Korolev had to revise the plan of his rocket on several occasions. We know how exasperated Sergey Pavlovich became in his last years with unavoidable dealings with bureaucratic officials who were becoming more powerful.

And so, the chronicle of events. In 1960 a decree on creating the N1 launch vehicle with a payload of 40-50 tons in 1963 appeared. Subsequently, the plan was reviewed on almost an annual basis, the capacity of the rocket increased, deadlines were postponed, until finally in November 1966 an expert commission under the chairmanship of Academician M. V. Keldysh issued a positive conclusion on the draft plan [eskiznyy proyekt] for a Lunar expedition using a 95-ton launch vehicle, which would make it possible to land one cosmonaut on the Moon, leaving a second crewmember in orbit. A decree on the work schedule that even indicated a deadline for the beginning of flight tests—the third quarter of 1967—was adopted in February 1967. It was already known that the Americans were to launch in 1969. But fully in keeping with the spirit of the times, our specialists were charged with the responsibility of ensuring the USSR's priority in exploration of the Moon.

A pressure-cooker style became the favorite and sole possible method of leadership. But there was hardly any need to force anyone—enthusiasm was abounding. I had occasions to talk about the N1 with many engineers—for all of us this was one of the happiest periods of life. If any one of the leading designers left work on time, he felt himself to be something of a moral deviant, a person avoiding the responsibilities of his work. Korolev never demanded overtime work, but everyone was engrossed in the timely, difficult and obsessively interesting effort. M. S. Florianskiy, who was still a quite young engineer, related the eagerness with which his colleagues grabbed at each assignment from the Chief: "Give me a rough estimate of this variant in a week's time." Literally all components of the powerful spacecraft had to be created anew. There was no room for haste in such a matter. But the work on the N1 was whipped on by an unnecessary race with the Americans.

Academician V. P. Mishin, who was appointed the chief designer of space systems after S. P. Korolev's death in January 1966, still has the shorthand record of one of the conferences conducted by D. F. Ustinov:

"The holiday is 2 months away, and the USA will launch once again, but what about us? What have we accomplished? And consider what October 1967 would be like. If there is one thing I want you to understand, it is this! All personal concerns and passions must be suppressed!"

Ostentation and the desire to publicize success, to hasten an effort even at the expense of the effort itself are impermissible in any sector of the national economy, but especially in cosmonautics, which is associated with great risk and with large material investments. However, in those days this mania for reporting accomplishments consumed ever more strongly our cosmonautics as well, a field in which a spirit of high professionalism had previously reigned, and in which pressure to achieve a launch on an anniversary date would have been impossible.

All of this eloquently characterizes the atmosphere in which preparations for a Lunar expedition and construction of the N1 rocket proceeded. But subjective complexities achieved no less importance as well. While America was racing full speed toward success, Korolev found himself without an engine for the N1. The engine is the heart of the rocket. If it is good, well-tuned, the numerous other rocket systems "breathe" easy. If it is uncooperative, hundreds of blocks and units complain of "ill health." A new engine that would be about fifteen times more powerful than any previously available could have been created at this moment in only one design office in the entire country—the one led by Academician V. P. Glushko. As with S. P. Korolev, he did a great deal for Soviet cosmonautics, but the moment we decide to portray the triumphant history of its development without touch-ups, and recreate a truthful picture, we cannot avoid the confrontations and disputes which are unavoidable between prominent characters seeking new roads. Every scientist capable of expressing his own, fundamentally new ideas in science and technology inevitably collides with the misunderstanding and opposition of other scientists, who may include not only reactionaries but also outstanding specialists.

The greatness of a scientist is not at all determined by how few mistakes he makes. On the contrary the mistakes a scientist makes are what characterize his greatness. And so, Korolev and Glushko adhered to opposite

views on the prospects of rocket engines in that period. It was clear to both that the kerosene and liquefied oxygen used at that time would not be able to satisfy the growing demands of cosmonautics. But it seemed to Glushko that fluorine, nitric acid, dimethylhydrazine and other extremely toxic substances would be the best propellant components. He emphasized on several occasions in the 1960s that hydrogen and oxygen were unpromising in rocket technology. There was a logic to these assertions: Low density requires large tanks, and the weight characteristics of the rocket worsen. At that time Glushko was unable to foresee the revolution in cryogenic technology. On the other hand, Korolev had faith in hydrogen-oxygen engines. While he admitted to the difficulties of storing liquefied components, he also pointed out the impermissibility of utilizing toxic fuel in manned spacecraft. The death of Marshal Nedelin during tests on one of Yangel's rockets confirmed these apprehensions.

Moreover, Korolev's design office arrived at the conviction that because time was short, it would be simpler to build the first stage of the N1 out of a large number of synchronously operating midsized engines. Glushko's proponents insisted on a grouping of large engines—it was their understanding that it would be too complicated to attain the required synchrony in an armada of small engines. There is an interesting comparison to be made here: The Americans equipped the first stage of Saturn-5 with five traditional liquid oxygen and kerosene engines, and it was in the subsequent stages of the rocket that they used liquid hydrogen for the first time. A few years later, life itself compelled V. P. Glushko to drop his prejudice against hydrogen engines, which are now working successfully in the Energiya launch vehicle. In a word, it would have been worthwhile for our scientists to work toward mutual compromises at that time. But neither would yield—this was a collision between two rigid characters. Glushko boycotted the N1 system, placing not only Korolev but also the plan for a Lunar expedition in a difficult position.

This forced Korolev to seek other engine designers on short notice. As we know, aviation experienced a retrenchment in the early 1960s, such that many plants were unable to get contracts. Thus, as a way to help each other out, S. P. Korolev's design office and N. D. Kuznetsov's Kuybyshev design office, which developed engines for TU airplanes, began cooperating. In many ways owing to the efforts of Kuybyshev national economic council chairman V. Ya. Litvinov and oblast party committee secretary V. I. Vorotnikov, in short time the necessary production capacities were allocated and 28 enterprises were put to work on space contracts.

What was the new launch vehicle like? In many ways it was essentially an embodiment of an idea, suggested some time earlier by S. P. Korolev, of assembling "rocket trains" in orbit for a flight to distant planets. Except in this case the train was assembled right in the plant shop.

The N1 launch vehicle was designed a quarter of century ago, but even today, many designers who planned it told me, they are not embarrassed with their creation. There were the control systems, the measuring equipment, the numerous design concepts, and especially the possibility, discovered for the first time in rocket technology, for manufacturing light but strong, spherical fuel cells, as well as abandonment, for the first time, of many load-bearing members. Brilliant engineering discoveries compensated for low engine thrust. Yes, despite all of the efforts, the propulsion unit of the first stage remained the most uncertain part of the rocket. It was difficult, and practically impossible for Kuznetsov's design office, which lacked the experience, to create, right off the start and without mistakes, synchronously operating engines of a design previously unknown in Soviet rocket construction. Nonetheless, while it was inferior to the Saturn-5 in regard to its engine, the N1 made up for this shortfall by means of other systems. The ultimate result is that the weight characteristics— the most important indicator of the "viability" of a design—remain for the N1 among the highest in rocket construction even today.

But there were also innovations that were nothing to boast about. Captive tests on the first stage were rejected in order to economize on time and money (once again this argument! How much damage was done by haste, by the desire to "be first in the world" at all costs!). "If the rocket does fly, and the second and third stages have been substituted by iron mock-ups, when I leave the observation bunker, what will I have gained?" said Korolev. In a word, a decision was made to test the entire system all at once.

Flight tests on the N1 rocket began on 21 February 1969. The flight was terminated 70 seconds after launch due to a fire in the tail section of the first stage. On 3 July 1970, during an attempt at a second launch, a powerful explosion occurred due to malfunction of an oxygen pump, destroying the launch complex. It took a great deal of time to repair it and to prepare a new rocket, such that a new attempt was not made until 27 July 1971. The rocket had barely gotten off the ground when the flight was broken off due to loss of rotation control, and once again the launch complex was damaged. As B. A. Dorofeyev, one of the testing supervisors, told it, such major accidents had an oppressive effect upon all personnel. But on the other hand no one felt that the N1 was doomed, that its defects were chronic. The people worked hard, many asked for extensions on their time of work at the proving grounds, everyone felt that the rocket was "maturing," and that success was not far away.

Finally, the fourth launch, on 23 November 1972. All systems of the bewitched first stage and all the engines worked normally, the flight lasted 107 seconds, but at the end of the active phase a malfunction arose in the tail section, and the flight was terminated. Nonetheless the designers and services of the cosmodrome were joyful beyond words. It was now clear, after all, that victory was but a half-step away.

"Even after attending a dozen launches of our Soyuz, it is still an emotional experience," recalls USSR Academy of Sciences Corresponding Member B. Ye. Chertok, one of Korolev's oldest assistants, who was appointed technical director of the last launch. "There is nothing with which to compare the spectacle of the launch of the N1. The Earth shakes as far as the eye could see, and a hurricane of fire is whipped up—only an unfeeling and a dissolute person could remain calm in such moments. All thoughts and feelings are strained. You have this desire to urge the rocket on: 'Go, go, higher, take off'."

Four or five trial launches during testing of space rocket technology is the way things usually go. Even the "No 7," which was incomparably less complex than the N1, did not fly until the fourth time. The next two craft were already ready in the assembly and testing building at Baykonur. A fifth launch was to occur in August 1974, and a sixth at the end of the year—the sixth and, the designers felt, the last prior to acceptance of the N1 launch vehicle for operation. Even the most cautious minds named 1976 as the latest that the new craft would be completely debugged.

It was a complete surprise to everyone when work on the N1 was first frozen, and later altogether terminated, following replacement of the chief designer in May 1974: V. P. Glushko was appointed in place of V. P. Mishin. On the very first day the new director of Korolev's design office declared the N1 to be a mistake; he said that he had arrived "not with an empty portfolio," and he proposed a new conception, which led in a little over 10 years to the creation of the reusable Buran plane and the Energiya launch vehicle of practically the same power as the rejected N1. There can be no doubt at all that we should be proud of both the Buran and the Energiya, but isn't it disappointing to write an almost finished craft off to the scrap heap? Designers who had visited Baykonur in the late 1970s still find the cyclopean mountain of N1 launch and assembly and testing structures, once teeming with people and now abandoned, to be a painful memory. As I understood from their stories, the picture recalled in some ways Tarkovskiy's "zone."

Anyway, emotions are unreliable. Is it true that perhaps the N1 could not have been perfected, and that the work had reached a dead end? Here is just one fact: Obviously troubled by the prestige of his design office, in 1976 N. D. Kuznetsov conducted bench tests on the N1's engine. The engine worked for as much as 14,000 seconds, while it would only have needed to work 114-140 seconds to insert a rocket into orbit.

This ends the story of the N1 launch vehicle. The last "swan song" of Korolev was thus left unsung. Of course, it would be unjust to write off the N1 as a loss entirely. The plant equipment, the assembly and testing and the launch complexes were subsequently used for the Energiya. The experience of designing and "perfecting" the powerful rocket was also doubtlessly useful: Energiya essentially took off the first time. Moreover some stages of the "rocket train" are still traveling successfully as individual "cars."

Nonetheless I am not about to sugar-coat the pill. Termination of the work on the N1 deprived our cosmonautics of its natural, progressive development, and knocked us off of the general line of forward movement charted by Korolev. Some specialists feel that it was precisely since then that the space sector has been living without a long-range program, satisfying itself with isolated projects. Was this perhaps the time when the first foundations of the broad critical campaign that has recently developed against cosmonautics were laid? In technology, as in living nature, there are inviolable laws of evolution, ones which no one may violate without consequences. After all, it has now already been 30 years that we have essentially been limited to a payload of 20 tons; given such a limit, how can we talk about achieving a substantial payoff from orbiting stations? The powerful launch vehicle, the need for which was brilliantly foreseen by Korolev, opened up the widest prospects before cosmonautics from the creation of large orbiting complexes, serious discussion of which began in our country only recently, to the launching of unmanned spacecraft toward other planets.

There were also specialists even in the early 1970s who understood that closing the book on the N1 would have an unfavorable effect on our cosmonautics. V. P. Mishin haunted the high-level offices, B. A. Dorofeyev wrote letters to the 25th Congress, and a number of specialists asked for "just a little"—permission to test at least the two finished rockets over the ocean.

It was all for naught; differing opinions sank without a trace in the silence of the high-level offices. The destiny of the N1 was decided not by specialists—the logic of scientific development was dictated by political leaders. Not a single session of the scientific council, not one conference with specialists, not one meeting of the council of chief designers.... What was it that influenced the destiny of the N1? In any case, there were considerations far removed from the interests of science and the true interests of the country. In the absence of an official version, let me suggest my own. For a number of reasons the work schedule on the N1 was dragged out and persons responsible for cosmonautics (chiefly D. F. Ustinov and Minister of General Machine Building S. A. Afanasyev) had been making promises for such a long time, first to N. S. Khrushchev and then L. I. Brezhnev, that they were beginning to feel anxious about their positions. It was safer to transfer the responsibility to the shoulders of others, and to declare the N1 to be a mistake. And second, the Americans had already landed successfully on the Moon six times by then. It was clear that we were behind them. Political and scientific leaders creating the appearance that they were defending the interests of the state and the prestige of Soviet science came up with a face- saving idea: would it not be better to declare manned exploration of the Moon an unnecessary venture, and to drop a curtain of secrecy over the

fact that we ourselves had been traveling in the same direction for a long time? It is curious in this connection that the first landing of man on the Moon was not televised only in the USSR and China. And no one gave any thought at all to a "small thing" such as the honest labor of thousands of people who devoted the best years of their lives to the N1. They not only took no consideration of the people, they did not even offer any explanations. Thus it turns out that together with the "offending" N1 they relegated to the scrap heap its builders as well, many of whom certainly experienced such a psychological blow that they could never create anything of equal value again. And these were the best personnel of Korolev's design office.

There is possibly a third reason as well. Having completed the Apollo program and having used the Saturn-5 to launch the Skylab orbiting station for the last time, the USA went on to developing reusable systems. We also completed our lunar program—with a different result, of course,—and once again sped off in an effort to catch up. This time we caught up, having created the Buran. But is it in any way to our advantage that the strategy for cosmonautics is now being dictated by someone other than the USSR, which gave the world its space pioneers? Voices that should have been raised long ago are just now being raised: do we really need reusable systems, which are so extremely expensive and operationally complex? But if to keep the peace we assume that they are useful, then as V. P. Mishin, B. Ye. Chertok, R. F. Apazov and many other specialists are convinced, it was fully possible to adapt the N1 to inserting a Soviet Shuttle into orbit. Thus we would have saved the enormous amounts of money that have been spent on the development of Energiya.

But let's talk about the outlays on the N1. I have no official data, but V. P. Mishin and B. Ye. Chertok said that close to 4.5 billion were spent on it during all the years of the program. If we make a comparison with the USA's outlays on Apollo—25 billion, then the winner in the "Lunar" debate could have been predicted. This makes the ability of Korolev and his colleagues for creating a powerful, competitive craft out of nothing all the more remarkable.

History is oblivious of the subjunctive mood. What was, was. Nonetheless it is hard to avoid the question: Had Korolev lived a few more years, would he have been able to make the N1 operational? But such a question might not be altogether precise. There were mistakes embodied in the plan of the heavy launch vehicle that were in many ways responsible for the four unsuccessful launches. But the mistakes were gradually corrected, such that it would be more proper to ask: Would Korolev have been able to persuade the country's leadership that continuing the work on the N1 was necessary? Sergey Pavlovich possessed a hypnotic gift of persuasion, and his authority was enormous, but it would be wrong to think that the chief designer was invulnerable. We know how enthusiastic he was with Khrushchev, in whom he obviously sensed a kindred spirit, and how cautious he was of his successor, who was noted for his indifference to the problems of cosmonautics and who acceded to the whispers of his confidants. By the way, Leonid Ilich wept at Korolev's funeral, and permitted the obituaries to refer to him for the first time as the creator of Soviet rocket technology.

The destiny of the Lunar expedition that never was, and of the N1 rocket that never flew, as is true for the destiny of any project of such grandiose scale, reflects the painful problems of the entire society. Included among them are excessive politicization of science, substitution of true goals by imaginary ones, voluntarism, the lack of collegiality in the adoption of important decisions, impermissibly great significance attached to personal relations with sector executives, and an indifference to the fate of the "cogs in the wheels"—that is, of the people who multiply the power of the state with their hands. But perhaps the main thing is the inability to foresee the prospects of technological development, to peer into the future, blind faith in foreign experience at the expense of common sense.

We could add to the latter that we might still perhaps see the N1 in the sky. Having had their fill of flying the Shuttle, the Americans have come to the conviction that cosmonautics would nonetheless be unable to carry on without heavy expendable rockets. Recently NASA examined 12 alternative variants for the development of rocket technology: One of them foresees transformation of the Shuttle into an analogue of the N1.

In my visits to Baykonur I often turned my attention to the strange shape of the roof raised over the dance floor in the park. I recently found out that this roof was unique in the world. It was made by the famous Academician Paton using argon-arc welding and X-ray control. A unique thing! Except that the roof was not initially intended to shelter musicians: It is part of a high-strength fuel tank for the N1 launch vehicle. It is said that they didn't know what to do with it for a long time—the material it's made from is everlasting.