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[Article in five installments by Yaroslav Golovanov: "Just Where Are We Flying To?"]

[12 Dec 91 pp 1, 3]

[Text] [First paragraph is introduction from page 1, under the rubric "'Izvestiya' Investigation"] Perhaps the rubric ["Izvestiya" Investigation] is not quite appropriate for what I'm about to tell you. This is not the kind of investigation that Andrey Illesh conducted on the unfortunate Korean "Boeing." There are no timers, no radio intercepts. My investigation is an attempt to do some discussing, some comparing, some analyzing, and, thus, to investigate—more from the standpoint of logic than from the standpoint of criminality—the problems associated with the extreme degree of misfortune that has befallen our space program. For 30 years, I was a "space journalist" on the pages of our own KOMSOMOLSKAYA PRAVDA, but this time I'm betraying it, inasmuch as I must admit that of all our newspapers, IZVESTIYA is the newspaper that pursued that topic with the most consistency and with the most critical eye, to the great credit of Boris Kononov and Sergey Leskov. That is why it was a pleasure for me to accept IZVESTIYA's offer to conduct this investigation.

Part One

On the ramp from the Yaroslavl Highway to the main administrative building, at one end of the second story of which was his office, Sergey Pavlovich Korolev had installed a so-called mousetrap, which was outfitted with photoelectric cells. The car would approach the gates, and, as if in a fairy tale, they would fly open silently. As soon as the car had gone through, they would immediately slam shut, and you would be in a fairly small courtyard enclosed on all sides, with two small entrances from which the republic internal security guards were already smiling at you. The "mousetrap" was for the Chief Designer, his closest associates, and important guests, on whom all this silent technology made the proper impression—and Sergey Pavlovich loved to impress his guests.

On the morning of 16 April 1985, the "mousetrap" gates were working especially hard, letting in black Volgas and Chaikas every minute. Academician Valentin Glushko, chief designer of the NPO [scientific production association] Energiya, was assembling some highly placed guests, for a top secret, highly important meeting. At a long table in a room next to the small office of the academician were seated Grigoriy Romanov, a member of the CPSU Central Committee Politburo; Leonid Smirnov, first deputy chairman of the USSR Council of Ministers and chairman of the Military-Industrial Commission; the minister of general machine building (i.e.,

rocket building—by the way, who thought up the idiotic name "general machine building" anyway? That's like saying "general animal husbandry"); the future putchist Oleg Baklanov; a large set of people from the Central Committee, the military-industrial complex, and various ministries; and business people, namely, USSR Academy of Sciences Corresponding Member Gleb Lozino-Lozinskiy, the general designer of the NPO Molniya, and Vladimir Lapygin, the general designer of the NPO for automatic equipment and instrument making and the heir of the deceased patriarch of rocket instrument-making, Academician N. A. Pilyugin.

Glushko, after bowing his already gray head of neatly combed hair, reported in a monotone voice in his customary passionless manner that the launch of "item 11K77" (in plain language, the Energiya rocket) had gone successfully. Preparations were under way for the leak tests of the second stage on the universal test stand/launch unit, as well as the...blah, blah, blah.

A very experienced administrative in-fighter, Glushko knew that Romanov had only a vague idea of what the leak tests were, and the intentional monotony of his report was intended to suppress any possible outbursts of indignation among the leadership. This time, however, he had made a mistake. Despite the upbeat coreport given by Lozino-Lozinskiy, who solemnly assured those at the meeting that the horizontal flights of item 11F35 (in plain language, the Buran orbiter) would begin on 28 May at the airfield at Ramenskoye, Romanov said in a stern, if not angry, voice that a bundle of money had already been spent and virtually the entire industrial potential of the country had been activated, but none of the deadlines had been met, and that meant that we couldn't match the American expansion into space with their Space Shuttles—never mind that the military was complaining about the payload shortfall. All that was really worrying the Central Committee and the Politburo, and, obviously, the issue needs to be taken up at the forthcoming meeting of the Defense Council...

Since ancient monarchal times, we in Rus have had this rule ingrained in us: the last word goes to the most important person. The most important person is the most intelligent and the most knowledgeable. And that rule is so deeply ingrained that we wouldn't think of it being any other way. How could it be possible for anyone but the most important person to "sum things up"? Is it acceptable for someone, after the "sum up," to interfere, not to mention object? Why, it's well beyond understanding even when someone just adds something! Why is that absurdity so tenacious? Is it possible to eliminate it?

What Romanov said was true, but they were things that were absolutely banal. In that room, there wasn't a single person to whom he had just reported anything that wasn't already known. It was absolutely irresponsible prattle at the highest level with individuals who were merely pseudoconcerned. As he departed the "mousetrap" in his long, black ZIL, Romanov was satisfied: "the

specified work has been done" (that kind of pedestrian apparat formula had existed for many years). He would report everything to the Politburo, he would tell how he had given them all orders, and now he imagined the smile that would come to the General Secretary's face, and the smiles that would soon follow on all the other faces. However, he would propound a strict "summing up," and in doing so he would remove from himself any responsibility ("I *told* them, I *warned* them...")—it would have to be discussed at the Defense Council, a draft of a decree would have to be prepared.... How many times now would it be that he had done something like that?

Napoleon advised that one should never give out orders if it were not absolutely certain that they would be carried out. No one here has listened to the emperor's advice. Worse than that, our Bonapartes were certain ahead of time that their orders would not be carried out. Let's perform a small chronological investigation.

On 17 February 1976, a decree was signed in the CPSU Central Committee and the USSR Council of Ministers concerning the creation of the reusable Buran space system. I wasn't able to ascertain who fathered the idea or who inspired it, because the father of an idea is announced only if his brainchild is an obvious success and offers every possible kind of encouragement; but if things start to go wrong, the father certainly doesn't want to pay an alimony of billions of rubles. The overwhelming majority of the people close to the problem say that one must look for the roots of Buran in the Ministry of Defense. Indirectly, that is confirmed by two other decrees dated May 1977 and December 1981. Those decrees mention the tactical-technical specifications required by that very ministry for the vehicle in question. Many years later, Academician Roald Sagdeyev would say, "We traveled the path of the old stereotype that had come about—a symmetrical response."

Venomous tongues say that, after becoming familiar with the American Shuttle, the leaders of our armed forces became very afraid and ran to Marshal Grechko to try to talk him into building the same kind of airplane. The minister of defense very sanely decided that that would hardly be necessary. So then, going around Grechko, they began to use the Shuttle to frighten L.I. Brezhnev, and they explained to him that that damned Shuttle could zoom down on Moscow at any minute, bomb it to smithereens, and fly away. And they're all hoping that Leonid Ilich himself understands how much responsibility rests on his shoulders, the shoulders of the Marshall of the Soviet Union and Chairman of the Defense Council. Brezhnev understood. Yes, of course, an alternative weapon is necessary. And the work on Buran got under way. What is meant by "work"? Primarily, it means they gave money over for it.

Thus, Buran in its initial study was that very alternative weapon. How effective the Shuttle is, how capable it is of bombing Moscow we will leave for the military specialists to judge. But even if all that were so and Buran were

needed as a response to a potential aggressor, a somewhat ticklish question arises.

In September 1969, right after the first landing of an American on the Moon, a long-range planning group at NASA released a report titled "The Next Decade of America in Space," which spoke pointedly about the Shuttle. At that time, NASA had signed the first contracts for a study of versions of an "integrated vehicle for launch and return." The question arises, why did we wait a whole seven years? In the past, the United States had passed us in the production of nuclear weaponry, but within four years, parity was reestablished. Such a brief period could in part be explained by the valuable information that we obtained illegally from abroad. With the Shuttle, no spies were necessary. We had entirely legal data on what the Americans were thinking of doing. And those who say that we copied Buran from the Shuttle are wrong. The external similarity is a tribute not to reconnaissance, but to aerodynamics. For similar problems, aerodynamics provides similar answers whether for communists or for capitalists—it just doesn't give a damn somehow. However, the first piloted flight of the Shuttle took place on 12 April (on the very day we designated International Day of the Space Program) 1981, before a single Soviet cosmonaut had ever gone aloft on Buran. So we're already behind by more than 10 years. If a reusable spacecraft is regarded as a weapon (and that's exactly how we regarded it at its birth), then that lag is monstrous and, for that reason, renders the weapon senseless.

Some examples of inspired, creative paperwork:

In December 1981, on the basis of suggestions made by the Council of Chief Designers—which at the time included, besides those who are still alive and well, the very experienced Valentin Glushko, Nikolay Pilyugin, Mikhail Ryazanskiy, and Viktor Kuznetsov—the CPSU Central Committee and the USSR Council of Ministers made it mandatory that all departments support putting Buran into service by 1985. The chiefs were representatives of the various departments, and it turns out that they were giving themselves an order, and that order was made into law by higher offices. Within just two months, however, advocates of the Stakhanov movement from the USSR Council of Ministers Commission for military-industrial issues were asserting their own general timetable for Buran, according to which the vehicle's first, pilotless flight tests were to be performed in the fourth quarter of 1984. But everyone knows that, for example, the volume of full-scale holddown tests of a launch vehicle constitute no more than 10 percent, and without them the rocket can't be tested on the ground or in flight, and, in turn, without the rocket how can one speak seriously about a Buran flight? And even 1985 was a totally unrealistic deadline. By that time, the project had "gobbled up" nearly 6 billion rubles (R), and barely half of the total volume of all the necessary operations had been performed. What has to be done in such situations? You guessed right! What else but issue a new decree!

The 2 August 1985 decree No. 750-222 of the CPSU Central Committee and the USSR Council of Ministers and the 25 August order No. 00100 of the Ministry of Defense set a date for the start of Buran flight tests—the fourth quarter of 1986. And that deadline was also pure “eyewash”: the electrical tests of the orbiter didn’t start until May 1986, and everybody knew that they wouldn’t be over until the middle of December. And that’s when Buran was sent to the production site, but not for launch—for assembly. Only 85 percent of its instruments had been installed, and only 25,000 of the 38,000 thermal-protection tiles needed for the design had been glued in place. Of the total flight-software structure, which contained 15 standard flight operations involving 198,000 commands, only three standard operations had been developed and were in place on the integrated unit.

So 1986 rolls around—the “year of the tiger” on the Eastern calendar—but the long-awaited leap still hasn’t happened. On the other hand, a program of experiments on Buran up to the year 1995 appears and is approved by the CPSU Central Committee and the USSR Council of Ministers. For pity’s sake, they’re talking about experiments, and the vehicle hasn’t even flown yet! I mean, let’s just see first what it can do, and then come up with some experiments for the first two or three flights. But not plan 10 years ahead before we even have anything! Who gave the order to build 10 Burans right away? For what purpose? Wouldn’t it be better to build two or three, “take them for some spins,” and identify the flaws, find the mistakes, and *then* build the others? And do we really need 10 Burans? The United States built four, and they’ve all been aloft in space. Or is it just more of our go-get-em desire to outdo everyone and surprise them?

Korolev had an iron rule: criticism, discussion, and redesign were allowable up to a certain point. But after that, just do it. All the brilliant ideas were “for later,” but an engineer who risked approaching the Chief Designer with a request to change the design felt as if his task were equivalent to trying to navigate across the Volga when it was completely frozen over. Between 1979 and 1987, more than 32,000 changes were made in the design documentation for Buran’s airframe alone! Can we talk about quality here? And can we manage to explain why the building of such a unique design as our first space plane was assigned to the NPO Molniya and the Tushinskiy Machine Building Plant (TMZ)? I’m not trying to insult those renowned, talented collectives, but everyone knows that the NPO Molniya came about in the consolidation of two small design offices, Molniya and Burevestnik, who not only never had anything to do with the brainstorming about a space plane, but also had no experience in developing ordinary airplanes from start to finish. I’m sure TMZ will forgive me for saying so, but you can hardly call it a leading enterprise of the aviation industry in terms of its equipment, its production capacity, or its production know-how. That became crystal clear when the heat-resistant tiles were being glued onto Buran’s airframe. Between 30 percent and 50 percent of tiles had to be reglued. During the assembly,

as well as for other reasons, tens of thousands of tiles were ruined, and each of them cost R150-400 apiece. Ultimately, TMZ did not do well with the tiles: a great many had to be glued in place at Baykonur, at improper facilities, without the proper supervision of specialists, and, what’s more, in a hurry, in a hurry, in a hurry. The main thing was to get it done!

Where to? For what purpose? Deadlines for the sake of deadlines, for the sake of getting praised? And in fact, that whole race wasn’t just confined to Molniya and TMZ. If in the early 1980s, nearly 500 contractor-enterprises took part in the development of Buran, that number was nearly 700 as the mid-1980s approached and more than 1,500 by 1985, etc., etc. And the greater the number of people involved, the harder it became to assign blame. Add-ons, misrepresentations, and out-and-out fraud seemed to come about on their own, generated by the environment itself, by the nature of window-dressing itself. The horizontal flight tests of the first Buran, for example, in which the airfield landing had to be perfected, were set for the fourth quarter of 1981. It wasn’t until November 1983 that the unfinished space plane—the airframe, essentially—was hauled from TMZ to the test airfield at Ramenskoye, supposedly to be prepared for flight. But it couldn’t have flown, no matter how skilled its remarkable testers were: Buran hadn’t been finished yet. As the machinists said, it was being finished practically “by hand.”

In December 1985, Buran was taken to Baykonur, but it wasn’t until the spring of 1987 that a new timeframe was assigned for its first flight—July-September 1987. And as we know, that deadline wasn’t met, either. Buran wasn’t really ready for another year.

On 26 October 1988, the State Commission named a final date for the first launch of Buran: 29 October 1988, at 0622. At 51 seconds before the launch, the automatic equipment gave a “System down”: a platform with one of the attachment system components was moving away too slowly. Buran lifted off on 15 November 1988 and completed its first and only flight, in unmanned mode. And now what? (*To be continued*)

[13 Dec 91 p 3]

Part Two.

The principal difference between the Buran-Energiya system and the American Shuttle—a difference we’re very proud of and have emphasized in a multitude of articles—is that the booster rockets for the Shuttle can’t be used for anything else, whereas our Energiya rocket, which lifts Buran, is an all-purpose rocket. You can put Buran on it if you want, or you can put a satellite on it, or a lunar craft, or a Mars rover—whatever your heart desires. And that’s all true. The Energiya rocket—item No 11K25 (a typo sneaked into yesterday’s issue)—is in fact an advanced, all-purpose vehicle, but it’s not without a number of flaws that we, guided by the longstanding traditions of rocket-and-space propaganda,

have preferred to keep quiet about. That didn't do us credit then, and it doesn't do us credit now.

Let's begin with the fact that the solid-fuel boosters of the Shuttle are more practical and less expensive than the oxygen-kerosene engines of Energia's strap-on boosters. The durability of the Shuttle's boosters, which is needed for solid fuel, is much greater than that required for parachute descent—that is a truly reusable part of the system, which, without any special expense, can be prepared for a subsequent flight. The thin-walled units of Energiya would hardly stand up to multiple use. In one very serious document, I read this sentence, which can be taken in only one way: "in the reusable Buran space system, the expensive control system, as well as the expensive oxygen-hydrogen engine of the second stage of the launcher, is unrecoverable, and it is doubtful that the problem involving reuse of its first stage can be solved." I can't corroborate what I'm about to say, and time will tell, but it seems to me that the only thing reusable in our "reusable" system will be Buran itself, and it'll mean a lot of fuss (and that means money!) to get it back out on the launch pad.

But if such difficulties attend the recovery of the units of the first stage, the question inevitably arises, Why did we choose liquid fuel over solid, which is what the Americans chose? It's hardly likely that they made the decision in what we call a "muddle-headed fashion." Liquid fuel is known to be more troublesome, servicing rockets that use it requires great skill, and keeping liquid-fuel units in a fueled state is incomparably more complex and expensive, never mind the fact that a solid-fuel rocket is simpler in its configuration, which means it's more reliable and more obedient to controls. Answering that question is rather difficult. There were subjective reasons for our choice: the recent General Designer of the NPO Energiya, Academician Valentin Glushko, was a confirmed opponent of solid-fuel rockets (which is entirely understandable to those familiar with his biography), and solid-fuel research, which grew to its height under S. P. Korolev—thanks primarily to the labors of Igor Sadovskiy—was (how can I put it a little more intelligently?) gently smothered. But there were also objective reasons. Liquid fuel is more energetic than solid fuel, and rocket thrust is greater. However, when it came down to a specific design, it turned out that liquid stages require more weight in the recovery systems, and that weight "addition" eats up the energy advantages of liquid-fuel engines. That is, it's exactly as Lomonosov said: "If you increase something in one place, you take something away in another place."

Finally, in terms of payload, Energiya still hasn't delivered what it promised. Newspapers have vaguely written that the payload the super rocket will deliver into orbit is "more than 100 tons." Let's get a little more specific: Energiya can lift, according to the calculations, 102 tons. But it won't. Tiny overruns in the mass of the structure and the individual assemblies—sometimes measuring just grams—combined to make tens and hundreds of kilograms during assembly. As a result, the overweight

rocket can lift 7.5 tons less than planned. What is 7.5 tons? The launch weight of the fully fueled Gagarin spacecraft, with the cosmonaut, was 4,745 kilograms. The maximum weight of the Shuttle with payload, in orbit, is 117 tons. The estimates of the payload that our space plane can lift also put Buran behind the Shuttle. In an orbit with an inclination of 97°, the Shuttle can "haul up" 29.5 tons into space, whereas Buran can take 16. The maximum figure for the Shuttle is 36 tons (or in low orbits, as much as 45 tons); the figure for Buran is 30.

And nevertheless, for all those critical remarks, I want to note that both Buran and Energiya represent a success for us, an unquestionable achievement, movement ahead. They were the school we needed to improve ourselves. We were incredibly late with it, we did worse than we could have, we replaced the objective with the subjective, we put the interests at hand behind parochial and short-term interests, we displayed a certain laziness of thought and an atrophy of the will. But by God, we got the thing built!

The fact that Energiya went up right away, on the first launch, represents a great success and a great achievement, without a doubt. Even with the great Korolev, such was more the exception than the rule. The TASS report said that the rocket "took a mockup equivalent in size and weight to a satellite up to the calculated point." That was a lie. It wasn't some sort of cheap mockup, but an intermediate, partially equipped version of the Skif-DM space vehicle, which, on the one hand, served as a test payload and, on the one other, was intended for perfecting the design and onboard systems of a future military space complex with laser weaponry. Skif did not go into orbit. It fell to Earth and sank, or in the language of TASS, "that mockup and the second stage touched down in the designated region of the waters of the Pacific Ocean." (Such reports, in which "sinking" was called "touching down" and in which the salty abyss was called "the waters," would better have been given as poems in hexameter.) The joy attending the successful launch of Energiya was so great that it was somehow awkward to mention Skif. As for the bungling, the TASS report said: "The aims and objectives of the first launch were fulfilled completely." Does that mean that sinking Skif was among the aims and objectives of the first launch?

But let's put an end, once and for all, to all that carping and nipping. It's not dignified against the backdrop of what we've accomplished. The second flight of Energiya (also successful!!) lifted into space an unpiloted Buran, which later made a precise instrument landing. Joyfully, Oleg Baklanov, the secretary of the CPSU Central Committee, began to try to prove that the second flight of Buran should be piloted, but nobody listened to him, and it was decided to follow the program thoughtfully and precisely. The program of 1985 called for performing 10 (!) flights over roughly three years, with the last eight carrying a crew of two or three people. But then three years went by, and not a single cosmonaut flew aboard Buran. In fact, the second pilotless flight never took place, either.

But suppose everything had gone well, even wonderfully. Suppose they had gotten the money they needed for the unfinished things, and all 10 launches had taken place without a single emergency situation, which would violate the laws attending the development of modern technology. Suppose the Mint had stamped out new gold stars and laureate medals, and candidates of science had become doctors of science, and doctors of science had become corresponding members [of the Academy], and corresponding members, academicians. There would be problems in the cosmonaut settlement with housing, and new homes would have to be built to accommodate everyone. In short, suppose everything had gone as well as it could have. Then what? What would we do after the tests had come to an end, and the stars had been hung around the necks, and the apartments had been given out? Just what would we need to do? What?

All of the history of technical progress shows that any machine, apparatus, or instrument that is created is created to solve a specific problem. Which problem was Energiya created to solve? IZVESTIYA has already published the sad story surrounding the creation of the N-1 super rocket. The disputes about the N-1 appear at first to be primarily scientific-technical disputes. But if you dig a little deeper and look a little more carefully, you see that they're not disputes that involve concepts—they're disputes that involve ambitions. Locked in hand-to-hand combat were several academicians—Korolev, Glushko, Pilyugin, Viktor Kuznetsov, Nikolay Kuznetsov, and high officials of the military-industrial complex and the army. The unfulfilled dream of Sergey Korolev, who died on the operating table—a dream that was decimated by Valentin Glushko, that was undefended by Vasiliy Mishin, and that took years of labor by Nikolay Kuznetsov—vanished in the gulf of ministerial paperwork and the flames of failed launches that turned billions of rubles into ashes. That's old hat, and, I'll say once again, it has already been written about, and we won't discuss here whether the N-1 rocket was good or bad or whether Korolev was right or wrong in his endeavor to pass the Americans on the road to the Moon. But Korolev knew full well what he needed the N-1 for—to fly to the Moon and land there. But for what purpose was the Energiya created? Yes, of course, our fleet of space rockets had clearly become out of date. Their developers were no longer even alive—S. P. Korolev, V. N. Chelomey, M. K. Yangel. Suffice it to say that the primary space rocket for manned flights—the Soyuz—was a modified version of Korolev's R-7, which was first launched in 1957. Like any other piece of equipment, a rocket requires not only updating, further modification, improvement of its most important characteristics, and increase in power, but also—and this is foremost and absolutely necessary—new scientific-technical thinking, improvement of the organizational techniques for solving the problems that are assigned, and comprehensive economic justification of the designs being chosen. In other words, operations that are performed on the modern level of the development of the world scientific-technical revolution. Today, other

General Designers have taken over the director's chairs of the deceased pioneers of the space program, but they have shown no desire to replace the organizational structures they have inherited, which in our rapidly changing times grow old faster than any structures could, because the new General Designers did not inherit from their teachers a clear idea of what they all—TOGETHER—are doing, when they are to do it, or what it will give them today and, what's more important, tomorrow and the day after tomorrow. That's why Korolev's "No. 7" has been flying for 35 years now, and Energiya is still trying to get some momentum.

Imagine if the BelAZ motor vehicle plant were assigned to build a 700-or even 1000-ton truck. Would they be able to do it? After spending oodles of money and endless labor, they could, I think, do it. But who would buy it? Who would want it to trample and destroy their roads, burning tons of fuel all the while? And most important, what would the buyer haul with it?

The General Designer of NPO Energiya (read: Korolev's design office), Yuriy Semenov, says this: "The development and operation of a new launch vehicle opened a new chapter in the exploration of outer space." That development got under way 15 years ago, and the operation of the launcher (if indeed it can be called "operation") got under way three years ago, but we have yet to see a single line from that new chapter. But then we're bound to see it sometime in the future. Nevertheless, I would like to ask what might seem a completely absurd question: What will we be "hauling" on Buran? What specifically?

Some will object, What do you mean "what?" The Shuttle hauls things up, and we'll be hauling the same kinds of things....

The history of the Shuttle is tragic for more than just the Challenger accident. One flight after another, it became increasingly clear that the shuttle craft is not capable of performing the tasks charged to it. A schedule that left the head spinning—60 flights a year—became, in reality, nine flights. But most important, the "reusability" of the Shuttle is not lowering the spending to anything less than what it would be with expendable rockets. For Shuttle modifications, the Americans have spent an additional sum of more than \$2.4 billion, not counting the \$1 billion spent for modifying it after the Challenger accident. The cost of a Shuttle flight is some 10-20 times higher than people initially thought it would be. Of course, our Buran, still in the embryonal stage of its own development, is infected with the same disease. In the opinion of the very authoritative space specialist Konstantin Feoktistov, using Buran to lift payloads to satellite orbits and to deliver them to orbital stations will be 10-40 times more expensive than using expendable Soyuz and Proton rockets. According to other data, the Buran launch cost roughly 170 million rubles (R). Calculations show that that puts the cost of lifting one kilogram of payload of Buran at R6,000. If that payload were launched on a Soyuz rocket, it would cost a sixth as

much. We don't have to get exact figures for this much to be clear: for now, sending cargoes into orbit with Buran and Energiya is not economical.

I had occasion to read that Buran will make it possible to return from orbit very valuable satellites—for example, complex, expensive extraatmospheric telescopes. And here is what Aleksandr Dunayev, chairman of USSR Glavkosmos, suggests: "Nor should one forget that at present, certain satellites that are very expensive must remain in orbit after their service life runs out—and reusable ships can bring them back to Earth." Fairy tales for simpletons. And Aleksandr Ivanovich himself knows full well that not a single one of our "puny" satellites is so valuable that its return via Buran wouldn't be wasteful. And as far as I know, we're not going to have, in the foreseeable future, any satellites that would be valuable enough for that. By the way, General Designer Yuriy Semenov also feels that bringing satellites down from orbit with Buran would be economically unprofitable. But what other little jobs are being thought up for Buran? "We do not hide the fact that our plans include the docking of the Buran orbiter with the Mir station," says Dunayev. (Why would that in itself need to be hidden?) Surprisingly, however, he quickly adds: "But we feel that delivering a two- or three-man crew to the Mir complex is best done with expendable rockets." Pardon me, Aleksandr Ivanovich, for taking you at your word, but then it would turn out that Glavkosmos's plans are inadvisable, right? And here's another "by the way": Former rocket minister Oleg Shishkin has said that using Buran as a transport craft is uneconomical.

Finally, the effectiveness of the military use of Buran—something our press isn't "taken" to talking about—also raises some big doubts. Many specialists feel that the space plane doesn't fit tactical and technical needs, especially in terms of weight of the payload being launched, and is not capable, as had been hoped, of solving applied military problems on a fundamentally new level. When those military specialists began to compare the Shuttle and Buran in terms of a number of very important characteristics, things didn't turn out in our favor. You don't have to be a military specialist at all to understand that the length of time required for prelaunch preparations, the gigantic launch complex that is needed and that is simply impossible to camouflage, and the rather limited selection of azimuths for Buran keep it from being a "quick-response" weapon, and it's absurd to regard it as any other kind of weapon. But even if Buran could be regarded as an advanced weapon, such a weapon would have still been obsolete many years before its own birth.

In summing up everything that's been said, I would like to ask a simple question: Who can explain to me and to the millions of my countrymen—people whose money has been used to build that star plane—why we need it if none of the space systems that has been created or is actually under development can be put into orbit via Buran and Energiya or brought back down from orbit? There are eight individuals in the detachment of Buran

pilots. Why do we torture those courageous test pilots with all those wearisome years of waiting? Anatoliy Levchenko died. Rimas Stankiyavichyus perished. In the summer of 1984, Igor Volk was tested in space, and it was predicted that he would get the seat for the first Buran commander. When the great, now-deceased flier Sergey Nikolayevich Anokhin introduced me to Volk, he said, "Remember this man. If I'm a better flier than Petr Nesterov, that's how much better a flier Igor Volk is than I am." Think of how much that brilliant test pilot could have done in the past seven years! His flight on Buran would be, for me, a personal holiday, because here feelings prevail over reason...

And so, in looking at Energiya and Buran, we can't help but acknowledge that there are grounds for us to have a pessimistic view of our space future. But we don't have to be upset—after all, the huge Mir station is in orbit...

(To be continued)

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Part Three

The late 1970s and the early 1980s saw the rocket designers, the engineers, and the manufacturers loaded down with work. In addition to the giant projects involving Energiya, Buran, and Mir and its modules, plus the orbital spacecraft that delivered crews to the station and the transport craft that kept them supplied with everything they needed, there were operations involving the creation of the special satellites Raduga, Meteor, Nadezhda, Okean, Foton, Resurs-F, and Gorizont and the unmanned observatories Gamma and Granat, as well as the new Interkosmoses and the endless number of satellites in the so-called Kosmos series, under which name we chose to hide our spy satellites, plus the unmanned interplanetary probes that "went off track" and some honest-to-goodness innovations that we didn't want to report. Such a concentrated effort on the production of all that equipment could hardly have been sustained by any other country. However, others, of course, can't tell us what to do, and the communists could handle any problem (I remember well hearing songs on the radio that said that we had to work until our "hearts bled"). And so there was the race, the unmet deadlines, the un-thought-through things, as we chased after two, three, or even 10 rabbits at the same time, with results that are familiar to everyone. Even the mighty America, which is a thousand times more organized than we are, wouldn't do several major space programs at the same time: Mercury was replaced by Gemini, Gemini was replaced by Apollo, and then Skylab, and then the Shuttle.

Without a doubt, we raced ahead in the creation and operation of orbital stations. But in analyzing the programs attached to those stations, you often come across things that are hard to explain. I'm not talking about the trips involving cosmonauts from the former socialist countries. Those purely political acts have nothing in

common with science or technology. In light of the time it takes to adapt to weightlessness, the foreign socialist cosmonauts simply didn't have the opportunity to do any kinds of more or less serious work in the timeframes allowed for "visiting expeditions." It was clear-cut squandering of systems and technology for all the world to see. And it would have been OK if, politically, we had gained anything at all from it. But then we didn't gain any such thing, because our whole "policy" was built on the primitive belief that, for example, we would send someone from Poland into space, and Poland would love us for it. So we sent someone from Poland up, and he returned, and he donned the star we awarded such people, but for some reason Poland continued to not love us. We could throw barbs and snicker about it for a long time, but why do that? It's water under the bridge. And yet, echoes of it still bounce around today, and so we'll talk about it a little longer.

Many space specialists agree that some of the launches were performed merely for the sake of performing a launch. Launch, and then report about it. Demonstrate SIA—that's an abbreviation born at Baykonur and translated as an "Simulated Intense Activity." The Salyut-7 station was operational in orbit when we launched the Mir station on 20 February 1986. How does one explain such impatience? Was Salyut-7 obsolete and physically too old? Could we no longer work on it? No, that wasn't the case. How would you then explain the flight of Vladimir Dzhanibekov and Viktor Savinykh, unparalleled in its daring and its mastery?

The organized transfer of Leonid Kizim and Vladimir Solovyev from the Mir station to Salyut-7 on 5 May of that same 1986 appeared to be very effective. They had virtually nothing to do on Mir, and we kept stubbornly repeating that they were "the first people in the world to fly from one station to another." The farthest thing from my mind is to reproach Kizim and Solovyev, wonderful masters of their profession, for anything. But what was the purpose of that "first ever" flight? To tune up Salyut-7? I mean, it was clear that Ground Control did not have the capacity to control two orbital stations, change crews, and dispatch cargo supply craft. In the newspapers, we proudly wrote that, after completing its principal program in 1986, the Salyut-7 station continued to serve people for a long time. But we had nothing to be proud of: we were giving ourselves some insurance, because we had incorrectly calculated the service life of a huge, expensive vehicle. (If you remember, the same thing happened with our Lunokhod-1. It was supposed to last three months, and it lasted nine, and we also rejoiced about that.) In launching any space vehicle, we should have a clear, accurate idea of how long we will be able to work on it, what we will receive for that work, and by how much our income will exceed our expenditures. But there is no mention of that. We were unable to correctly estimate even the lifetime of Salyut-7 after the station was transferred to a higher orbit, our calculations being off by several years.

The Mir station is called a third-generation station. It would seem that we have garnered some amount of "experience of the generations" that diminishes the probability of egregious errors. Yes, there are six docking ports on Mir, but just what is the sense of that? The station can operate productively and turn an economic profit only if all the scientific-research modules created for it are docked to it. But the station, which was launched in February 1986, has been flying "incomplete" for almost six years already. Because Mir's engineers miscalculated the weight of the station's cable system and made it heavier by 2.5 tons, many instruments had to be left on the ground and sent up later in cargo supply craft. At first, the science program for the cosmonauts was minimal, since there was no equipment there. But later, in April 1989, we interrupted the manned operation of the entire Mir complex, because the modules were not ready and there was nothing for the cosmonauts to do on the station. And at that very same time, there was a lively discussion in NPO [scientific production association] Energiya of a project involving a Mir-2 station with a 100-ton base unit. Clearly, six years is a long time for a space-based structure. Today, many of Mir's instruments and systems have been in operation two and a half times the service life set for them. The onboard computer broke down, which made it impossible to control attitude, which means impossible to conduct astrophysical experiments. The "metallurgy" units of the Kristall module have broken down. Kristall would obviously work more effectively in unmanned mode, since any movements made by the cosmonauts inside the station produce a change in the local gravity field, which does not facilitate the growth of high-quality single crystals. Over the time that has gone by, irreversible processes have taken place in the aging and wear of parts that are either very difficult or impossible to repair or replace: the cable system, pressurization seals, viewports, etc. It could happen that by the time the last brand-new module is docked to the station, the station itself could need to be replaced. Where on earth is there any real proprietary accounting here? Where is there even a weak attempt to produce maximum profit with minimum spending? The evidence points to chaos, a lack of coordination in what is being done, and a total lack of responsibility in all the programming.

The lack of automation, the unreliability and endless breakdowns of the equipment, and the dispatch aboard cargo supply craft of ever newer instruments and assemblies that require installation, checking, and adjustment all make the crewmembers of orbital stations freight handlers, riggers, assemblers, repairmen—whatever you want to call them—but not researchers! And if you consider that they live the lives of Robinson Crusoes, with nobody to look after them but themselves and that returning to Earth in proper physical shape requires training sessions that take a great deal of time, it becomes clear that cosmonauts simply don't have enough time to do research. Specialists estimate that

nearly 80 percent of the time a station crew spends working is spent on measures that involve life-support for the crew.

The most memorable episodes in the work performed by cosmonauts aboard space stations do not involve sensational scientific discoveries, or the detection of some previously unknown laws of nature, or the discovery of new objects in the universe, or the unlocking of mysteries of our own planet. They involve the correction of all sorts of malfunctions and failures. What really makes our cosmonauts true heroes is the imperfection of their space home, and stellar characters are forged in the crucible of the malfunctions that are constantly being found. Everyone remembers how Vladimir Lyakhov and Valeriy Ryumin, by performing an EVA, were able to free one of the docking assemblies of the Salyut-6 station from the KRT-10 radiotelescope antenna that was snagged on it, but who knows why the antenna got snagged on the assembly or which "hero" it was who made that snag possible. L. Kizim, O. Makarov, and G. Strelakov found themselves in what they knew to be an "emergency" situation when they were forced to change the panels of the hydraulic pumps in the heat-regulation system of that same station. That same L. Kizim and V. Solov'yev made several EVAs to repair the Salyut-7 propulsion system. Finally, there's the unprecedented flight of V. Dzhanibekov and V. Savinykh to the dead Salyut-7 station. Everything there—from the severe conditions in the icy, uncontrollable station to the complex repair operations that required exceptional ingenuity and initiative and some unusual decisions—everything there was truly, without any newspaper embellishment, a feat. But a feat placed on the altar of someone else's incompetence, thoughtlessness, and lack of discipline. Who was punished, and how, for having forced our cosmonauts to perform those feats? I don't want blood, I want a fair glasnost. Person A and person B were in charge of the communications. A disappeared somewhere, and B left to have a smoke, and C, remembering that energy was supposed to be conserved, in muddling fashion disconnected the orbital station's receiver, and it wasn't able to receive any kinds of commands from Earth. So I'd like it if everyone knew who A and B are. Out of purely pedagogical considerations, for the edification of whoever is in charge of communications today and whoever will be in charge tomorrow.

In this age of scientific-technical progress, true scientific work requires a high degree of specialization and skills. Genuine discoveries are rarely made by dilettantes. A cosmonaut, no matter how smart he is, no matter how much you train him, can't be an astronomer, and a physicist, and a chemist, and a biologist. In the span of 30 years of manned flight, we have never once launched a scientist into space! During Voskhod, we wrote that a scientist, Konstantin Feoktistov, was part of a crew. For all the many years of respect I have for Dr. Tech. Sci. Konstantin Petrovich Feoktistov, I have to say that he is, first of all, a brilliant project planner, designer, creator and tester of space hardware, engineer nonpareil, and only after that is he a scientist.

In the initial stages of the development of the space program, when every flight was in its own way an experimental flight, choosing spacecraft commanders from among fighter pilots was justified. And it was from among just such pilots that S. P. Korolev recommended the commander of the first Vostok be chosen. But Korolev, in fact, was organizing a group of civilian cosmonaut-engineers in his own design office. The years have gone by. And even today, of course, any space flight is, to some extent, an experimental flight. But who can explain to me why fighter pilots are spending months at a time on the station, instead of ecologists or astronomers? I want to be clear about this. The majority of those pilots are renowned, intelligent guys. I have ties with many of them through many years of friendship, and I have nothing against any one of them in particular. But can it really be that the Air Force, which got a mortal grip on our space program 30 years ago, does not understand that state interests do not always require the presence on the orbital station of someone in shoulder boards?

Every cosmonaut, whether military or civilian, has always been genuinely attracted to one scientific experiment or other, and it has turned out that they all have come up with some interesting results. But in actuality, no serious scientists (I'm not referring to physicians) have worked on orbital stations. Perhaps that partially explains the fact that research projects have never been completed and have never been done on time. That's true of peaceful and military programs alike. Over the entire existence of the Salyut-6 and Salyut-7 orbital stations, all the applied military experiments have been confined primarily to visual and instrument observations that accounted for only a very small percentage of the program itself, because, if we are to be absolutely frank, those observations were, you can be sure, not so necessary for either the KGB or the Ministry of Defense. Suffice it to say that 11 percent of the day-to-day requests for reconnaissance involving the locations of American aircraft carriers and warship detachments were fulfilled, as were 2 percent of the requests by the Main Intelligence Directorate of the General Staff and the Center for Space Reconnaissance for monitoring the "hot spots" on our planet. Plans called for Salyut-7 to be the base for important, long-term experiments involving, among other things, the observation of land and maritime objects (Kontrast-KRT), communications with submarines travelling at great depths in the ocean (Model-2), and space-based photo reconnaissance (Parus), but none of that was done. Even though there was certainly quite a bit of time and quite a few people: 26 crews worked on Salyut-6 and Salyut-7, and there were almost 50 months of manned-mode operations. I should note that the American space-based unmanned reconnaissance vehicles Aquacade and Chalet, just before the start of combat operations against Iraq, were switched to round-the-clock operation, and on the eve of air assaults by the U.S. Air Force, they provided a complete picture of possible activity of Hussein's air defense system and eavesdropped on staff orders and even conversations among tank crews.

But imagine the ideal situation: the station has managed not to age, all the research modules are docked to it, everything is in good order and is working well. We actually have an orbital, multipurpose laboratory. It's clear that the staff of such a laboratory must be bigger than what is usual for a station crew today (two or three people). How much bigger? Would five or 10 people be needed? How would that affect the life-support system? More raw materials would be needed for the experiments. More food would be needed. But more by how many kilograms? How many additional cargo supply craft would need to be sent? By how much would that increase all the operational expenses, and what would be the cost of the research that is conducted? I was unable to find the answers to any of those questions. Perhaps they exist, and I just didn't search very well. But that's not likely. I think that we just haven't had time to come up with the answers to such specific questions, because today we can't even find the answer to a more general question—what, in general, is our space-based science program like?

(To be continued)

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Part Four

World statistics show that all the "space" powers are continuing to expand their outer space programs and to increase the appropriations for them. In our country, the "caravans of rockets"—beautiful words from the favorite song of Yuriy Gagarin—have stopped at dried-up financial wells: appropriations for space dropped by roughly 10 percent and were, in 1990, some 12.4 billion rubles (R), as compared with \$10.9 billion in the United States. Based on recent exchange rates, our country is spending roughly 100 times less (!) on space research than is the United States. According to foreign data—precise data is not published in our country—as much as 75 percent of that money goes to defense projects in our country. Other figures sometimes appear. For example, in 1989, we spent R1.7 billion on space science. Why 1.7, and not 0.7 or 3.7? The answer, which seems very logical, is this: because that's the very sum that is needed to execute the Soviet science program for space research. But that answer is false. We don't even have such a program!

That may seem like some sort of nonscience fiction, but it's exactly how things are. And there hasn't been such a program for several years now! The Interdepartmental Scientific-Technical Council for Space Research is headed by the president of the Academy of Sciences, Guriy Marchuk. The multifacetedness of his scientific interests is so great that the polyhedron is virtually degenerating into a smooth sphere of theoretical indifference, which is particularly noticeable with regard to the space program. In 1988, Marchuk chaired a meeting of the presidium of the Academy of Sciences that discussed a draft of the science-oriented space program. At the meeting, Marchuk voiced the opinion that our

country "is among the leaders" in space research. What that meant, no one knew. Either you're the leader, or you're not the leader. There's no such thing as being "approximately first." That's how the president disguised the fact that our country has lost preeminence in the world in space.

Two reports were given at the meeting. Academy astronomer Aleksandr Boyarchuk spoke of the successes of astronomers working in ground-based observatories. Unquestionably, there were successes, but they had absolutely nothing to do with space research. In the wake of that report, Academician Roald Sagdeyev, who was still the director of the Space Research Institute at the time, spoke of the victories achieved in extratmospheric astronomy. With fervor, Sagdeyev sought to persuade those in attendance that the main part of our space program should be devoted to "an in-depth study of Mars"—obviously, the theoretical base was underpinned by launches of the two Foboses.

The study of Mars is something we need to do. But it's not *the* space program, just one of the branches of the space program. Mars is romantic and beautiful, but Mars can't replace the Moon, or the other planets, or biology and space medicine, or the very alarming global ecology problems. It can't replace technological, physical, or chemical research in the world of weightlessness or the enormous number of applied problems in remote sensing of the Earth. Sagdeyev didn't talk about any of that. His report evoked a rather lively discussion, out of which it became clear that "an in-depth study of Mars" is not a space program for a great space power. That didn't put off Marchuk, who announced that the presidium was approving that program and that it merely needed to be modified in accordance with the desires that were expressed.

The echo of that discussion bounced around the pages of our press for a long time. Here, for example is what the scientists said.

The director of the Institute of Geochemistry and Analytical Chemistry, Academician V. Barsukov: "For the first time in the entire history of this country's research, we, in 1990, have not had an approved program for two years already... We are replacing decision making that is carefully thought out and answerable to science with endless discussions and semantics... Instead of sorting out and approving a State Scientific-Technical Program of Space Research for the period up to the year 2005, the Academy of Sciences is creating a program solely for the study of Mars...."

Academician R. Sagdeyev (as of August 1989, Sagdeyev was no longer director of the institute, and the Foboses had already gone their own way—that is, Roald Zinurovich was at that point a personage with no responsibility for anything): "In any serious terms, we have no strategic policy for the exploration of space."

Dr Tech Sci K. Feoktistov: "I am convinced that we have no strategic policy and haven't had one, even though we can't do anything without plans or programs."

Cand Jur Sci V. Postyshev, member of the International Institute of Space Law: "People are getting the impression that the USSR does not have a unified concept for the exploration of outer space.... No one knows who bears the responsibility for realizing a given space project or cancelling it."

Nobody bears that responsibility! If people die, the person responsible is found. So, why do we need a program? In 1989, a total of 102 launch vehicles lifted off, and 136 satellites and two interplanetary probes were put into orbit, as was one manned craft. In 1990, a total of 75 launch vehicles went up, as did three manned vehicles and six Glonass satellites—for a global navigation system. (It doesn't matter that of 39 of our Glonass satellites, only four were in operation as of the beginning of 1990—we need to launch more.) And there were three new navigation satellites for the old Tsikada system, and a new satellite, Nadezhda, for the international emergency system Cospas. (Again, it doesn't matter that of the five of our rescue satellites, not one has saved or could save even one of our airline passengers, because our airplanes aren't equipped with the emergency radio beacons. But that's small stuff. What's important is that the satellites are aloft, and the whole world is aware of our noble initiatives.) And satellites for optical and various types of electronic surveillance number in the dozens. And all that without any state-wide plans or programs! And—I say this with the data to back it up—that scandalous fact is known to all levels of authority. We don't have a program, but thousands (!) of industrial enterprises are fulfilling orders for rocket hardware and the space industry. How that can happen is beyond human understanding.

People might retort: "What do you mean, we don't have a program? We have one! Scientists have gotten together and have decided that studying Mars is of the greatest interest, that we shouldn't spread our money out, we should focus it. We'll do one job, but a very valuable one. What's so bad about that?"

What's bad, I would answer, is that no one has proven that Mars today is what we need the most. Nobody has proven the soundness of that decision in terms of science, or industrial base, or economics. What's bad, I would add, is that I and many other people better informed than me have no faith that that voluntaristic, albeit interesting, program will be completed. Back in 1987, when the 30-year anniversary of the first satellite was being celebrated in Moscow, it was announced that in 1994 we would send to Mars an interplanetary probe that would make a detailed photographic survey of that planet, i.e., refine (or repeat?) what had been done 20 years ago by the American Mariner 9 probe and 15 years ago by the Viking probe. Then our probe is to acquire data on the chemical and mineral composition of the Martian surface and on the temperature distribution,

which was also done by Viking. Then our probe is to release research and television gear. But Viking already showed Earth a Martian panorama back in 1976!

Again, some might retort: "The Soviet research will refine the American research and add to it, and even if it were to repeat the research, that would give it greater credibility."

Nothing of the sort will happen. Our gear is no better than what the Americans had 15 years ago. In the summer of 1972, four years before the Americans, we made the first soft landing on Mars with the unmanned Mars-3 probe, but it wasn't able to show us anything. Its main achievement was that it delivered pennants bearing the Soviet Union insignia to the Red Planet. But the problem is not even with gear. We're not going to be able to launch a probe in 1994, and, it seems, that's already clear to everybody. After announcing the launch date in 1987, we did virtually no work whatsoever on the vehicle until the end of 1989, although a competition did select the instruments for hefty sums of hard currency. Interest in the Mars program sagged after the Fobos failures. In 1990, no money was allotted for that program. People stopped writing about it, and survey articles about space didn't even mention it. Nevertheless, in late November of that year, everyone again gathered, to confer with foreign colleagues (a special, warm friendship had already formed: sometimes they would come to confer with us, and sometimes we would go to confer with them, which was even better, because it was more nourishing). Again we discussed the program and the instruments. And the new RSFSR minister of science and technical policy, Boris Saltykov, assured everyone that the government of Russia would do whatever was necessary to have the flight to Mars take place right on schedule. God is with us. But wait, Vladimir Bulgak had been appointed minister of communications, information science, and space in July 1990. So why is Saltykov concerning himself with the Mars program? It turns out that Bulgak's job by now has been "cut back" to just the one "communications." It's nothing but a puppet theater.

I'd like to note that since our system itself limits its leaders and forces them to look after the fate of only what they're in charge of, communications among chiefs, chief designers, and general designers are often unstable. That, and the absence of clear planning, results in the preparation of all scientific experiments in space taking place, without exception, in a very rushed environment. We're always hurrying and always being late. That can't help but affect the quality of the gear and the techniques used and, consequently, the number and quality of the results we get. We tried to get in a hurry even with the study of Halley's Comet, even though our grandfathers knew well before that Great October when it would be arriving.

The first director of the Space Research Institute, G. I. Petrov, complained to me that he had suggested direct radio transillumination of the core of the comet, which

would have enabled accurate determination of its density. Petrov is very interested in solving the mystery of the Tunguska meteorite, and the data on the comet's density would be helpful to him here, on Earth. A Space Research Institute preprint on the subject was published, but the academician's idea wasn't even discussed in his home institute, and nobody had time for him, and the instrument wasn't installed on the probe. Halley's Comet visits us once every 76 years, and that, to some extent, may explain the hurry: "Well, if we miss it, what are we supposed to do—wait another 76 years?" But why are we always rushing around when it comes to the Moon, Mars, or Venus, when a launch may have to be moved not decades, but only days or, at worst, several years.

As you get closer to the heart of the problem, you see that there is actually someone who sets up our plans and the program. That working organ, created by M. V. Keldysh and S. P. Korolev, has in its past many years of experience involving very fruitful work. I'm speaking of the Interdepartmental Council for Space Research (MNTS KI). Its job is to decide what needs to be done and to map out all the programs. After bringing all the programs together, it checks to see which points of the programs overlap, and it determines who gets what money from the budget and who will be invited to be coauthors from which plants and NPOs, and, if required, it determines where abroad to place orders for production and sets precise deadlines for implementing all the points of the adopted programs.

It's clear to everyone that the scientists should have priority. Today they don't have that priority and can't have it, because they're not united by common goals or interests—each one is "hogging the blanket." Physicist K. Gringauz is concerned about a cutback in the number of satellites for research in near-Earth space. Astrophysicist R. Syunyayev is worried about high-energy astrophysics. Geophysicist V. Barsukov doesn't want to wait for a 1994 flight to Mars and demands that it be launched in 1992. B. Chertok, a specialist in automatic equipment and control systems, understands that work has to be found quickly for the Energiya super rocket and, in trying to save the prestige of the firm to which he has given 46 of the best years of his life, is fighting for the giant communications satellite that would solve all the television, telegraph, and telephone problems in our country. (Boris Yevseyevich's proposal seems to me to be quite worthy of consideration.) And they're all probably right, but none of them can give up any of his own private problems, departmental obligations, collegial attachments, or nomenclatural preferences. None of them can "rise above" the whole of this gigantic system—the Soviet space empire that exists within the union of independent states. None can rise above and ponder the paths to progress for the entire space program in the foreseeable future.

When he came to the Soviet Union, the Nobel laureate Professor Leontyev was asked what our country lacked most.

"Strong personalities," he answered.

President Guriy Marchuk is not, unfortunately, President Mstislav Keldysh, whose energy and authority actually put us in the lead—not "among the leaders"—in world space activity in the late 1960s and early 1970s. General Designer Yuriy Semenov is 56 years old. His great predecessor Sergey Korolev was younger when he put together the grandiose plan for the exploration of space that we adhered to for many years after his death. I knew Korolev, and I can't imagine him allowing a situation like the one in which this country has lived now for several years, with no science program for the exploration of space. And he wouldn't accept any excuses of collapse and ruin, believe me.

But Korolev isn't around any longer, and I don't think any such individual will appear soon: nature is thrifty when it comes to that kind of person.

But "a sacred place doesn't stay empty long." Once the Interdepartmental Council demonstrates complete scientific impotence, all kinds of replacements can be found that, more often than not, are less powerful, but are considerably more adept at concealing it. In late October 1990, the CPSU Central Committee Commission for Science, Education, and Culture was set up. The 35 commission members included 11 party apparatchiks, more often than not first secretaries of obkoms (as everyone knows, those are the most prominent leaders in science, education, and culture), and, for some reason, one electric welder from Kharkov. In his best king's speech, the chairman of the commission, Academician Ivan Frolov, said: "It's time we bade farewell to our scornful attitude toward apparatchiks. In performing difficult coordination and organizational work that often goes unnoticed from the sidelines but is very important, they have become the targets of attacks, often unfair." (How unfair those attacks are, we have already seen from everything that was said above.) The first of the named tasks that the new commission performed was this: "develop conceptual principles for the optimal use and further development of the intellectual potential of the country and for the top-priority development of science...." God is gracious: the commission had no time for "intellectual potential" or "top-priority development." Just like the CPSU Central Committee as a whole.

But all kinds of "saviors of the Fatherland" are constantly appearing. Here's a quite recent document: "Order of the Presidium of the USSR Academy of Sciences" from 3 October of this year, on the creation of a consulting council "Space-Earth," signed by the president of the Academy of Sciences. After reading the order, I had no idea what the council was created for. To take some work off the shoulders of G. Marchuk and give it to the MNTS KI? Or to come up with the new position of "Consulting council coordinator" for Dr Tech Sci V. Shvarev? I couldn't find any other explanations for the

existence of the new council: his work consists of knowingly duplicating the work done by other, existing organizations.

In a very direct way, the following organizations are involved in our space program and are deciding exactly which direction we'll be flying in: MNTS KI, the Space Research Institute itself, the Ministry of Defense, the Central Scientific Research Institute of Machine Building (the head institute of the former Ministry of General Machine Building), the State Center Priroda of the State Committee for Geodesy, the NPO Planeta of the State Committee for Hydrometeorology, and the All-Union Scientific Research Center Ekologiya of the Ministry of Natural Resources [Minprirody]. It's like having seven nannies for one child (in fact, there are more than seven!). So let's remember the old Russian saying and not be surprised that the Deputy A. Neumyvakin, the chairman of the All-Union Society of the Blind, is the one who defended the appropriations for the space program at meetings of the Supreme Soviet before any scientists or cosmonauts did.

Enough of this rousing and unnerving of the readers, though. The program was and is, but it's as if it doesn't exist, because it has never been discussed anywhere publicly, has never been published, has never been voted on at any of the Supreme Soviet sessions, and, until recently, was purely a departmental, almost private, affair, inasmuch only a few people—primarily the heads of the space centers themselves—were able to change it, change the deadlines, insert anything, or emphasize anything, whenever something benefitted them. It's my understanding that not even the President of the country was among the "decision makers." In answering a question about who would be the first journalist to go into space, for example, he publicly announced this on the pages of PRAVDA: "The question has already been decided. The first journalist will be one of ours, and he will go up before the Japanese journalist." But those who "put together" our programs didn't listen to that, and the first journalist to go aloft was a Japanese.

Until very recently, the final decisions in matters of the development of our space program came out of the interior of the military-industrial complex, or to be more precise, out of the offices of the Ministry of General Machine Building.

The head of Glavkosmos, Aleksandr Dunayev, admits this: "The main tenets of the all-academy program 'Issledovaniya kosmosa' [Space Research] (*obviously, he is speaking of the notorious Mars—Yaroslav Golovanov*) have been coordinated with Glavkosmos (*which is simply a subdivision of the Ministry of General Machine Building*) and the 'Program for the Creation of Space Hardware for Science and Scientific-Economic Applications for the Period Up to the Year 2005,' which was developed by the USSR Ministry of General Machine Building." Working in Glavkosmos, I must remind you, are beginning businessmen. The ministry has been directing the plants. Thus, everything is upside-down:

the scientists don't set the objectives for the manufacturers of instruments and equipment; rather the ministry, with its contractor-manufacturers, decides what the scientist-customers need. "You need a hat? Well, you'll get a cap. And if you don't take it, you'll walk around with your head uncovered." That's the formula for their relationship.

I'd like to see the faces of NASA officials if, for example, the president of Lockheed announced that his company didn't think it would make the Hubble telescope, but might rivet together an all-terrain vehicle for Mars instead. But now, God willing, everything will get right with our space program: after all, the Ministry of General Machine Building has been dismantled. And Minister Oleg Shishkin is no longer a minister. Elected by the directors of the enterprises that made up his ministry, he is the president of a special corporation. "Most probably, they saw me as a specialist. After all, I was involved in the development of the Energiya-Buran project," Oleg Nikolayevich modestly comments on the results of the election.

All they did was change the sign out front.

When you're thought of as a complete idiot, you get a very unpleasant feeling that's like some sort of internal itch...

(To be continued)

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Part Five

It was roughly 1959, just two years after the triumph of the first satellite, that people began to say that space was not profitable, that it was dooming the people to beggary, and that it was basically time to close that office down. Then, when N. S. Khrushchev made the space program a powerful lever of his foreign policy and his internal ideology, they quieted down some. When times became a little leaner, they started up again. Our space program is like the Jews: it's to blame for everything bad that's happening around us. But those voices, especially loud and quite official, sounded out a new call from the rostrums of the USSR Supreme Soviet: "freeze" space!

Later, advice that was more moderate was heard: we don't need to freeze space, they said—we need to make it pay for itself: let them twist in the wind a little, and they'll begin to be a little more lively about expanding conversion.

Everything I wrote in the previous installments in IZVESTIYA was permeated with caustic criticism sent out in many directions. 'Things are bad everywhere' might seem to be the conclusion of this investigation.

But despite all my negativism, I am firmly against any kind of clamp down or freezing of research in space. Making the space program pay for itself is economic nonsense. Lt Gen Avn Vladimir Shatalov says that in 1990, from the one flight of the Japanese [journalist] we

got as much money as was allotted the cosmonauts for all of 1991. Does that mean that after the flight of the Englishwomen and the flight of the Austrian, we're way in the black? In not one single country does a space program pay for itself, and ours couldn't, even if we were to become a lowly space "carrier" who didn't give much of anything to science or technology, much less national prestige, but merely gratified the vanity and advertising ambitions of customers. The space program should provide us knowledge, technology, materials, and information in the broadest spectrum. Those things are valuable, and in no small way. We have to pay for them. That's why an unsubsidized space program is a fiction and a myth that we've got to part with once and for all.

"How can you say that?" some would retort. "Look at how much the space program gives our national economy!"

That's a very difficult issue to deal with, because no one knows what that figure is, and there exists quite a sound hypothesis that says that that figure is negligible.

Look at how much has been written about the work done on the Mir orbital station, for example! But did you know that Mir's orbit, because of requirements for radiation safety, has a low inclination, which enables the cosmonauts to view only about 20 percent of the former USSR? Even if we were to incline the orbit at 65°, a third of our country still couldn't be seen. Round-the-clock observations can't be made, and the best observations are possible on only a small portion of each orbit.

The whole secret of the attractiveness of the numerous florid articles on the Space-Earth subject is that they give examples not of what is being used or has been implemented, but of what could be used and implemented. But then the question resounds, But what is hindering that use?

I discussed that topic with many people—the chairman of the State Committee for Environmental Protection, Nikolay Vorontsov, for example; his deputy, Aleksandr Bazykin; and the first deputy director of the Main Administration for Environmental Protection Information Systems, Viktor Kutsenko. Do they need space-derived information? Yes, very much so! *Very* much so! And they need all kinds of information! But you have to pay for the information you get, and they don't have anything to pay for it with—there's no money!

"The defense people are generous people," they told me. "They allotted more than 24 million rubles (R) for ecology, but none of it ever got to us. We didn't get even 1 percent of all the money that was released for saving the Aral Sea. We're too poor to outfit the orbital station with our own equipment..."

Vorontsov showed me a large color image. It was the Kuznetskiy Rayon of Moscow. Clearly visible were the smoking dumps and the turgid flows into the reservoirs, and red threads of heat losses surrounded the residential buildings.

"This was given to me by Pavel Popovich because I'm a deputy from the Kuznetskiy Rayon," says Nikolay Nikolayevich. "But we don't have the kind of money it takes to buy such images..."

We're at the Okean Center. Here's the head of the department for the development of techniques and equipment for remote observations of fisheries, Yuriy Zonov:

"Only the Meteor satellite can provide fishermen with daily information on the weather. We gather fishery information and send it to the fishermen once a week. The Okean satellite (it's actually Kosmos-1500, which in all our articles we call so proudly the "fisherman's satellite"!) gives us virtually nothing, because its orbits are such that it sees fishery regions that are of interest to us only once every 10 days. And if there's a wind, you can't make anything out..."

The chief of the Scientific-Technical Administration of the USSR Ministry of the Fishing Industry, Sergey Dyagilev, says this:

"Let's talk frankly: there is no satellite for fishermen. The Okean provides a very rough location of schools of fish, measured from space not in minutes of arc, as we need it, but in degrees. What we need is a satellite with gear that is capable of pinpointing schools of fish and productive plankton areas and of promptly throwing that information down if not to our ships, then to our receiving centers in Murmansk, Kaliningrad, Vladivostok, Sevastopol, and Moscow. Three years ago, we didn't have to pay the "space people" anything, because we got everything free of charge. Now we have to pay. But doesn't it seem logical that what we have to pay should depend on how much we catch?"

It certainly does! The fishermen should pay the space program for fish, the farmers should pay for harvest forecasts based on harvest prices, and the geologists should pay for a tipped-off deposit based on its yield and how easy it is to work. That's exactly how I think the relationship between the national economy and the space program should be structured in the context of the market.

A different argument, which also requires critical analysis, is also cited in defense of the space program.

"Moreover," they tell us, "look at how much we will learn in space. And then the work itself that involves space facilities and is performed here on Earth will create new technologies and materials and will raise the standard of labor. In short, it improves our lives here on Earth. Did you know, for example, that while working on the Energiya-Buran system, specialists created 581 variations of new materials? The names alone of the materials and the various units and assemblies of Buran, declassified and intended for use here on the ground, take up three fat tomes!"

It's that same old story: wishful thinking instead of reality.

"I don't know of one ruble that's been received for, say, the transfer of technology from that very Buran to the national economy," says Konstantin Feoktistov, cosmonaut and doctor of technical sciences.

Boris Olesyuk, from the Flight Control Center, says that not one thing has been transferred, and no one is even taking anything for free.

And again the question, Well, then, just what is preventing us from crossing the space program with the ground-based economy and producing a remarkably fruitful hybrid?

First and foremost is this: the conservatism of the very system that created the word "vnedreniye" [transfer], which isn't even in the prerevolutionary dictionaries. The second thing is objective: the absence of the equipment and raw-materials base that are available to the enterprises of the military-industrial complex, but not to those who could use the technologies and the things that have been developed by those enterprises. The third is this: the secrecy is so rigid that it can change any new technology at the moment of its "transfer" into an obsolete technology. Every country has secrecy, but only in our country does it curtail state revenues instead of increasing them. The fourth thing is this: the need to retrain personnel, replace equipment, etc., which promises a slow-down of existing production. Such, in my view, are the things keeping the space program from helping the national economy and, consequently, from strengthening its own social authority, from convincing people of its economic capabilities, from proving its usefulness.

Now about conversion, in which the rocket-and-space enterprises themselves are changing over to "ground" production. Everyone welcomes the idea of conversion on paper, but when it comes to actually doing it, there is a sometimes clear, more often than not secret, but wholly explicable and, from my point of view, justified resistance to conversion.

People who yesterday were making atomic bombs, rockets, and advanced fighter planes do not want to be making chamber pots, kitchen appliances, or baby carriages, because they lose their salaries, their ratings, their sense of professional worth, and the pride they have in their "firm." In addition, everybody forgets that conversion takes some big spending, because a warhead with a handle welded on the side—it's not a chamber pot. Order will have come to our country when everybody is working in his profession: when the "bomb-makers" (as L. I. Brezhnev called them) will be making nuclear reactors that are as reliable as their bombs and will be bringing us closer to an understanding of controlled thermonuclear fusion; when the aircraft designers are building airplanes—not fighters, but passenger planes, and lots of them, so that people don't live in airports for

weeks at a time; and when the rocket-makers are making rockets. But why do we need rockets?

If our space program can't pay for itself inside the country, then it could make a pretty good living in the outside market. It could, but it won't. And here again, we must blame, above all, our system of secrecy: when we're ahead, we can't talk about anything, because our "enemy" might catch up with us; when we're behind, we can't talk about anything, because we don't want him to find out about it. It wasn't until 1985 that the "legal" offshoot of the "closed" Ministry of General Machine Building—Glavkosmos—was set up. Its first commercial success reminds one of the business that kids have cleaning windshields while cars are stopped at traffic lights: \$7.5 million for the launch of the Indian IRS-1A satellite in March of 1988. OK, the first step is the hardest. But soon it turned out that a real misfortune occurred: we had slept through the alarm for the outside aerospace market. Sure, there are objective reasons that we use today to excuse ourselves: COCOM forbade the export of advanced technologies to the USSR. We aren't allowed to launch a rocket if it has even one American part or if it uses U.S. technology in its application. And an agreement with Space Commerce Corporation for the launch of an American satellite atop a Soviet rocket was already signed. But it didn't take place.

We and our partners suffer because of all that. After all, if our Proton rocket charges \$35 million for putting a 2.2-ton cargo into stationary orbit, the American Delta 2 charges \$50 million for 1.5-1.8 tons.

Yes, there are objective reasons for our not being able to earn money, but they're outnumbered by subjective reasons. We do not understand the business conditions of the foreign market very well. We concluded a contract with the Japanese firm Pax Corporation, and in terms of certain points, the contract was unfinished, and it was signed without our trade representative specialists, and we advertised the firm all around. And then the firm went bankrupt, and now we have to file suit for \$6 million, and we don't even know how to go to court over there. Why did we get \$12-15 million (the exact figure is a trade secret) for taking a Japanese journalist aloft, when the Americans would have gotten \$35 million? When Toyohiro Akiyama himself was asked about that, he answered in English, in a tone that makes me burn with shame: "You really don't see? They need the money."

It's an absolute mystery to me the soup we got ourselves into after we sent the Englishwomen Helen Sharman up into space. I mean, we were ready to collect \$15 million, but we only got \$5 million—that was just for training two Englishmen in Zvezdny Gorodok. But what about the money for the flight? For the use of the equipment in orbit? Or was it like before—we thought that now England would love us and would send us sausages for free? I don't know of a single well-thought-out space-program action that we've performed on the outside commercial market. Our being a space "carrier," which

is feeding the Cosmonaut Training Center, is only reinforcing the suspicion that Glavkosmos is impotent. Last year, the Chinese rocket Chang Zheng 3 broke into the world market and put an American satellite into orbit. Why hasn't ours? The Chinese were allowed to launch nine American satellites three years ago if they kept the launch fees in the mid-range of world prices. They didn't stick to the agreement, but on the first launch, they earned \$30 million—much more than our entire annual space budget. The Japanese are selling the Americans engines for space rockets. And why are we not selling? All our attempts today to put our outside space business in order should be encouraged in every possible way and should be welcomed.

No matter what political and economic forms what we used to call the Soviet Union is remelted into, we will remain the great world power that opened the space age. Yes, in recent years, in my opinion, many mistakes have been made and there has been some outright bungling. But does anyone really think that it's just been in the space program? We speak of the "new thinking" in politics. We also need some new thinking in the space program.

We say that we've got to relearn economics. Basically, we need to relearn how to live. The space program needs a radical reorganization. A business involving billions and billions can't be managed so inefficiently, so chaotically, in such an uncoordinated fashion, never professing in the process any general idea that consolidates socioeconomic and scientific-technical interests in the formulation, analysis, approval, and embodiment of all programs and projects. The space program needs a boss—an intelligent, educated (those are not the same thing!) individual who has been given the authority to make decisions and finance them and who is capable of justifying those decisions in a well-reasoned fashion, apart from all departmental interests, and of explaining them to the public.

Breaking is not building. If we destroy and financially strangle the space program, we will destroy one of the major areas of modern progress and one of the very few areas in which we have dignity and prestige in the world community. The calls to curtail the financing of the space program are calls against the state. We again risk showing the entire world our narrow-mindedness and our firmly entrenched habit of building our lives on the basis merely of concerns for the moment, without a thought for tomorrow. There is already much for which posterity will not forgive us. And it might also not forgive us for destroying the space program.

Events at Baykonur Cosmodrome During Coup Attempt

917Q0185 Moscow PRAVDA in Russian 14 Sep 91 p 3

[Article by test engineer Yuriy Markov: "How It Was at Baykonur"; first paragraph is PRAVDA introduction]

[Text] Did you know, when sprinkling your pilaf with Indian pepper, washing it down with Indian tea, and in the meantime looking at the screen of a Japanese Toshiba television, which was delivered from India, that this is the payment of the Indian side for the IRS-1A satellite, which was launched three years ago by a Soviet Vostok launch vehicle? Now, very likely, there will be even more tea, because at the end of last August the Indian IRS-1B satellite was launched from the Baykonur cosmodrome and began to probe successfully the surface of earth. The days of its preparation and launch turned out to be hot—not just in the climatic sense. The notes of the test engineer of space hardware are about that.

Notes of a Tester

...One after the other, blunt-nosed trucks drive up to the IL-76 airliner. From its enormous belly they remove crate after crate. The job is not easy. The temperature is nearly 40 degrees, and there is a strong searing wind. Salt comes out on cracked lips.

All these instructions somehow resemble the famous souvenir—the Russian matryoshka doll. To get to the satellite, it is necessary first to open our container and get the Indian one, then open the "cylinder," and then remove the snow-white protective covering, and only then will the fine golden cube-shaped satellite appear before you. But that won't happen for two days, in the hall of the technical complex. But while the satellite is taking the first steps on the land of Baykonur, the column has been setting out.

For the present I cannot say exactly how the fate of the second satellite will turn out, but I know that its completion at the cosmodrome will be difficult for Soviet specialists. Why? Many troubles have befallen the cosmodrome. The most serious situation is with water. There are heaps of work to be done before a new water line can be put into operation, and besides, deliveries are being disrupted. The old line, which was laid 35 years ago, is continuously breaking down: pipes burst, worn-out pumps break. Roads, services, and structures are "crumbling." The frequent and unpredictable whims of the power transmission lines make one shudder. The cosmodrome needs a considerable amount of money fast to maintain a normal life for the people and the efficiency of equipment. But who will provide it...

But what about earning it? Our domestic industry has a wide range of launch vehicles of every possible class: the Vostok, Molniya, Soyuz, Tsiklon, the extremely reliable Proton, the now-under-development Zenit, and, finally, the powerful Energiya. We can ensure the launch of practically any payload. But first money just has to be invested into the infrastructure of the cosmodrome, in order to attract wealthy clients, including from developed countries, in order to enter the world market of space services...

...Two launch vehicles—a Soyuz for the Progress and a Vostok for the IRS—came to the cosmodrome on the same train. Oh, what a hard time the rocket specialists