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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Launch-Complex Designer Barmin on Past, Future of Space Science

93UM0419A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 2-3

[Interview with Vladimir Pavlovich Barmin by V. Smirnov under the rubric "Topical Interview": "Space Starts With the People on the Ground"]

[Text] *Not long before the 35th anniversary of the launch of the first artificial Earth satellite, our correspondent met with Vladimir Pavlovich Barmin, general designer of space launch complexes, colleague of S. Korolev, academician of the Russian Academy of Sciences, honored president and honored member of the Academy of Cosmonautics imeni K.E. Tsiolkovskiy, full member of the International Academy of Astronautics, Hero of Socialist Labor, holder of six Orders of Lenin, the orders of the October Revolution and Kutuzov 1st Degree, two orders of the Red Banner of Labor and laureate of the Lenin, Stalin and three State prizes.*

[V. Smirnov] Vladimir Pavlovich, please tell us how your path started in the field of missile and space engineering.

[V.P. Barmin] I began to be occupied with missile engineering on the eighth day of the Great Patriotic War, being the chief designer of the design bureau at the Kompressor Plant that was entrusted with the development of launchers for non-guided rockets (the "Katyushas"). The collective created several dozen types of launchers over the course of the war, thirty six of which were adopted into service with the Soviet Army. Everyone knows their role in routing fascist Germany. Their significance was great in the battles around Moscow, at Stalingrad, in the Black Sea during the capture of the Novorossiysk Bay and in other theaters of combat operations.

After the war Korolev and I started to study the missile technology of Germany. I was later a member of the council of chief designers created by Sergey Pavlovich. Our design bureau developed ground-based mobile, fixed and silo launch installations for the Strategic Missile Forces along with space launch complexes for a span of fifty-one years. Gagarin's launch pad, for example, was created for the first intercontinental ballistic missile in the world, the R-7, able to deliver a thermonuclear charge of up to five tonnes to any point on the globe. There were six such launch complexes—two at Baykonur and four at Plesetsk. They were all suited for the launch of spacecraft and manned craft.

[V. Smirnov] The R-7 appeared more than thirty years ago—it is a missile of the past—so the launch complexes for it are also clearly in need of modernization?

[V.P. Barmin] The R-7 launch vehicle that was developed in the fifties has been upgraded; it has been made from a two-stage into a three-stage (Vostok, Soyuz) and a four-stage (Molniya) rocket. The reliability of the rocket is very high. It is the only one that puts manned spacecraft into orbit.

The Americans created their own Atlas intercontinental missile, which could put up one tonne of payload, at roughly the same time, and are still operating it successfully with a broad program for further modernization of the engines and control systems. We have also developed plans to modernize the "seven."

As for the old launch complexes, their technical standards are at a higher level than foreign models, and they are more modern and cheaper. Questions of fire and explosion safety have been resolved. We have always been striving in our work for high reliability and low cost. We even used launch silos for the launch of satellites in that regard.

[V. Smirnov] The press did not report that.

[V.P. Barmin] Yes, everything was tightly controlled at the time, and was explained by the high secrecy. I have been working as a chief designer for more than fifty years, and have been "open" to the press only in recent years. My articles in the newspaper PRAVDA used to be under a pseudonym, Professor Vladimirov, with features by Korolev under the name Professor Sergeyev.

The first satellites for military purposes were launched from the experimental Mayak launch silo at the Kapustin Yar test range. Those silos were developed by our design bureau for launching the R-12 military missile, whose chief designer was Yangel. He was occupied with "little" space, that is, he designed, manufactured and tested small Earth satellites using an upgraded two-stage 63S1 launch vehicle. The second stage did not fit into the silo and protruded above the surface.

We created launch silos for other missiles as well, including reusable ones.

[V. Smirnov] Vladimir Pavlovich, what other launch complexes were designed by your design bureau?

[V.P. Barmin] The launch complex for the N-1 launch vehicle. A hydrocarbon combustible and supercooled oxygen were used in that rocket instead of the traditional components. When this launch vehicle was first conceived, Chief Designer Glushko proved, including to Korolev, the inadvisability of using liquid hydrogen in missile engineering. All of the launches of the N-1 were unfortunately not successful. The further development of that rocket was curtailed.

The Proton launch vehicle (Chief Designer Chelomey) using nitrogen tetraxide and asymmetrical dimethyl hydrazine was created in the sixties for the launch of heavy satellites and Mir-type long-term orbital space stations. The highly reliable and automated launch complex for that rocket was also developed by our design bureau.

We redesigned the complex for the N-1 launch vehicle and turned it into the launch complex for the Energiya—Buran rocket-space system. It is better than the Space Shuttle, first and foremost because the launch vehicle and the spacecraft were developed separately. The launch vehicle is able to put up to a hundred tonnes of payload into a reference orbit.

International Astronautical Federation Vice President G. Hanford (United States), giving a speech at a conference devoted to the international space year that was held this year in Moscow, touched on the problems of the development of astronautics. He noted that the further assimilation and study of the moon, Mars and Venus, as well as the other planets of the solar system, could not be accomplished without a launch vehicle that could lift a hundred tonnes of payload. They are thus now facing a dilemma today—either create such a launch vehicle themselves, or buy a license for our launch vehicle. That statement confused some specialists, who asserted that we do not need the Energiya and the Buran. Hanford later made note of our successes in ensuring the reliability of spacecraft docking in orbit, and called them a fundamental achievement in the development of astronautics.

Domestic space science could offer other advanced technologies to our foreign counterparts, for example systems for the placement into orbit, docking and landing of space objects at an assigned spot on the planet. They have a high degree of reliability. We have carried out thousands of operations now.

[V. Smirnov] Is your design bureau engaged in the creation of space objects?

[V.P. Barmin] Yes. The development, creation and launching of space robots of two types should be noted. The first of these, the LB-09, was intended for drilling the soil of the moon to a depth of up to three meters, taking core samples and delivering them to Earth without disturbing the stratification of the layers.

Four such robots have handled their tasks on the moon.

The second, the VB-02, was intended for drilling the ground on Venus, performing chemical analysis, recording the results on magnetic film and transmitting them in two stages to Earth—first from the descent craft to the Venus station, and then from it to the Earth. Four such robots have visited the planet.

[V. Smirnov] Does your design bureau interact with foreign firms, and what does that collaboration provide?

[V.P. Barmin] Today our space-science field, like the national economy as a whole, is experiencing difficulties caused by cutbacks in financing, the destruction of cooperation that had taken shape over decades, the turnover of personnel etc. We are searching in this situation for ways of maintaining the prestige of Russia in the international arena in the use of space engineering for peaceful purposes. The design bureau possesses many technological innovations, and is incorporating them in programs of collaboration.

The joint Soviet-German venture Splav, for instance, has been working successfully in the field of space technology for two years now. A study of the creation of Proton launch complexes in Australia and India is still underway at the departmental level. Matters are proceeding slowly, since that launch vehicle uses toxic fuel components.

The conversion program of the design-bureau collective includes the development of advanced technology for the liquefaction and use in the national economy of natural gas, as well as the storage and processing of agricultural output—grain, sugar and even cocoa beans.

Many young and skilled specialists are working at the design bureau who are able to resolve a broad range of national-economic tasks. Some executives unfortunately strive to acquire ready-made machinery and equipment abroad, without thinking about the fact that domestic developers could be cheaper and more efficient.

[V. Smirnov] Please say a few words about the prospects for space science.

[V.P. Barmin] I feel that no one doubts the future of space science, this stage in the development of mankind cannot be stopped. Even space projects that are not realized or implemented, it would seem, can be the engines of advanced technologies and science.

The future is reserved for cheap and accessible forms of energy, reusable and multipurpose craft and the bold and thrifty thinking of scientists.

I would especially like to emphasize that we currently do not lag behind the level of development of foreign space science. That was demonstrated by the conference that was held in Moscow that I was talking about. Individual statements that space does not provide immediate advantage, is unprofitable and the like are founded on the impossibility of giving a precise economic assessment of, for example, weather information or space communications systems under the conditions of the contemporary economic structure.

[V. Smirnov] Vladimir Pavlovich, what would you like to wish our readers in this anniversary year?

[V.P. Barmin] Interest in space science around the world is great. That is because of the constant aspiration of man to know his surroundings, the largely mysterious world of space. The readers of your journal are interested, inquisitive people who undoubtedly understand that the mastery of outer space is given to mankind by difficult labor both in space and, first and foremost, on Earth. I would like to wish readers, designers, manufacturers and the workers of cosmodromes and the command, control and telemetry system successes in this cause, so necessary to Earth civilization, in the International Space Year. It is all the more essential in these difficult times for Russia to seek out opportunities to develop space science, adopt advanced technologies, reinforce the defense of the state and expand our knowledge of space.

Cosmonaut Survival Training Detailed

93UM0419B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 4-6

[Article by Candidate of Technical Sciences Colonel Ye. Khludeyev, chief of the Crew Training Department for Interaction with the Search and Rescue Service, Survival After Non-Standard Landings, and engineer Lieutenant-Colonel (Reserves) Yu. Timofeyev under the rubric "Cosmonaut Training": " 'Space' Survival School"]

[Text] It has long been noted that people often perish in extreme situations only because they do not know how to fight for life, they have not grasped the art of survival. They teach survival under various conditions and in various climate and geographical zones at the Cosmonaut Training Center [TsPK] imeni Yu.A. Gagarin. The well-known traveler, and creator and head of the first "survival" school in Europe, the Italian Yatsek Palkevich, took part in one of the winter simulations of our cosmonauts above the Arctic Circle. After spending several hours in the descent craft (SA), working some in the cold and spending several hours in a shelter at night, he left the "game" before our guys and admitted that Soviet cosmonauts are being trained under very tough conditions that have never even been created at his school.

We meanwhile do not specially create those tough conditions or come up with different variations; we only provide an opportunity for people to experience what could happen to them in reality. We experience everything for ourselves ahead of time, of course. And if the cosmonauts, as they say, are not lost in the winter tundra, desert, taiga, the mountains or water, that is to the credit of the staffers of the department who "baptized" them at the department's survival center.

"...The descent vehicle of the spacecraft has landed in the designated area..." We have become accustomed to those reports from TASS for the more than thirty years of manned space flight. Fortunately, it almost always happens. Almost.

In March of 1965 the Voskhod-2 spacecraft did not land in the designated area, and was quite far from the city of Perm. No dwellings, no hunting cabins—just the taiga heavily covered with snow. Pavel Belyayev and Aleksey Leonov had not only to fight for life in the fullest sense of the word, but also to preserve their health. They had to get nourishment somehow, get out of the cold someplace, and wait for the arrival of the search-and-rescue group. And then, after they found the crew, the cosmonauts were put on skis—there was no other way to get out of the taiga across the deep snow. There was no equipment at that time, after all, for their evacuation to a hovering helicopter.

April 1975—the launch of the next Soyuz. A spacecraft with Vasiliy Lazarev and Oleg Makarov on board was just "a few steps" away from reaching orbit. As in the song, "Just a little more, just a little bit more..." But a failure in the system for separating the second and third stages of the launch vehicle led to the fact that the descent vehicle was rushing earthward. After enormous G-forces (up to 22 Gs) there was a let-up. But who would have thought that the SA would "pick" an exceedingly "unsuitable" spot to land—the mountainous Altay region! The parachute canopy caught on some trees growing on a steep slope. The descent craft was hanging, swinging threateningly over the abyss. Were it not for the quick actions of the cosmonauts and their courage, coolness and fine professional skills when acting under extreme conditions, something irreparable could have happened...

The flight of the Soyuz-23 would seemingly be fine. It was launched in October 1976, carrying cosmonauts Vyacheslav Zudov and Valeriy Rozhdestvenskiy to the Salyut-5 station. But a failure in the convergence system did not permit the craft to dock, and they had to make an early landing. It occurred on the surface of Lake Tengiz. All of the means of the search-and-rescue complex were operating under unfavorable weather conditions. The air temperature dropped sharply, and the half-frozen lake began to "steam" while snow started. Not all of the helicopters necessary for search, detection and the rendering of assistance were able to take off under those conditions. It was impossible to approach using a rubber boat due to the broken ice and sludge. The cosmonauts were in a most difficult situation—upside down- -since the parachute was acting as an anchor and had turned the SA escape hatch under. The ventilation (breathing) apertures were covered with ice... A rescue helicopter came at dawn.

That is probably enough examples. There have been quite a few non- standard situations in cosmonautics, as in any complex field. And the problem arose each time—how can the crew survive? There is one answer--they must be trained. "How can you teach someone to survive?" the uninformed person cold ask. "Everyone can survive—the instinct for self-preservation compels it." And he would be wrong! Instinct is instinct, but it is not enough to want, you also have to know how. That is why the special service was created at the TsPK. It is occupied precisely with solving the problems of survival—it tests the means of search, evacuation and special gear, trains the cosmonauts to interact with the manpower and equipment of the search-and-rescue complex and teaches survival under extreme conditions in various climate and geographical zones. The performance of survival simulations, after all, is an important element in ensuring the safety of manned space flight.

Test engineers Viktor Vasilyev, Iosif Davydov, Vladimir Gaydukov and Yuriy Timofeyev and test physicians Vitaliy Znachko and Boris Chirkov (Vasiliy Ozerov, Gennadiy Kasatkin, Nikolay Filatov and Yevgeniy Shustov came later) first started to be engaged in this work more than twenty years ago. They themselves went off to various regions of the country with difficult climatic conditions—how else could they teach others? The training programs and techniques emerged after several such most difficult tests, and the regular training of cosmonauts under real conditions began. What made it useful? First of all, they acquired skills in survival and the maintenance of functionality under extreme conditions as part of fragmented groups and, second, it facilitated a rise in their individual psychological stability and developed cohesion among the crews.

Such exercises were conducted, for example, in August 1990 in the Kara-Kum Desert. The cosmonauts, divided into hypothetical groups (of two or three) and dressed in their protective suits, abandoned their descent craft. Their flight suits, spacesuits, the emergency supplies (NAZ) they carried and parachute canopy were all they had at their disposal. The assignment was to spend thirty-six hours in the desert. And they were not easy to spend, erecting a sun and wind protective structure and correctly distributing their meager food reserves, especially the water (two liters apiece).

There was a safety support group a few hundred meters away to back them up. Test engineers Viktor Shalimov, Viktor Fedorov and Aleksandr Kozlov, test physicians Gennadiy Kasatkin, Nikolay Filatov and Oleg Fedorov and test technicians Vladimir Kosarev, Aleksandr Semenov and Andrey Filiptsev organized and ran a standing medical-assistance post (when necessary).

It is difficult to survive in the desert, but it is no easier to spend two days in uninhabited and difficult-to-reach terrain in winter at temperatures of -40 to -45°C and strong winds. The landing of cosmonauts Aleksandr Viktorenko and Aleksandr Serebrov in February of 1990, for example, took place at an air temperature of -37°C and wind speeds of 10—12 meters/second. Training under those conditions is conducted in the Vorkuta region, at air temperatures below -24°C. The cosmonauts obtain their first skills in classrooms, and only then is a full-scale mock-up of the SA placed in an uninhabited stretch of tundra. Its inner spaces are heated ahead of time to the usual temperature before landing—about 20°C. The cosmonauts in spacesuits then take their places. The suits do not protect against the cold, and thus the crew, having taken them off ahead of time, put on flight and thermal-protection suits and Forel wet suits. After that, of course, they could try and "sit it out" in the descent craft. But the concentration of carbon-dioxide gas reaches a dangerous level in a few hours, and they have to air out their "accommodations" through a hatch. The cold "comes in" with the fresh air, and the SA freezes from the outside.

Suppose time goes by and there are no rescuers. The descent craft has cooled down quite a bit—what should they do? They should get out and construct shelter. Too cold? But you have the parachute fabric at your disposal to warm yourself! It is also possible to be protected from the wind and warm oneself in a hut—a snow "igloo." You can cut snow "bricks" with the machete from which to build the shelter. This is not a simple matter—the snow blocks have to be cut in such a way that they can be laid in an ascending spiral. That is how a dome-shaped structure is erected. It can be built in less than an hour if a crew of three works harmoniously. A trench in the snow covered by the parachute is another method of getting out of the wind. But you also have to know how to do that.

The exercises in the tundra, as in the desert, are quite tough. There are training specialists and physicians nearby, but it is as if they are not—the cosmonauts even carry out radio conversations without reply. One can of course request assistance from the test engineers and physicians, but only in the most extreme cases.

A large portion of the planet, as is well known, is covered by seas, oceans, rivers and lakes, so the likelihood of landing in the water cannot be ruled out. And who knows how much time the crew will have to spend in the water in that case? A few hours, or days? A skilled and knowledgeable cosmonaut is not troubled by a water landing. He calmly determines the fact of a water landing itself according to the characteristic inclination of the SA, the splash of water and, finally, a look out one of the viewing ports. A finely tuned and well-trained crew remembers that if the parachute has been jettisoned properly and nothing threatening happens, they have to stay in the SA, enter into communications according to the cyclogram and wait for the arrival of the rescuers. In other cases they can abandon it in advance if the situation presents itself, and put on the standard rescue kit. This is quite difficult to accomplish due to the small volume of the SA.

Everything has been taken into account, even possible prolonged drifting. The NAZ, along with other useful items, has fishing gear. The ocean can not only feed them, but also provide water for an experienced person. How can fresh water be obtained? Our techniques say, from those same fish. The fish is wrapped in a cloth and wrung dry, and moisture collects in a container. Not the water from home, of course, but suitable to maintain the water-salt balance in the human body. Matters are organized in such a way that the search-and-rescue service should come to their aid in time.

An emergency landing in the mountains is also entirely likely. Our experienced testers Iosif Davydov, Yuriy Timofeyev and Mikhail Konovalov and physicians Gennadiy Kasatkin, Nikolay Filatov and Yevgeniy Shustov thus conducted testing in the Zailiyskiy Altay in the summer of 1986.

They "forced" two crews to land in a clearing above the Tuyuksu mountain base at three o'clock in the morning. The first crew was composed of two-time Heroes of the Soviet Union Pilots and Cosmonauts of the USSR Vladimir Lyakhov and Leonid Popov along with cosmonaut test pilot Sergey Tresvatskiy, and the other of two-time Hero of the Soviet Union Yuriy Malyshev and cosmonaut test pilots Viktor Zabolotskiy and Yuriy Sheffer. The erected a shelter from materials at hand in the complete darkness to spend the night. In the morning, gathering up their gear and improvised backpacks made of parachute fabric, both crews went up the slope—that is what the requirements of the exercise demanded. The cosmonauts broke camp at an altitude of 3,000 meters after a difficult day's march. Here they got to know all the "charms" of the mountain climate. Clouds gathered and rain started by evening. At night it turned to hail, and by morning the camp was buried in snow. The cosmonauts, however, calmly waited out the bad weather in excellent tents they had fashioned from the parachute and other materials at hand. They moreover went on a new march the next morning, to a glacier. It is not in vain that the cosmonaut survival school is in operation...

Listings of Cosmonaut Crews Through June 1992

93UM0419C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 7-9

[Material prepared by S. Yegupov and I. Karpenko under the rubric "By Reader Request"]

[Text] *The journal has published data on the crews of Soviet spacecraft and stations and the additions to the cosmonaut corps of the Air Forces through 1988 inclusive.*

In this issue we are publishing that information as of June 1992, as well as familiarizing you with the additions to the cosmonaut corps of the Energiya NPO [Scientific-Production Association].

The material was prepared by TsPK [Cosmonaut Training Center] imeni Yu.A. Gagarin staffers S. Yegupov and I. Karpenko.

I. Crews of Spacecraft

Crew number	Composition		Call sign	Spacecraft or orbital station	Date and duration of flight
	Principal	Back-up			
1	2	3	4	5	6
66	Aleksandr Stepanovich Viktorenko, Aleksandr Aleksandrovich Serebrov	Anatoliy Yakovlevich Solovyev, Aleksandr Nikolayevich Balandin	*Vityaz*	Soyuz TM-8, Mir	6 Sep 89—19 Feb 90, 166 days
67	Anatoliy Yakovlevich Solovyev, Aleksandr Nikolayevich Balandin	Gennadiy Mikhaylovich Manakov, Gennadiy Mikhaylovich Strekalov	*Rodnik*	Soyuz TM-9, Mir	11 Feb 90—9 Aug 90, 179 days
68	Gennadiy Mikhaylovich Manakov, Gennadiy Mikhaylovich Strekalov	Viktor Mikhaylovich Afanasyev, Musa Khiramanovich Manarov	*Vulkan*	Soyuz TM-10, Mir	1 Aug 90—10 Dec 90, 131 days
69	Viktor Mikhaylovich Afanasyev, Musa Khiramanovich Manarov, Toyohiro Akiyama (Japan)	Anatoliy Pavlovich Artsebarskiy, Sergey Konstantinovich Krikalev, Ryoko Kikuchi (Japan)	*Derbent*	Soyuz TM-11, Mir	2 Dec 90—26 May 91, 175 days; 2 Dec 90—10 Dec 90, 8 days
70	Anatoliy Pavlovich Artsebarskiy, Sergey Konstantinovich Krikalev, Helen Sharman (Great Britain)	Aleksandr Aleksandrovich Volkov, Aleksandr Yuryevich Kaleri, Timothy Mays (Great Britain)	*Ozon*	Soyuz TM-12. Mir	18 May 91—10 Oct 91, 145 days; 18 May 91—25 Mar 92, 312 days; 18 May 91—26 May 91, 8 days
71	Aleksandr Aleksandrovich Volkov, Toktar Ongarbayevich Aubakirov, Franz Vibeck (Austria)	Aleksandr Pavlovich Viktorenko, Talgat Amangeldiyevich Musabayev, Klemenz Lothaller (Austria)	*Donbass*	Soyuz TM-13, Mir	2 Oct 91—25 Mar 92, 175 days; 2 Oct 91—10 Oct 91, 8 days

II. Air Forces Cosmonaut Corps

No.	Military rank, name	Date and place of birth	When left the cosmonaut corps	Current occupation
1	2	3	4	5
9th Recruitment (January 1989)				
1	Major Gennadiy Ivanovich Padalka	21 Jul 58, city of Krasnodar	—	cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
2	Major Yuriy Vladimirovich Onufriyenko	6 Feb 61, town of Ryasnoye, Zolochevskiy Rayon of Kharkov Oblast	—	cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
3	Lieutenant-Colonel Sergey Vladimirovich Krichevskiy	9 Jul 55, city of Lesovodsk, Primorye Oblast	—	cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
10th Recruitment (August 1990)				
1	Major Sergey Yuryevich Vozovikov	17 Apr 58, city of Alma- Ata	—	candidate cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
2	Major Sergey Viktorovich Zaletin	21 Apr 62, city of Shchekino, Tula Oblast	—	candidate cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
3	Captain Salizhan Shakirovich Sharipov	24 Aug 64, city of Uzgen, Osha Oblast	—	candidate cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin
The following journalists were added to the cosmonaut corps for general space training by order of the Air Forces Commander-in-Chief of 19 Sep 90:				
1	Colonel Aleksandr Stepanovich Andryushkov	6 Oct 47, city of Luga	—	mission specialist, newspaper KRASNAYA ZVEZDA
2	Colonel Valeriy Vasilyevich Baberdin	28 Oct 48, city of Sterlitamak	—	mission specialist, newspaper KRASNAYA ZVEZDA
3	Pavel Petrovich Mukhortov	10 Mar 66, settlement of Yelizovo, Kamchatka Oblast	—	mission specialist, newspaper DELOVOY MIR
4	Yuriy Yuryevich Krikun	3 Jun 63, city of Kiev	—	mission specialist, Ukrainian Telefilm film studios
5	Svetlana Oktyabrevna (Yeremeyeva) Omelchenko	20 Aug 51, Ordzhonikidzenskaya Station, Sunzhenskiy Rayon, Chechen-Ingush ASSR	--	mission specialist, newspaper DELOVOY MIR
6	Valeriy Yuryevich Sharov	26 Dec 53, city of Moscow	—	mission specialist, newspaper LITERATURNAYA GAZETA
Additionally enrolled in the cosmonaut corps of the TsPK imeni Yu.A. Gagarin on 6 Mar 91:				
1	Major Talgat Amangeldiyevich Musabayev	7 Jan 51, settlement of Kargaly, Dzhambulskiy Rayon, Alma-Ata Oblast	—	cosmonaut-test pilot of cosmonaut corps of TsPK imeni Yu.A. Gagarin

III. Cosmonaut Corps of Energiya NPO

No.	Name	Date and place of birth	Educational institution and when completed	When left cosmonaut corps	Notes
1	2	3	4	5	6
1964					
1	Konstantin Petrovich Feoktistov	7 Feb 26, city of Voronezh	MVTU [Moscow Higher Technical School] imeni Bauman, 1949	1988	Professor at MGTU
1966					
1	Aleksey Stanislavovich Yeliseyev	13 Jul 34, city of Zhizdra, Kaluga Oblast	MVTU imeni Bauman, 1957	1986	Member of the firm of IBM

III. Cosmonaut Corps of Energiya NPO (Continued)

No.	Name	Date and place of birth	Educational institution and when completed	When left cosmonaut corps	Notes
1	2	3	4	5	6
2	Valeriy Nikolayevich Kubasov	7 Jan 35, city of Vyazniki, Vladimir Oblast	MAI [Moscow Aviation Institute] imeni S. Ordzhonikidze, 1958	—	deputy division chief, Energiya NPO
3	Vladislav Nikolayevich Volkov	23 Nov 35, city of Moscow	MAI imeni S. Ordzhonikidze, 1959	1971	killed while performing a space flight, 30 Jun 71
4	Georgiy Mikhaylovich Grechko	25 May 31, city of Leningrad	Leningrad Mechanical Institute, 1955	1986	laboratory head, Institute of Atmospheric Physics of the Academy of Sciences
5	Oleg Grigoryevich Makarov	6 Jan 33, town of Udomlya, Udomelskiy Rayon of Tver Oblast	MVTU imeni Bauman, 1957	1987	deputy division chief, Energiya NPO
1967					
1	Nikolay Nikolayevich Rukavishnikov	18 Sep 32, city of Tomsk	Moscow Engineering Physics Institute, 1957	1987	deputy division chief, Energiya NPO
2	Vitaliy Ivanovich Sevastyanov	8 Jul 35, city of Krasnouralsk, Sverdlovsk Oblast	MAI imeni S. Ordzhonikidze, 1959	--	cosmonaut-instructor, deputy department chief, Energiya NPO
1968					
1	Viktor Ivanovich Patsayev	19 Jun 33, city of Aktyubinsk	Penza Polytechnical Institute, 1955	1971	killed while performing a space flight
2	Valeriy Aleksandrovich Yazdovskiy	8 Jul 30, city of Yenikayev, Donetsk Oblast	MAI imeni S. Ordzhonikidze, 1954	1983	lead engineer, Energiya NPO
1972					
1	Boris Dmitriyevich Andreyev	6 Oct 40, city of Moscow	MVTU imeni Bauman, 1964	1983	senior scientific associate, Energiya NPO
2	Valentin Vitalyevich Lebedev	14 Apr 42, city of Moscow	MAI imeni S. Ordzhonikidze, 1966	1989	director of a scientific geoinformation center of the Academy of Sciences
3	Yuriy Anatolyevich Ponomarev	24 Mar 32, Nerchenskiy Rayon of Chita Oblast, Kadaya Mine	MAI imeni S. Ordzhonikidze, 1957	1983	lead engineer for sector topics, TsNIIMASh
1973					
1	Aleksandr Sergeyevich Ivanchenkov	28 Sep 40, city of Ivanteyevka, Moscow Oblast	MAI imeni S. Ordzhonikidze, 1964	—	deputy division chief, Energiya NPO
2	Vladimir Viktorovich Aksenov	1 Feb 35, town of Giblitsy, Kasimovskiy Rayon of Ryazan Oblast	All-Union Correspondence Polytechnical Institute, 1963	1988	general director, Planeta NPO
3	Gennadiy Mikhaylovich Strekalov	28 Oct 40, city of Mytishchi, Moscow Oblast	MVTU imeni Bauman, 1965	—	department chief, Energiya NPO
4	Valeriy Viktorovich Ryumin	16 Aug 39, city of Komsomolsk-na- Amure	Moscow Timber Engineering Institute, 1966	1987	deputy general designer, Energiya NPO
1978					
1	Viktor Petrovich Savinykh	7 Mar 40, village of Berezkiny, Borichevskiy Rayon of Kirov Oblast	Moscow Institute of Engineers in Geodesy, Aerial Photography and Cartography [MIIGAIK], 1969	1989	rector at MIIGAIK
2	Aleksandr Aleksandrovich Serebrov	15 Feb 44, city of Moscow	Moscow Physio-Technical Institute, 1967	—	senior scientific associate, Energiya NPO, instructor—cosmonaut-test pilot
3	Aleksandr Pavlovich Aleksandrov	20 Feb 43, city of Moscow	MVTU imeni Bauman, 1969	—	department chief, Energiya NPO

III. Cosmonaut Corps of Energiya NPO (Continued)

No.	Name	Date and place of birth	Educational institution and when completed	When left cosmonaut corps	Notes
1	2	3	4	5	6
4	Vladimir Alekseyevich Solovyev	11 Nov 46, city of Moscow	MVTU imeni Bauman, 1970	—	division chief, Energiya NPO
5	Aleksandr Ivanovich Laveykin	21 Apr 51, city of Moscow	MVTU imeni Bauman, 1974	—	division chief, Energiya NPO
6	Musa Khiramanovich Manarov	22 Mar 51, city of Baku	MAI imeni S. Ordzhonikidze, 1974	1992	vice-president of Smolsat MKhA
7	Aleksandr Nikolayevich Balandin	30 Jul 53, city of Fryazino, Moscow Oblast	MVTU imeni Bauman, 1976	—	cosmonaut-test pilot, Energiya NPO
1980					
1	Irina Rudolfovna Pronina	14 Apr 53, city of Moscow	MVTU imeni Bauman, 1976	1992	staffer at Energiya NPO
2	Svetlana Yevgenyevna Savitskaya	8 Aug 48, city of Moscow	MAI imeni S. Ordzhonikidze, 1972	—	deputy department chief, Energiya NPO
3	Natalya Dmitriyevna Kuleshova	14 Mar 55, new settlement, Odintsovskiy Rayon of Moscow Oblast	MAI imeni S. Ordzhonikidze, 1978	1992	staffer at Energiya NPO
1984					
1	Sergey Aleksandrovich Yemelyanov	3 Aug 51, city of Kamensk- Uralskiy, Sverdlovk Oblast	MAI imeni S. Ordzhonikidze, 1974	1992	staffer at Energiya NPO
2	Aleksandr Yuryevich Kaleri	13 May 56, city of Yurmala, Latvian SSR	MFTI [Moscow Physio-Technical Institute], 1979	—	cosmonaut-test pilot, Energiya NPO
1985					
1	Sergey Konstantinovich Krikalev	27 Aug 58, city of Leningrad	Leningrad Mechanical Institute, 1981	—	cosmonaut- test pilot, Energiya NPO
2	Andrey Yevgenyevich Zaytsev	5 Aug 57, city of Tula	MVTU imeni Bauman, 1980	—	cosmonaut-test pilot, Energiya NPO
1987					
1	Sergey Vasilyevich Avdeyev	1 Jan 56, city of Chapayevsk, Kuybyshev Oblast	MIFI [Moscow Engineering Physics Institute], 1979	—	cosmonaut-test pilot, Energiya NPO
1989					
1	Nikolay Mikhaylovich Budarin	29 Apr 53, settlement of Kirya	MAI imeni S. Ordzhonikidze, 1979	—	cosmonaut-test pilot, Energiya NPO
2	Yuriy Vladimirovich Usachev	9 Oct 57, city of Donestk	MAI imeni S. Ordzhonikidze, 1985	—	cosmonaut-test pilot, Energiya NPO
3	Yelena Vladimirovna Kondakova	30 Mar 57, workers' settlement in Pushkinskiy Rayon of Moscow Oblast	MVTU imeni Bauman, 1980	—	cosmonaut-test pilot, Energiya NPO
4	Aleksandr Fedorovich Poleshchuk	30 Oct 53, city of Cheremkhovo, Irkutsk Oblast	MAI imeni S. Ordzhonikidze, 1977	—	cosmonaut-test pilot, Energiya NPO

Varied Nature of Satellite Ground Control Operations Viewed

93UM0419D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 12-13

[Article by Colonel V. Glebov and Candidate of Technical Sciences Yu. Krichigin under the rubric "In the Space Units": "The People of the TsUP"]

[Text] Automatic spacecraft for meteorological, oceanographic, natural-resources and scientific purposes of the Meteor, Okean, Resurs, Bion and Foton types, as well as automatic all-purpose orbital stations of the Interkosmos type, are constantly in orbit to perform important national-economic and scientific tasks.

The reliability and technological feasibility of controlling satellites depends largely on the level of general and special software of all the interconnected processes—the planning of command-and-control sessions and the reception of all types of information from the spacecraft, ballistic support, the processing and analysis of telemetric data, the formulation of command-program information into a unified bloc and the organization of communications with individual command, control and telemetry (OKI) complexes on the territory of the country.

The satellites are controlled by the personnel of the space units of the Ministry of Defense from the Flight Control Center (TsUP), located in Moscow. The center operates around the clock. The composition of the duty crews, which are staffed by officers, warrant officers and civilian personnel of the Soviet Army, includes specialists for the direct control of the spacecraft and analysis of the state of on-board gear, as well as the gear for the ground control complexes (NKCh) and the receipt of scientific information, the development of operating programs for the spacecraft apparatus and NKCh gear, mathematics, specialists in the processing of telemetric information, ballistics specialists and specialists supporting the operability of the technical equipment of the data-processing system (IVK) of the TsUP.

The control of spacecraft is a complex, multifunctional and continuous process. Non-standard situations can arise both on board the spacecraft (failures of individual systems or non-design operating regimens) and in the operation of the complex technical gear of the ground control complexes, or in the reception of information. The decision on how to get out of a difficult situation frequently has to be made and carried out right during the communications sessions themselves, and the window of visibility of the ground stations usually does not last more than 10- -15 minutes.

Many years are required to train the specialists for the direct control of the spacecraft, for whom an invaluable quality—aside from profound professional knowledge and skills—is psychological stability combined with a promptness of thought and action and an ability not to lose self- possession or confidence in one's knowledge in the most critical situations. Many years of experience in training these specialists shows that only well-developed techniques of theoretical and practical training and a well-thought-out and streamlined system for transmitting experience can have positive results in the succession of generations. Our "controllers," colonels S. Sikalenko and V. Nyunin and lieutenant colonels V. Gorokhov, Yu. Vyrva, S. Makashin, S. Kozhevnikov and many others perform their duty at their posts in confident and reliable fashion.

One continuous process when supporting the functioning of spacecraft is planning the operations of the ground control gear, the on-board support and scientific systems, the communications gear and the data transmissions to the ground control circuits. Profound knowledge of the technical and operational capabilities of the ground control gear and the apparatus on the spacecraft, as well as the gear and channels for data transmission, are required of the "planner" specialists. Their tasks include the gathering of requests for work from consumers of the various types of information, information on the readiness of the ground control gear with a regard for the meteorological and geophysical situation, and the receipt of the orbital characteristics of the satellites from the ballistic centers. The "planner" specialists, on the basis of all of this data regarding the actual state of the on-board gear, develop programs for the operation of the spacecraft on-board gear and the ground control equipment using the technical means of the IVK of the TsUP, which are then entered in the OKI complexes ahead of time on automated channels for transmission to the spacecraft during communications sessions. These tasks are performed with great effectiveness by lieutenant colonels Candidate of Technical Sciences M. Grekhov and D. Alekseyev, along with majors R. Idiatullin and S. Spitsyn.

Continuous control of a spacecraft assumes, first and foremost, the receipt of trustworthy data from it on the functioning of all of its systems, the observance of the stipulated requirements for the orientation and stabilization of the craft and for conformity of the power, temperature, humidity and other parameters to the assigned values. That information comes from the spacecraft on the telemetry transmission and receiving channels to the TsUP, where it is subjected to prompt processing and analysis.

All of the work connected with assessing the status of the spacecraft is performed by the "analyst" specialists. They need an understanding of the operating logic of each system separately and the spacecraft as a whole. Based in their analysis, they develop concrete technical solutions and proposals for conducting the next communications sessions for the flight supervisor. The work performed by the "analysts" requires exceptional attentiveness and punctuality, and the profound and trustworthy analysis of data from the spacecraft under conditions of an acute shortage of time is expected, especially in non-standard situations. These qualities are possessed to the full by, for example, Lieutenant Colonel S. Yakushin and majors Yu. Kharchenko and A. Polevoy.

It is also impossible to manage without the highly skilled specialists of the TsUP—the programmer-mathematicians and data processors. They include mathematicians lieutenant colonels V. Biryukov and V. Mankevich, Major S. Terekhov and civilian employee O. Rudenko.

The IVK, which has its own modern computers, individual and shared display equipment with the necessary special software and a system to provide power and maintain the required temperature and humidity conditions in the facilities, is the heart of the Flight Control Center. The ability of the TsUP to perform the tasks assigned to it depends on the reliable, around-the-clock operation of the IVK. Colonels N. Safiullin and A. Byzhko, lieutenant colonels I. Smetanin and Yu. Chirikov, majors V. Denisov, V. Pulkin and Ye. Ryzhanov and Senior Warrant Officer S. Dvurechenskiy, among others, are true masters of their profession. The common efforts of these specialists also makes it possible to ensure the uninterrupted and precise control of the satellites.

New Koronas Spacecraft to Join Ranks of Solar Explorers

93UM0419E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 14-15

[Article by Colonel A. Pashchenko under the rubric "Cosmonautics for Science": "Both Aristotle and 'Koronas'..."]

[Text] One of the priority scientific tasks being resolved with the utilization of space hardware is researching the sun and the interconnections of the phenomena that occur on that heavenly body and on the Earth (the so-called solar-Earth ties).

Researching the sun, first of all, gives mankind the sole opportunity for the immediate study of the stars, and our knowledge of it could be used in the search for answers to many questions on the evolution of other stars and galaxies.

Secondly, the results obtained in the course of that research facilitate a better understanding of general laws in the realm of the physics of the Earth's atmosphere and biosphere. The idea of links among the processes occurring at the Earth's core, the atmosphere of our planet and its closest "neighbors" in space is not a new one; it was expressed as early as Aristotle. It has already been established in our time that the general state and health of people, yields of agricultural crops, propagation of radio waves and climate and seismic activity of the Earth are all connected with phenomena occurring on the sun. Major scientists from around the world thus defined the necessity of taking solar activity into account when predicting sharp climate changes and earthquakes at the 15th General Assembly of the International Geodesic and Geophysical Union in 1971.

Scientists have already been studying the closest star to us with the aid of the first Earth satellites and automatic interplanetary stations (AMS).

Research on the sun using space hardware comes down to the performance of the basic tasks of determining the chemical composition of the upper layers of the sun and researching the mechanisms for the generation and transfer of energy in them, the formation of solar wind and solar activity. This is accomplished, by and large, with the aid of systematic observations of processes in the photosphere, chromosphere and corona during periods of solar activity.

The solar wind was detected with the aid of the Soviet Luna-1 and Luna-3 AMSs and the American Pioneer-4 that were sent to the moon in 1959. An assumption of the presence of solar particle fluxes had been expressed by the Norwegian scientist Olaf Birkelend as early as 1896. It was only with the use of space hardware, however, that it was possible to establish the nature and mechanism for the formation of that surprising phenomenon. The solar wind is a plasma of the solar corona expanding at a rate of 300—550 kilometers/second, consisting of charged fluxes of electrons and ions with an energy of up to 10 KeV and pierced by flying solar particles of high energy (more than 10 MeV). Streams of particles spiral off the sun as a consequence of its rotation and the unusual activity of processes on its surface, which literally blow the magnetic field of the Earth, giving it the shape of a droplet.

Solar activity is manifested in the form of dark spots, prominences surrounded by flares and active formations in the corona and solar eruptions. These phenomena, complex in and of themselves, are closely connected with each other.

Considerable efforts have been undertaken by many nations in order to study and expand our notions about the sun.

Research has also been conducted in our country using a series of spacecraft in the Kosmos, Elektron and Prognoz series. The American Explorer spacecraft, Pioneer AMS, OSO and OGO orbital solar and astrophysical observatories and the GRO gamma observatory, as well as the Ariel-1 (England), Aeros-1 and -2 and Helios-1 and -2 (FRG), Shinsi and Teio (Japan) and Ariabata (India) spacecraft, have all served the same purpose.

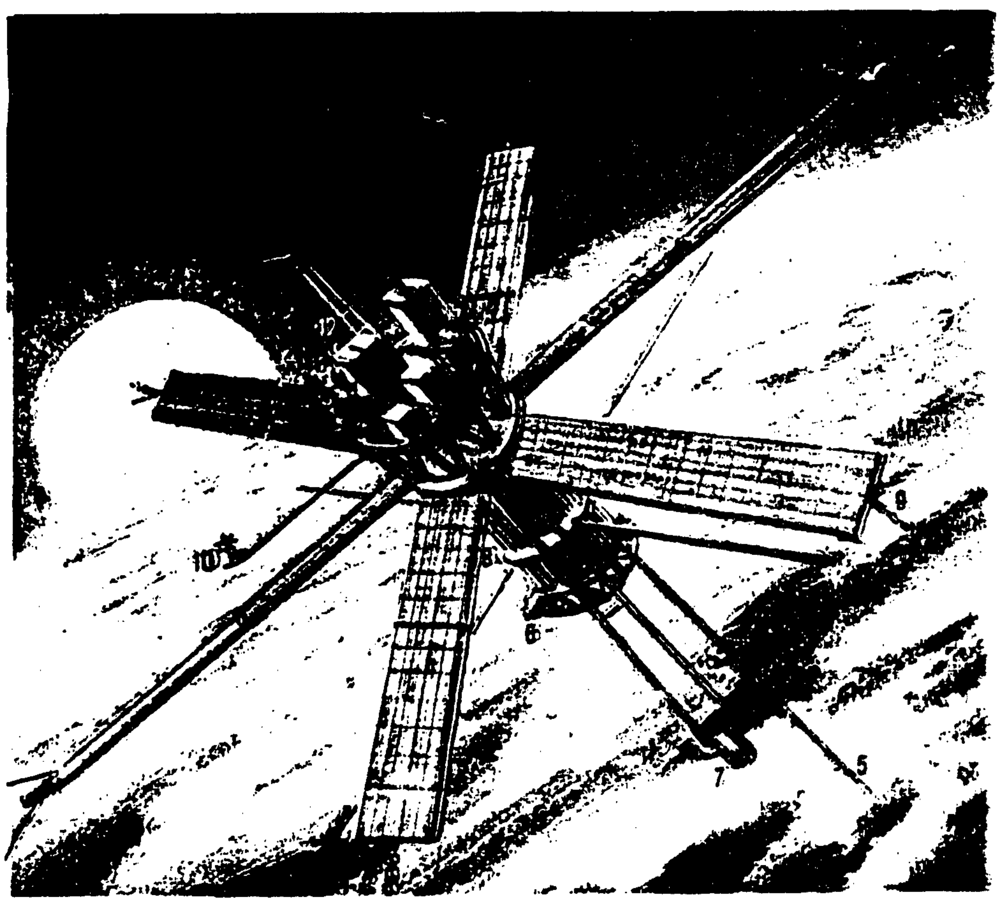
Interested countries are combining their efforts, insofar as the complexity of the development of such projects and the spending on their implementation are constantly increasing. The GEOS-1 and -2 spacecraft were put into highly elliptical orbits around the Earth at the initiative of the European Space Agency, and they were used to determine the intensity and direction of solar particle fluxes over a seven-year period. More than twenty satellites in the Interkosmos series have been launched within the framework of the program of collaboration of the former socialist countries, in order to study the sun and conduct other astrophysical research.

Manned orbital stations (Salyut, Mir, Skylab) are also used along with the automatic spacecraft.

Our Gamma space observatory recorded high-energy (up to 2×10^9 eV) gamma radiation (10^{11}—10^{12} GHz), which has great significance for clarifying the processes of acceleration of charged particles, in solar eruptions for the first time during a flight launched in 1990 and that functioned until February 28 of this year.

A substantial contribution to the science on the sun has been made, and an enormous amount of factual materials on the nature of it and its effects on the environment has been obtained as a whole, over the 20- year period of research using space hardware.

Many of the details of the mechanism of solar activity are still not clear, however, and the composition of the principal factors that determine it have not been fully ascertained; the internal structure of the solar body requires elaboration, and further research on magnetospheric and ionospheric processes is necessary.



Key:
1. special gear
2. external frame for special gear
3. photoelectric array
4. command-program antenna for trajectory radio line
5. antenna for first radio spectrometer
6. electric-field sensor
7. magnetic field sensor
8. sealed container
9. antenna for orbital measurements
10. antenna for radio telemetry gear
11. antenna for second radio spectrometer
12. top of optical instrument for orientation toward the sun.

The Koronas spacecraft is thus planned to be launched in our country for that purpose in 1992 under the program for the International Space Year. It is a standardized platform consisting of a complex of supporting on- board systems and structural elements in which special scientific gear is accommodated. The possibility of altering the configuration of its special gear, depending on the scientific tasks being performed, is one feature of this type of spacecraft.

Specific features of the Koronas spacecraft

Mass, kg	2,300
Mass of the special on-board system, kg:	
—total	720
—including special gear	410
Precision of orientation of spacecraft longitudinal axis to the sun, minutes of angle	no worse than ± 10
Time of active existence	no less than a year
Orbital parameters:	
—height of perigee, km	488
—height of apogee, km	509
—orbital inclination, degrees	82.5
Launch vehicle	Tsiklon
Launch cosmodrome	Plesetsk

The on-board support complex includes command-program apparatus for the trajectory radio line and radio telemetry systems and systems for control, electric power and maintenance of temperature conditions.

The scientific instruments, combined in a special on-board complex, make it possible to perform measurements of solar emissions in various wavelength bands, record the dynamics of active processes in the solar atmosphere and determine the structure and variations of the geomagnetic field connected with active solar processes. That set of apparatus includes telescopes, spectrometers, polarimeters, photometers, a coronograph, a gamma-radiation analyzer and a low-frequency diagnostic system.

The instruments in the special complex operate principally in the illuminated portion of the orbit. They are turned on and off by the control system when entering or leaving the shadow in accordance with the "Shadow" and "Light" commands. Two basic operating modes are envisaged for this gear during flight—the mode of high solar activity and the mode of low solar activity (standby mode). The readout of information and its transmission to the Processing Center are performed up to four times a day in the first mode, and once or twice a day in the second mode.

All nations, of course, have a vested interest in the results of this research—the sun, after all, shines on everyone, as they say. Domestic space science is experiencing far from the best of times today, however, with financial problems, a collapse of cooperation and the drain of highly qualified specialists from the space field.

Space science, as any basic science, is an area of human activity that does not provide immediate returns. Its dividends come in the future. Calculations show that a long-term program for the development of space hardware for national-economic and scientific purposes and in the interests of international collaboration could bring about eight billion rubles of profits, in the face of overall spending of four billion (in 1990 prices).

Wisdom among the leaders of the state is needed as never before when resolving issues connected with the development of space science. The positions we have won in space with such labor will otherwise be lost.

USSR Spacecraft Launches in 1991

93UM0419F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 16-17

[Article by Lieutenant-Colonel S. Vladimirov: "Table of Launches of Spacecraft in the USSR in 1991"]

[Text]

Table of Spacecraft Launches in the USSR in 1991

				Initial orbital parameters:				
Date of launch	Cosmodrome	Craft	Launch vehicle	period of rotation, min	inclination, degrees	maximum altitude, km	minimum altitude, km	Period of ballistic existence, years (or date of end of operation)
1	2	3	4	5	6	7	8	9
14 January	Baykonur	Progress-M6	Soyuz	88.4	51.7	224.0	192.0	(15 Mar 91)
17 January	Plesetsk	Kosmos-2121	Soyuz	88.7	82.6	275.4	176.5	(21 Feb 91)
18 January	Baykonur	Kosmos-2122	Tsiklon	92.8	65.0	432.0	413.0	60
29 January	Plesetsk	Informator-1	Kosmos	104.8	82.9	1,022.0	877.0	1,200
5 February	Plesetsk	Kosmos-2123	Kosmos	104.9	82.9	1,019.0	981.0	1,200
7 February	Plesetsk	Kosmos-2124	Soyuz	89.6	62.9	337.5	193.9	(7 Apr 91)
12 February	Plesetsk	Kosmos-2125	Kosmos	114.4	74.0	1,495.2	1,399.8	9,500
12 February	Plesetsk	Kosmos-2126	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2127	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2128	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2129	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2130	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2131	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
12 February	Plesetsk	Kosmos-2132	Kosmos	115.1	74.0	1,494.8	1,451.6	9,500
14 February	Baykonur	Kosmos-2133	Proton	24 hr 04 min	2.3	35,913.0	35,913.0	1,000,000
15 February	Baykonur	Kosmos-2134	Soyuz	89.5	64.8	330.8	201.4	(1 Apr 91)
15 February	Plesetsk	Molniya-1	Molniya	11 hr 42 min	62.8	89,113.0	471.0	16.5
26 February	Plesetsk	Kosmos-2135	Kosmos	104.6	82.8	1,044.0	944.0	1,200
28 February	Baykonur	Raduga	Proton	23 hr 16 min	1.4	35,029.6	34,958.4	1,000,000
6 March	Plesetsk	Kosmos-2136	Soyuz	90.2	62.9	335.7	256.6	(20 Mar 91)
12 March	Plesetsk	Nadezhda	Kosmos	104.9	82.9	1,030.0	975.0	1,200

Table of Spacecraft Launches in the USSR in 1991 (Continued)

Date of launch	Cosmodrome	Craft	Launch vehicle	Initial orbital parameters: period of rotation, min	inclination, degrees	maximum altitude, km	minimum altitude, km	Period of ballistic existence, years (or date of end of operation)
19 March	Baykonur	Progress-M7	Soyuz	88.4	51.6	229.0	191.0	(7 May 91)
19 March	Plesetsk	Kosmos-2137	Kosmos	94.0	65.9	494.6	447.9	60
22 March	Plesetsk	Molniya-3	Molniya	11 hr 41 min	62.8	39,082.0	468.0	14.5
26 March	Plesetsk	Kosmos-2138	Soyuz	89.6	67.2	369.3	175.1	(24 May 91)
31 March	Baykonur	Almaz- 1	Proton	88.7	72.7	280.0	170.0	—
4 April	Baykonur	Kosmos-2139	Proton	11 hr 16 min	64.8	19,158.0	19,138.8	1,000,000
4 April	Baykonur	Kosmos-2140	Proton	11 hr 16 min	64.8	19,158.0	19,138.8	1,000,000
4 April	Baykonur	Kosmos-2141	Proton	11 hr 16 min	64.8	19,158.0	19,138.0	1,000,000
16 April	Plesetsk	Kosmos-2142	Kosmos	105.0	83.0	1,031.0	983.0	1,200
24 April	Plesetsk	Meteor- 3	Tsiklon	109.5	82.6	1,229.0	1,190.0	520
17 May	Plesetsk	Kosmos-2143	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
17 May	Plesetsk	Kosmos-2144	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
17 May	Plesetsk	Kosmos-2145	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
17 May	Plesetsk	Kosmos-2146	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
17 May	Plesetsk	Kosmos-2147	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
17 May	Plesetsk	Kosmos-2148	Tsiklon	114.2	82.6	1,444.0	1,414.0	10,000
18 May	Baykonur	Soyuz TM-12	Soyuz	88.5	51.6	231.0	201.0	(10 Oct 91)
21 May	Plesetsk	Resurs- F	Soyuz	88.8	82.3	274.0	194.0	(19 Jun 91)
24 May	Plesetsk	Kosmos-2149	Soyuz	89.7	67.2	377.4	175.8	(4 Jul 91)
30 May	Baykonur	Progress M-8	Soyuz	88.6	51.6	248.0	191.0	(18 Jun 91)
4 June	Plesetsk	Okean	Tsiklon	97.8	82.5	679.1	651.6	60
11 June	Plesetsk	Kosmos-2150	Kosmos	100.8	74.1	823.0	785.0	120
13 June	Plesetsk	Kosmos-2151	Tsiklon	97.8	82.5	676.0	648.0	60
18 June	Plesetsk	Molniya-1	Molniya	12 hr 16 min	62.6	40,824.9	457.0	16.5
28 June	Plesetsk	Resurs- F	Soyuz	88.8	82.3	269.2	191.6	(21 Jul 91)
2 July	Baykonur	Gorizont	Proton	23 hr 50 min	1.5	35,672.4	35,672.4	1,000,000
9 July	Plesetsk	Kosmos-2152	Soyuz	88.7	82.3	265.5	188.2	(23 Jul 91)

Table of Spacecraft Launches in the USSR in 1991 (Continued)

				Initial orbital parameters:				
Date of launch	Cosmodrome	Craft	Launch vehicle	period of rotation, min	inclination, degrees	maximum altitude, km	minimum altitude, km	Period of ballistic existence, years (or date of end of operation)
10 July	Baykonur	Kosmos-2153	Soyuz	89.0	64.9	292.1	191.6	(8 Aug 91)
23 July	Plesetsk	Resurs- F	Soyuz	88.7	82.3	261.5	194.9	—
1 August	Plesetsk	Molniya-1	Molniya	12 hr 17 min	62.9	40,681.5	652.8	16.5
15 August	Plesetsk	Meteor- 3	Tsiklon	109.4	82.6	1,219.0	1,196.0	520
21 August	Baykonur	Progress M-9	Soyuz	88.6	51.6	246.0	192.0	(30 Sep 91)
21 August	Plesetsk	Resurs- F	Soyuz	88.8	82.3	271.7	195.3	(20 Sep 91)
22 August	Plesetsk	Kosmos-2154	Kosmos	105.0	82.9	1,021.1	990.6	1,200
29 August	Baykonur	IRS- 1B	Vostok	102.8	99.2	929.0	861.0	—
13 September	Baykonur	Kosmos-2155	Proton	23 hr 56 min	1.3	35,850.0	35,850.0	1,000,000
17 September	Plesetsk	Molniya-3	Molniya	12 hr 17 min	62.7	40,859.0	464.0	14.5
19 September	Plesetsk	Kosmos-2156	Soyuz	89.6	67.1	368.9	175.8	(17 Nov 91)
28 September	Plesetsk	Kosmos-2157	Tsiklon	114.0	82.6	1,433.0	1,392.0	10,000
28 September	Plesetsk	Kosmos-2158	Tsiklon	114.0	82.5	1,437.0	1,399.0	10,000
28 September	Plesetsk	Kosmos-2159	Tsiklon	114.0	82.6	1,437.5	1,401.0	10,000
28 September	Plesetsk	Kosmos-2160	Tsiklon	114.0	82.5	1,437.0	1,408.0	10,000
28 September	Plesetsk	Kosmos-2161	Tsiklon	114.0	82.5	1,442.0	1,409.0	10,000
28 September	Plesetsk	Kosmos-2162	Tsiklon	114.0	82.6	1,444.0	1,410.0	10,000
2 October	Baykonur	Soyuz TM-13	Soyuz	88.7	51.7	252.0	202.0	—
4 October	Plesetsk	Foton	Soyuz	90.6	62.8	416.8	222.7	(20 Oct 91)
9 October	Baykonur	Kosmos-2163	Soyuz	89.3	64.8	331.0	174.0	(6 Dec 91)
10 October	Plesetsk	Kosmos-2164	Kosmos	94.5	74.0	720.0	290.0	—
17 October	Baykonur	Progress M-10	Soyuz	88.6	51.6	245.0	190.0	—
23 October	Baykonur	Gorizont	Proton	24 hr 07 min	1.4	36,005.0	35,998.0	1,000,000
12 November	Plesetsk	Kosmos-2165	Tsiklon	113.8	82.6	1,434.3	1,385.1	10,000
12 November	Plesetsk	Kosmos-2166	Tsiklon	113.8	82.6	1,435.8	1,391.7	10,000
12 November	Plesetsk	Kosmos-2167	Tsiklon	113.9	82.6	1,435.7	1,396.6	10,000
12 November	Plesetsk	Kosmos-2168	Tsiklon	114.0	82.6	1,438.2	1,402.1	10,000

Table of Spacecraft Launches in the USSR in 1991 (Continued)

				Initial orbital parameters:				
Date of launch	Cosmodrome	Craft	Launch vehicle	period of rotation, min	inclination, degrees	maximum altitude, km	minimum altitude, km	Period of ballistic existence, years (or date of end of operation)
12 November	Plesetsk	Kosmos-2169	Tsiklon	114.1	82.6	1,441.3	1,409.7	10,000
12 November	Plesetsk	Kosmos-2170	Tsiklon	114.1	82.6	1,443.3	1,414.7	10,000
20 November	Plesetsk	Kosmos-2171	Soyuz	89.6	62.8	342.8	195.8	—
22 November	Baykonur	Kosmos-2172	Proton	24 hr 22 min	1.4	36,340.0	36,297.0	1,000,000
27 November	Plesetsk	Kosmos-2173	Kosmos	104.8	83.0	1,030.3	965.2	1,200
17 December	Baykonur	Kosmos-2174	Soyuz	89.6	64.9	331.0	204.0	—
18 December	Plesetsk	Interkosmos-25	Tsiklon	121.7	82.6	3,083.0	440.0	—
19 December	Baykonur	Raduga	Proton	24 hr 33 min	1.4	36,569.0	36,431.0	1,000,000

Notes:

1. **Progress M-6, 7, 8, 9, 10**—automatic freight craft. The purpose of the launch was to deliver consumables and various freight to the Mir orbital station.

2. **Kosmos**—the name of a series of artificial Earth satellites that have been regularly launched from the country's cosmodromes (starting on 16 Mar 62). Their missions include studying the concentration of charged particles in the ionosphere with the aim of researching the propagation of radio waves, particle fluxes and low-energy particles, the energy composition of the Earth's radiation belts in order to assess the radiation hazard for prolonged space flights, the processes of adaptation to weightlessness, the primary composition of cosmic rays and variations in their intensity, the Earth's magnetic field, shortwave emissions of the sun and other heavenly bodies, the upper layers of the atmosphere, the effects of meteoric matter on the structural elements of objects in space; research in space materials science, determining the effect of the factors of space flight on living organisms, the receipt of up-to-the-minute information on the natural resources of the Earth in the interests of various sectors of the national economy and the international community; working out elements and apparatus for a space navigational system (being created for the purpose of supporting the determination of the location of aircraft and ships), experimental apparatus intended for a system to determine the location of stricken ships and aircraft, an experimental apparatus for the relay of telegraph and telephone information, equipment, assemblies and structural elements of satellites in various flight modes, including joint; and, the receipt of up-to-the-minute information and continuation of the processing of new types of information-measuring apparatus and methods of remote research of the Earth's surface and atmosphere and the world's oceans in the interests of various sectors of the national economy, science and international collaboration. The Kosmos-2139—Kosmos-2141 satellites are part of the Glonass global navigational system, intended for the determination of the positions and speeds of civil aircraft and maritime vessels.

3. **Informator-1**—a satellite intended for the creation of a net for the prompt exchange of geological and geophysical information among sources of primary information and centers for its analysis and processing.

4. **Molniya-1**—a communications satellite intended to support the operations of long-range telephone and telegraph radio communications, as well as the transmission of the programs of Central television to points on the Orbita network.

5. **Raduga**—a communications satellite. Multiple-trunk relay gear has been installed on board supporting a further expansion of telephone and telegraph radio communications across the territory of the country.

6. **Nadezhda**—a navigational satellite intended for the determination of the location of vessels in maritime and fishing fleets, as well as for operation as part of the International Space System for the search and rescue of stricken vessels and aircraft (SARSAT)

7. **Molniya-3**—a communications satellite (a further upgrading of the Molniya-1 and Molniya-2 communications satellites) to support the operations of long-range telephone and telegraph communications, transmissions of the programs of Central Television to points on the Orbita network and international collaboration.

8. **Almaz-1**—a satellite intended for all-weather radar sounding of the surface of the Earth and the world's oceans.

9. **Meteor-3**—a satellite intended for the receipt of hydrometeorological information, as well as information on the radiation situation in near-Earth outer space and the state of the ionosphere, in the interests of the national economy and international collaboration.
10. **Soyuz TM-12, 13**—an improved spacecraft intended for the delivery of crews to modular-type multipurpose manned systems. New systems for convergence and docking, radio communications and emergency rescue, as well as a new combined engine and parachute system, have been installed on the craft.
11. **Resurs-F**—a satellite intended for the performance of variable-scale, multiple-zone and spectrozonal photography for the purpose of conducting research on the Earth's natural resources in the interests of various sectors of the national economy and the accomplishment of tasks in ecology and international collaboration.
12. **Okean**—a satellite with on-board mechanical-optical and radiophysical scanning apparatus for obtaining up-to-the-minute oceanographic information and data on the ice situation in the interests of various sectors of the national economy and international collaboration.
13. **Gorizont**—a communications satellite to support around-the-clock long-range telephone and telegraphic radio communications and the transmission of radio programs to stations of the Orbita and Moskva systems, as well as for use in the Intersputnik international system of satellite communications.
14. **IRS-1B**—a satellite intended for the remote sounding of the Earth (research of natural resources) using electro- optic gear.
15. **Foton**—a satellite intended for the performance of research on space materials science. The flight program envisages the performance of experiments to obtain crystals of proteins and semiconductor materials with improved properties under microgravitational conditions, as well as the run-through of the technology for their experimental commercial production. Scientific- research gear from the National Center for Space Research of France is also accommodated on the satellite.
16. **Interkosmos**—a satellite intended for performing space experiments in researching the effects of artificial influences of modularized electron and plasma pulses on the Earth's ionosphere and magnetosphere.

Some 83 spacecraft in all launched into orbit, including Kosmos-2125—Kosmos-2132, Kosmos-2139—Kosmos-2141, Kosmos-2143—Kosmos- -2148, Kosmos-2157—Kosmos-2162 and Kosmos-2165—Kosmos-2170 by one launch vehicle.

Development History of MiG-25 Aircraft

93UM0419G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 18-21

[Article by Yu. Polushkin under the rubric "Domestic Aviation Hardware": "The MiG-25: Through the 'Thermal Barrier'"]

[Text] At the end of the 1980s, the country's PVO [air defenses] faced the task of defending the airspace against the high-altitude and high-speed aircraft being developed at the time in the United States and Great Britain—the B-70, B-58, Victor, Vulcan and Valiant bombers, the U-2 and Canberra reconnaissance aircraft and cruise missiles of the Hound Dog type. The fact is that the air-defense missiles of the time had short range—a few dozen kilometers—and the defense of the borders and the extensive territories within the country thus required a supersonic fighter interceptor with a supersonic flight range of more than 500 km [kilometers], powerful on-board radar and long-range air-to- air missiles.

Proposals to create such an aircraft (code number Ye-155) and, based on it, a high-altitude reconnaissance aircraft were prepared at the very beginning of the 1960s. The decision on the design engineering, building and testing of the experimental aircraft was made in February 1962. The basic coordination of the developers was affirmed at the same time. The use of existing work in progress to the maximum possible extent was envisaged, including at the Mikoyan OKB [Experimental Design Bureau], using the Ye-150, Ye-152 and Ye-152M with the R-15-300 engine, which could fly briefly at altitudes of more than 20 km at high speeds; the Smerch on-board radar set, developed for the Tu-128 long-range interceptor; semi-active missile homing heads; the Lazur on-board guidance vectoring gear; and, means of radio communications, identifying national affiliations and radio navigation.

All of this made it possible to focus basic attention on resolving the main tasks—working out a new aerodynamic configuration and creating a design able to function at temperatures of 200—300°C, caused by its heating in prolonged flight at high supersonic speeds (surmounting the "thermal barrier").

It was necessary to convert to a design using steel and titanium. Welded structural tanks of VNS-2 and VNS-5 formed the basis of the fuselage and the wings. Only the low-load elements were manufactured of duralumin alloys. New grades of materials for the canopy glass, rubber items, paints and sealants were also required.

The creation of the MiG-25 forced a technological retooling of both the experimental plant and the Nizhnegorod Aviation Association, where the aircraft was series produced until 1985. Technological processes of machining new types of steel, titanium and duralumin alloys, non- metallic materials, highly automated welding processes and the heat treatment of large structural elements without deformations and internal stresses were all assimilated therein, and a great deal of work was performed to ensure a long service life and service lives for the design elements, as well as to provide for repairs under field conditions.

Eleven interceptors, four reconnaissance aircraft and one airframe were built to perform the testing.

OKB Chief Test Pilot A. Fedotov took the first experimental aircraft (it was a reconnaissance aircraft, even though it had no reconnaissance equipment on it, with plant serial number Ye-155R-1) up on 6 Mar 67.

Vertical fins with increased area were installed during the course of flight testing to increase lateral stability and controllability (extra fuel tanks were installed in the tail fins on the reconnaissance aircraft), and differential control of the stabilizer was introduced. This led to the rejection of "foot fins" at the wing tips on the first interceptor and non-jettisonable external fuel tanks with extensive vertical empennage (at the wing tips) on the first reconnaissance aircraft, along with an increase in the indicated airspeed to 1,300 km/hr.

State testing of the reconnaissance aircraft was completed in 1969, and its series production began. The interceptor went into series production a year later.

Two versions of the MiG-25 were initially planned to be produced—a photo reconnaissance aircraft with three sets of photographic gear installed in removable hatches in the nose portion of the fuselage (for general photo reconnaissance with a scan strip of 90 km; detailed photo reconnaissance with high resolution capacity but a narrow band for photographing; and, photo reconnaissance at night and in twilight with the simultaneous installation of the SRS-4A and SRS-4B electronic surveillance gear), and an electronic surveillance aircraft (MiG-25RBK).

Another version was assigned in 1965—the MiG-25RBS. The electronic surveillance gear on it was subsequently replaced with more modern gear. The replacement of the SRS-4A and SRS-4B sets with the SRS-9, and then with even more modern ones, was thus performed in order to expand the range of wavelengths of the radars being scanned, types of operating modes (pulse, continuous and with adjustment of emitting frequency), along with the incorporation of more advanced types of recording.

The retrofitting of the MiG-25 reconnaissance aircraft into reconnaissance/bomber aircraft was performed in 1970 for high-precision strikes against targets at assigned geographical coordinates. Four FAB- 500M-62 high-explosive bombs with a total mass of 200 tonnes were suspended under the wings from the racks for the 100-kilogram photoflash bombs in the first stage of their testing. The racks were later moved under the fuselage, and the quantity was increased to six. The last variation had ten bombs with an overall mass of five tonnes (six under the fuselage and four under the wing on tandem racks). The Peleng navigational system was modified in order to increase bombing precision, and a high-precision inertial navigation system was introduced into its configuration. The increased area of the upper panel of the air intake made it possible to preserve maximum altitude despite the increased mass of the bomb load and frontal resistance.

A serious upgrading of the MiG-25P interceptors and R-40 missiles was undertaken in the second half of the 1970s. The aircraft received the improved Sapfir-25 on-board radar gear, infrared radar, IFF gear, a command vector line, communications gear, a radio compass and other equipment. The possibility of installing two R-60 (R-60M) close-range air-to-air missiles in place of the R-40 of the external hangers was also provided. The output of the MiG-25PD aircraft at the Nizhnegorod Aviation Plant began in 1978, and the MiG-25P aircraft that had been produced earlier were retrofitted at aircraft repair plants two years later. Those equipped with the Sapfir-25 radar received the designation MiG-25PDS.

An experimental prototype of an aircraft for PVO penetration—the MiG- 25BM—was created on the basis of the reconnaissance/bomber aircraft at the very end of the 1970s. It was equipped with powerful EW gear and air-launched antiradar missiles. The bombing armament was retained, and the photographic gear was removed. This version was successfully tested and series produced from 1982 through 1985.

Dual trainers—the twin-seat MiG-25PU and MiG-25RU trainers—were also being operated along with the aircraft for basic applications starting in the middle of the 1970s.

The MiG-25 was executed according to a unique aerodynamic configuration with an advanced fuselage, a high-mounted tapered wing and a twin-fin vertical empennage. The engines are located side by side in the tail unit, with lateral air intakes that can be adjusted in flight depending on the Mach value using a horizontal wedge and lower lip panel. The adjustable nozzles are located next to each other.

The landing gear is original in design, with complex kinematic main struts that are retracted into the fuselage, to which are attached controllable all-moving stabilizers and air brakes. Underneath is a jettisonable fuel tank with a capacity of 5,300 liters.

The fuselage consists of a nose cowling whose forward portion is the fairing for the on-board radar set, a nose portion (cockpit and the equipment compartments surrounding it from front, sides and bottom), the main frame section and tail section. The cockpit is airtight and has a heat-resistant canopy. The KM-1M ejection seat provides for saving the pilot across the whole range of altitudes and speeds.

The middle portion is structural tanks welded from stainless steel through which the air-intake ducts pass. Ventral fins have been installed under the tail section, and a fairing holding the braking chute is on top. The wing is a twin-spar welded structural tank and is mounted at a negative transverse V angle in relation to the fuselage. The leading edges, ailerons and aerodynamic surfaces are manufactured of duralumin alloys using a honeycomb soldered design.

The power plant provides for reliable operation across a broad range of Mach numbers and flight altitudes. The power plant includes R-15B-300 low-pressure turbojet engines with afterburners designed by the OKB of A. Tumanskiy, with adjustable air intakes and systems for fuel pumping, fuel measurement and filling of the fuel tanks with inert gas. R-15BD- 300 engines, which are distinguished by the design of the accessory drive assembly, were installed on the MiG-25PD and MiG-25PDS aircraft.

The Smerch-A on-board radar set or modifications of it are the principal element in the on-board equipment configuration of the interceptors. It supports target detection either autonomously or by target designation from the ground, and later automatically performs the operations of target lock-on, homing to the missile launch zone and issue of target designations to the homing heads. The "breakoff" command is issued in the event of a danger of collision with the target.

The Sapfir-25 radar that replaced the Smerch can detect targets at ranges of more than a hundred kilometers, and has greater capabilities for detecting them against the ground. The MiG-25 long had no analogues in the extent of automation, performance of the mission of interception of airborne targets, flight on an assigned heading, return to the airfield for landing and entry into landing approach to an altitude of 50 meters. The Polet-1I system plays a large role in the automation of the aircraft, and consists of electronic gear for navigation and landing approach, heading and attitude indication, systems for airborne signals and automatic control. The latter includes links with the radar and vectoring gear, thanks to which vectoring to the target is accomplished in automatic or directed (semi-automatic) modes. The modes of gain in altitude and assigned Mach number, stabilization of flight altitude or Mach number, reduction to horizon and stabilization of heading, pitch and bank angles are supported autonomously. There is also a system to limit the maximum G-forces and angle of attack.

The reconnaissance aircraft have surveillance gear installed instead of the radar, including a photographic system that is unique in scan field resolution capacity. An inertial system with radio correction with an on-board computer included in the automatic flight-control circuitry was created in the country for the first time.

The armaments of the interceptor consist of four R-40 missiles or two R- 40 and four R-60 (R-60M) missiles. The R-40 missiles were specially developed for the MiG-25 aircraft, and were produced in two versions—the R-40R with a semi-active radar homing head, and the R-40T with a thermal seeker. The R-40 missiles may be employed across the whole range of flight speeds and altitudes, and support all-aspect attacks on targets. The ballistic launch range approaches 100 km, although it is 65 km against a bomber-type target due to limitations in the missile apparatus.

The reconnaissance aircraft may employ both 500-kg HE aerial bombs and smaller-caliber photoflash bombs. The MiG-25BM can carry either four antiradar missiles or bombs like the MiG-25RB.

The transition to a new aerodynamic configuration, high level of flight automation and presence of an on-board computer were the characteristic traits of the new, second-generation supersonic aircraft of which the MiG-25 was the first representative in this country.

MiG-25 aircraft are in service with the armed forces of the CIS, as well as in Algeria, Bulgaria, India, Iraq, Libya and Syria. They have been used in armed conflicts in the Near East.

Quite a bit of experimental work has been performed using the MiG-25, on new engines and an aerial refueling system in particular. The MiG-25, for instance, had R-15BF-2-300 engines, which are interchangeable with the series-production models. They are typified by greater thrust and better economy, thanks to which the aircraft had better flight range, acceleration and maximum altitude; it had the prospect (with the completion of measures to increase the thermal resistance of the airframe) to increase flight speed to approximately 3,500 km/hr. The engine was not put into series production, however, owing to difficulties that arose in connection with the lack of free capacity for production and the manufacture of tooling.

Article 99 was the MiG-25 aircraft with the PS-30F6 engines from the OKB of P. Solovyev. Bypass engines with great thrust, they were to have provided for increased range—especially in subsonic modes—and acceleration. The flight range surpassed 3,000 km without an external tank. The aircraft was effectively turned into a flying laboratory for designing the power plant of the MiG-31, however, to whose testing a great deal of attention was being devoted at the time.

A system of aerial refueling was successfully developed on several MiG- 25s at the end of the 1980s and proposals were prepared to retrofit the series aircraft, but it was never done owing to limitations on the number of tankers for PVO aviation and the reconnaissance units of frontal aviation.

Versions for various purposes, including a supersonic administrative aircraft (for the transport of several passengers), were designed on the basis of it.

The general designers A. Mikoyan and R. Belyakov made a large contribution to the creation of the MiG-25. The development of the project at the stage of technical proposals was headed by M. Gurevich and N. Matyuk. The latter has been an irreplaceable chief designer of the aircraft for 30 years, since the stage of preliminary design. His deputies were L. Shengelaya and V. Syrovoy. The most difficult flights were made by test pilots A. Fedotov, P. Ostapenko, A. Fastovets, O. Gudkov, A. Bezhevets and I. Lesnikov.

There were 29 world records—14 of which have not yet been broken—set by the MiG-25, MiG-25M and MiG-25PU (Ye-266, Ye-266M and Ye-133 respectively) aircraft.

Principal Tactical-Performance Data of the MiG-25 Aircraft

Engines	R-15B-300 (R-15BD-300)
Engine thrust with afterburners (M = 0, H = 0), kgf	2 x 11,200
Wing area, m^2	61.4
Normal takeoff mass (MiG-25P with 4 x R-40), kg	37,000
Maximum takeoff mass (MiG-25RB with five tonnes of bombs), kg	41,200
Top flight speed, km/hr:	
at ground	1,200
at altitude	3,000
Service ceiling, meters:	
MiG-25P with missiles	20,700
MiG-25R	23,000
Flight range, km:	
at supersonic speeds at Mach 2.35:	
—MiG-25P with 4 x R-40	1,250
—MiG-25R with external tanks	2,130
at subsonic speeds:	
—MiG-25P with 4 x R-40	1,730
—MiG-25R with external tanks	2,400
Landing speed, km/hr	290
Separation speed, km/hr	360
Takeoff run, meters	1,250
Landing runout with braking chute, meters	800

Case Made for Artificial Intelligence Systems on Combat Aircraft

93UM0419H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 30-31

[Article by Candidate of Military Sciences Colonel (Reserve) Vladimir Kirillovich Babich under the rubric "Combat Training: Experience, Problems, Opinions": "Artificial Intelligence at the Service of the Pilot"]

[Text] *Only aircraft equipped with elements of artificial-intelligence systems, computer devices with stores of knowledge and the logical "reasoning" of a highly skilled specialist not subject to stress are counted among fourth-generation aircraft abroad. It is assumed that "computer intelligence" will penetrate deeply into spheres of mental activity of the pilot that were recently considered to be "off limits" to it. What has brought about the incursion of electronics into the realm of heuristic thinking in military aviation?*

We think the answer to that question can be provided by a series of articles under the overall title of "Artificial Intelligence at the Service of the Pilot," which is opened by Candidate of Military Sciences Colonel (Reserve) Vladimir Kirillovich Babich.

1. The Lessons of Local Wars

The armed conflicts that have repeatedly rocked the world in the last several decades were a tough tryout for the opposing sides in the operational tactics of their aviation, newly developed methods of training flight personnel, the combat qualities of the aviation hardware, the lethal capabilities of the weaponry and the merits of the means of command, control and support that were employed.

The aviation of the warring countries suffered appreciable losses at the same time. Specialists relegate some of them to objective losses, that is, inevitable in any armed conflict, but most were considered to be "little justified," being the consequence of the making of erroneous decisions when planning and carrying out combat assignments.

Analysis of information received has made it possible to arrange the causes of the "little justified" losses into "priority" order. The incompetent or untimely making of decisions of a tactical nature proved to be in first place. The conclusion suggested itself, in accordance with established views, that the training of flight and supervisory personnel was poor and the experience that is accumulated, it was felt, only under enemy fire was lacking. More profound study of the problem, however, revealed other general features that pointed to the presence of solid links between the level of development of the combat hardware, the capabilities of the person and nature of the military activity.

The basic forms of combat operations in aviation—strikes and aerial combat—altered their substance quite quickly "in reply" to technical progress, and the stages of it were "compressed" in time to the utmost. All-aspect short- and medium-range missiles, for example, began to be employed along with cannons, and individual and group means of electronic warfare (EW) were comprehensively utilized, requiring the introduction of immediate corrections to the theory and practice of aerial battle.

The crews, withstanding an already intense pace of activity in a combat situation, with time came to be "overloaded" with additional work with the equipment. New on-board sighting and navigational systems with a host of sensors had "access" to the pilot's cockpit, filling it with images and control devices. There were seven to nine buttons and switches on the aircraft and engine controls! In battle, after all, especially at medium ranges, an enemy could begin and end a missile attack on a target from any direction, even without making visual contact with it. The necessity of close interaction among crews came into conflict with the steady trend toward the break-up of the battle formation, as did the requirement for continuous command and control with its increased cycles (formulation of commands—sending them "down"- -execution—report—command). The increased pace of battle did not conform to the volume of information raining down on the pilot with his limited "processing" capabilities.

Mental processes that are connected with the need to perform an instantaneous analysis of the situation, evaluate the possible variations of actions, predict and plan were all added to the exhausting physical labor of the pilot in a maneuvering combat flight.

Only recently have military scholars unexpectedly established that the intellectual burdens experienced by an aircraft crew in a combat flight have never been measured. The threshold limits, at which interpretation of the external situation and the making of the correct decisions becomes difficult, had also not been researched. It was allowed that the pilot could become physically tired (after a 20-minute low-altitude flight, for instance), but not mentally. The problem of the thinking of the aerial warrior had also not been studied, although writers had often called battle a struggle of the minds. The "alarm bell" from the experience of local wars thus sounded a desperate call to action.

Experts have determined that three "levels" take part in an aerial battle: the pilot, his commander and the operator of the command-and- control station. Each of them has certain duties. These "levels" are united in the process of a battle (or execution of a strike) by cause-and-effect ties, and imprecision in the actions of one is thus transformed into an error by the next and leads to fateful consequences for the third.

An analysis of the use of aviation in local conflicts has shown that combat losses due to incorrect (or late) decisions by the pilot, command or operator are roughly equal. It has been noted that the pilot made incorrect decisions most often due to his own lack of combat experience. It is well known that roughly half of the overall losses suffered in an operation or battle come in the first ten combat sorties. A pilot who gets across that threshold adapts to the situation, gains the required reactions and is able not only to repeat the maneuvers of the lead man, but also to incarnate his tactical intent. The wingman was shot down in most cases after he "broke away" from the formation and was left alone, without support on the part of his lead man.

The commander of a group—who already has the experience of the first ten flights, as a rule—possessed sufficient skills to orient himself accordingly in situations that arise. Some of his attention is freed up through his rapid reactions to make well-founded decisions. The piloting still had to be combined with leading the group, however, whose crews had been assigned various functions in accordance with plans developed earlier.

The arrival in the arena of third-generation jet fighters equipped with long-range guided weaponry made it possible to achieve a turning point in the aerial duel, thanks to the effective missile strikes of one or two aircraft. Other crews were preparing such an attack, however, whose tasks were defined by the commander leading the strike group as "demonstrative" or "distracting." He brought auxiliary forces into battle by his decision, where necessary clarifying the intent of the battle, and after its completion he gathered the crews into a common battle formation and organized mutual cover...

The field of activity of the commander broadened considerably to the extent of the arrival in the line units of new generations of aircraft and armaments. The difficulties of combat command and control were supplemented with the complexities of organizing tactical (fire) interaction. Technical assistance was required in order to coordinate the efforts of groups (crews) for various tactical purposes dispersed across the airspace, but only a radio—most often jammed by the enemy—remained at the disposal of the commander. The percentage of incorrect organizational decisions made by group leaders was thus increasing steadily as a result.

The operator differed in his activity from the other two "levels" in that he was not occupied with piloting an aircraft or aiming a weapon. His duties in controlling an airborne group of fighters (or bombers) ended after the detection of the assigned target by the group leader. The information field of the operator was much greater in dimensions than the zone of possible search of the commander, but his assessment of the situation was made according to a small indicator with the blips of aircraft moving across it. The two-dimensional depiction was converted in his head into a three-dimensional one so as to gain a clear conception of the disposition of forces and, by adapting to it, to manage the air traffic. His conditions for making decisions thus proved to be no less complex than those of the leader of the group of aircraft. The operator frequently "got mixed up" in the ever more complicated situation and was late in issuing the next command, while the enemy meanwhile had been able to take up an advantageous position and seize the initiative in an aerial battle.

Those decisions, out of the quite broad set of erroneous ones that lead to fatal consequences, that are connected with the assessment of the situation and the entry of reserves into battle were singled out.

The following conclusions were thus formulated from the lessons of employing aviation in local wars:

—first, the pilot and crew of an aircraft have long since exhausted their "human" capabilities to assess the situation—the pace of the development of situations in the air has come to contradict the ability of the human mind to process the information and realize the decision made;

—second, the process of automation of professional activity that has begun has encompassed only the working processes of its lower level connected with choosing weaponry, aiming it, monitoring the operation of aircraft systems and the like. But aircraft, stuffed with automated systems and expensive EW equipment, take off and often do not return to base only due to the fact that the commanders have made an incorrect decision even before entry into battle, that is, long before the choice of weaponry and aiming; and

—third, a "stagnation" has been noted in the search for new tactics. The choice of a variation for action under combat conditions is made from a large number of those worked out in advance. There were always more than two of them, but fewer than twenty (there was no need to exceed that limit). An experienced commander could keep ready variations in his memory and even pass them along to his subordinates in a training class before a sortie. The "switching mechanism," however, was triggered too late in a strained situation in the air, especially with sharp changes in it. And there was no one from whom to get help.

The chief conclusion from the lessons obtained is reduced to the necessity of creating **means of intellectual support for all three "levels,"** and first and foremost the commander, burdened with an inordinately large number of duties. Flight personnel taking part in battles justly point out to the creators of hardware the "electronic chess players" now playing against grandmasters, in the creation of which the choice by the machine of the most advantageous tactical move from a host of possible moves is realized. Posing the question of a "pilot's electronic assistant"—a fast-acting on-board electronic system—has thus become entirely appropriate.

Technical Data on Tu-22 Bomber

93UM0419I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) p 32

[Article by V. Ilin under the rubric "Information for Reflection": "Bombers"]

[Excerpt] *The first series-produced supersonic heavy bomber in the world was the B-58A Hustler created in the United States. The "reply" of the USSR to the threat posed by that nuclear-weapons carrier was to be the M-50 missile carrier, but priority in the means of delivery of nuclear weapons here had shifted to intercontinental ballistic missiles by the time of its first flights. The first domestic series-produced supersonic heavy bomber became the Tu-22. The B-58A and Tu-22 aircraft are second-generation jet bombers.*

Tu-22

Versions. Tu-22R—reconnaissance aircraft; Tu-22U—trainer; Tu-22K—missile platform; Tu-22P—EW aircraft. A number of Tu-22 aircraft were used as flying laboratories.

Crew. Three men.

Dimensions. Wingspan 23.5 meters, area 162 m^2, sweep angle at leading edge 52°; length of aircraft 42.6 meters, height 10.0 meters.

Mass. Maximum takeoff mass 92,000 kg [kilograms], maximum takeoff mass with four booster rockets 94,000, normal takeoff mass 85,000, normal landing mass 60,000, fuel 42,500 kg.

Flight characteristics. Top speed 1,610 km/hr [kilometers/hour]; service ceiling with dedicated ordnance load at supersonic speeds 13,300 meters, effective flight range 4,900 km, transfer range 5,650 km, effective operating radius (depending on flight profile and ordnance load) 1,300—2,200 km, takeoff run 2,250 meters, landing runout 2,170 meters (1,650 with braking chute), landing speed 310 km/hr.

Engines. VD-7M (2 x 16,000 kgf) or RD-7M-2 (2 x 16,500 kgf).

Armaments. Weapons bay can hold a bombload of up to 12,000 kg. Gravity bombs (24 FAB-500 or one FAB-9000 in particular) of 250—9,000 kg. One supersonic guided missile accommodated in a semi-recessed position under the fuselage of the Tu-22K. Defensive armaments—an R-23 cannon with remote control in a tail mount; EW system.

Equipment. Rubin airborne radar, providing for the detection of naval targets at long range; PSB-11 bombsight; PRS-3 or PRS-4 defensive fire-control radar; TP-1A television sight for defensive armaments; RV-25 radio altimeter; Doppler meter for groundspeed and drift angle; ARK-11 radiocompass.

The aircraft in the first series did not have aerial refueling equipment, but the bombers later began to be fitted with the "drogue—probe" system that became standard for aircraft in the Soviet Air Forces (Tu-16N aircraft were used as the tankers).

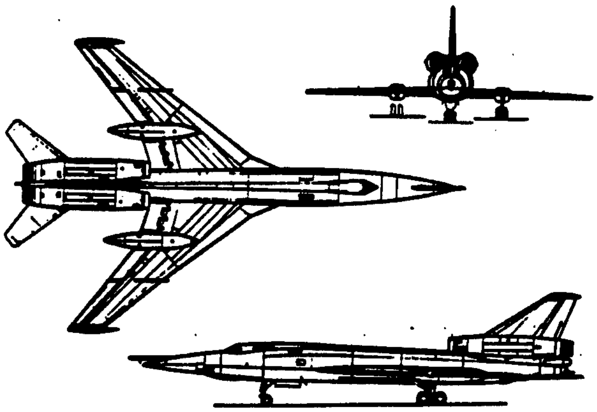
Ejection seats that are lowered when the crew is being put into the aircraft were specially created for the Tu-22.

The Tu-22P aircraft is equipped with active and passive jamming systems in the meter, decimeter and centimeter wavebands. The Tu-22R has equipment to perform radio, radar and visual reconnaissance, as well as photo reconnaissance and aerial topographic photomapping.

Status. In service with the domestic Air Forces and Navy since 1962, as well as the air forces of Libya and Iraq.

Additional information. Flight testing of the Tu-22, with the prototype having the designation Article 105, in

1958, and it was accepted into service in 1962. It served as the basis for the development of the Tu-22M with a variable-sweep wing.



The Tu-22U trainer was created for the training of bomber crews (the instructor's cockpit was placed behind and above the pilot's cockpit), along with ground simulator equipment with a movable cockpit.

The shortcomings of the Tu-22 include, for example, the insufficient field of view from the cockpit, conditioned in particular by the wedge- shaped forward part of the canopy, as well as the information overload of the pilot flying the heavy aircraft by himself.

The aircraft were used in combat operations in Afghanistan (with the sorties made from Soviet territory) and in the Iran-Iraq war (no reports on losses received), as well as in the Libya-Chad conflict of 1983 (French SAM systems shot down one aircraft).

[Information on B-58A omitted.]

Former Soviet Advisor Sums Up Results, Lessons of Air War in Vietnam

93UM0419J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 10, Oct 92 (signed to press 1 Sep 92) pp 42-43

[Article by Hero of the Soviet Union Major-General of Aviation (Retired) M. Fesenko under the rubric "Aviation in Local Wars": "The Vietnam Syndrome"; conclusion—for beginning see Nos. 7—9]

[Text] I will present, for an objective evaluation of the results achieved by the fighter pilots of the DRV in their confrontation with U.S. aviation, some data describing the reversals of fortune in the air in 1972 that concluded the many years of war in the skies of North Vietnam.

The pilots of the four fighter air regiments of the VPA [Vietnamese People's Army] Air Forces carried out 823 combat sorties over the course of the year (540 using MiG-21s, 207 with MiG-17s and 76 with MiG-19s) and engaged in 201 aerial battles, shooting down 89 American aircraft of six types and losing 48 of their own therein (34, 9 and 5 respectively). The North Vietnamese pilots, as we see, were able to achieve double the victories won. That is explained, in my opinion, as follows.

The VPA Air Forces command made skillful use, in their choice of the types of combat operations to repel the mass strikes of American tactical aviation, of the circumstance that the pilots of the F-105 and F-4 fighter/bombers, "loaded down" with ordnance and thus having lost their maneuvering properties to a considerable extent, could not independently repel the lightning attacks of the Vietnamese interceptors. The fighter crews assigned to escort those aircraft were not recommended to engage in active battle, since in the opinion of the Americans containing the attackers by maneuver meant trailing behind the strike group continuing to fly toward the target, leaving it unprotected. All attempts to close the breach in providing reliable protection by the allocation of an additional detail of fighters, as a rule, ran into complications in the combat command and control of a large number of crews.

A pair of MiG-21s that had gone up to repel an attack was usually brought by commands from the ground to the rear hemisphere of the combined enemy group at a distance that made it possible for the pilots to accelerate (at this stage of the vectoring they most often did not yet have visual observation of the targets), converge and launch a missile attack "in pursuit." An interceptor that saw several targets ahead of it at once could select the most "convenient" for attack. The crews of the fighter escort were, in that case, too late with their reciprocal actions to prevent the breakthrough of the attacker to the bombers.

Problems that had appeared as early as April of 1965 (when the pilots of the MiG-17s shot down the first two supersonic F-105s) connected with the performance of escort tasks for strike groups could in no way be explained by the inability of the American pilots to fight. One marked gap in their tactical training—which was, in my opinion, of an international nature, if one may say so—should be noted nonetheless.

A one-time missile attack on a target "in pursuit" was recognized as the basis of aerial battle in the air forces of many countries, including our own, in the 1960s (the so-called decade of the interceptors). Proper attention was not devoted to defensive actions; the fighter pilots rehearsed attacks in training flights, by and large, against non- maneuvering targets. Errors in theory thus had a negative effect on the results of combat operations. The crews of the B-52 strategic bombers during night flights, who left their wingtip lights on for the sake of maintaining "formation" (the safety sacrificed the density of the bomb strike), are a visible demonstration of the careless attitude toward defense. Matters were no better in U.S. tactical aviation.

The success of the North Vietnamese was largely facilitated by the doggedness with which they mobilized their forces to battle the aggressor. The fact that after the bombings of enemy airfields the American pilots operated in the air as if they were absolutely confident of the inaction of DRV fighters in the next day or two is striking in that regard; the next flight seemed like a walk in the park for the escort crews. But they were unexpectedly attacked in the air by MiG-21s in which, as the Americans later ascertained, the Vietnamese pilots had taken off with the aid of booster rockets from the taxiways of the heavily damaged airfields.

Yet another example. The American pilots, destroying the forward radar positions of the DRV PVO [air defenses], counted on an unimpeded flight to the strike targets. But it turned out that an F-105 burst into flames and fell to the ground even before the beginning of reforming into battle formation, struck by cannon fire from a subsonic MiG-17. It turned out that a flight of those aircraft had been transferred on the eve of the enemy raid to a staging airfield under cover of darkness, and was vectored to the targets from a visual observation post deployed at night in the sector of the expected appearance of the American aviation. The aggressor then struck the most "active" airfields; their runways and taxiways suitable for takeoff were destroyed as a result. It seemed that the North Vietnamese fighters were tightly "bottled up" on the ground. But crews of American aircraft again did not return from the next flight, with a pair of MiG-21s lying in wait for them this time (they had been transferred to an intact airfield after the bombing by Mi-6 helicopters using specially designed suspension systems).

And more. During the course of the air war, the North Vietnamese pilots developed and successfully used the tactics of waging war "in the minority." They were founded, first of all, on a careful analysis and prediction of the development of the situation for the purpose of determining the most favorable time and place (line) for the entry of the pair (or, less often, flight) into battle, while making use of the vulnerable points in the aggressor's defenses during the attacks; second, the use of total concealment and surprise in their actions; and, third, constant psychological pressure on the enemy through the creation of the threat of an attack on him at any moment.

Typical in this regard are examples where the pilots of MiG-21s, making use of the slightest opportunity for concealed convergence with the target, boldly attacked groups of American aircraft that were greater in numbers. Pilot Ha Van Thuc entered into battle with 36 (!) enemy aircraft and shot down the aircraft of the deputy commander of the air wing, Colonel G. Folin.

The DRV Air Forces fighter command, aside from everything else, reacted promptly to the slightest changes in the aerial situation, rejecting actions that had become stereotypical and were well "read" by the enemy. It is noteworthy that when the high-altitude MiG-21 interceptor entered service with the Air Forces, the Vietnamese studied its "sensitivity" to maneuver of the target and the "non-disposition" of the crew of that aircraft to wage close-quarters aerial combat at the recommendation of the Soviet military specialists. They thus selected operational tactics that allowed them to catch the aggressor unawares and break off the attack effectively.

Here are just a few figures describing the conceptual framework for the application of the fighter aviation of the DRV Air Forces. The interceptors went up 369 times in the course of aerial battles in 1972 (31 solo, 280 pairs and 58 flights) to repel raids by the airborne enemy, with one out of four sorties moreover being completed with the destruction of an American aircraft. The wager of the North Vietnamese fighters on surprise in operations using groups of aircraft few in numbers thus proved to be decisive in the confrontation with U.S. aviation.

One cannot pass over one more circumstance in revealing little-known facts of the history of the war in Vietnam, in my opinion. As difficult as it is, on the one hand, to explain the unsettling results of the air battles for the aggressor by the weakness of training for the American pilots, it is just as difficult, on the other, to consider the main cause of the losses of VPA fighter aircraft the quantitative advantage that the U.S. Air Force possessed in the air over the enemy. The losses sustained by the Vietnamese Air Forces, I think, would have been significantly fewer had the system of command and control for their combat operations been more streamlined. This conclusion is also confirmed by the statistics of the vectors of the fighters to the targets that were performed.

The commander of a group of fighters or a solo aircraft, devoid of an opportunity to "get" reliable information on the airborne enemy independently, usually got it from the CP in the form of reporting or command information. So then. Of the 369 intercepts performed, only 88—that is, 23 percent—were completed by bringing the fighters to the target, with the crews proving to be in a tactical position unsuitable for attack in 12 cases and the rest relegated in general to the report column, "Did not take place." Such instructive information became grounds for the Soviet military specialists in Vietnam to draw the following conclusions.

First, the combat command-and-control officer located at the command post at the radar screen could now be considered with full certainty to be the same as the pilot who was the full-fledged participant in the air battle. The time to disengage, after all, sometimes depended largely on how precisely the operator reproduced in his consciousness a three- dimensional picture of it, picked up on the intent and logic of the actions of the interceptor crew and to what extent the information he was transmitting corresponded to the dynamics of the development of the situation.

Second, the active use of electronic warfare by the Americans gave us to understand that counting on a "clean" radar screen in contemporary battle (both on the ground and in the air) and clear-cut identification (or tracking) of "targets" on them was now impossible. But notwithstanding the fact that the officer crews of the command posts always had masters of their trade among them who were able to monitor the situation in the air even in the face of an electronic jamming background, we recommended joint training for the performance of the assigned mission by the guidance operators and the flight personnel, which ultimately produced positive results. I think that should not be forgotten today as well.

Third, the frequent disruptions in vectoring to the target for the North Vietnamese fighters, which occurred for a number of reasons already mentioned, frequently forced the VPA Air Forces command to orient their pilots toward the waging of autonomous operations in the air. Practice showed that a plan recommended by us to our colleagues was of substantial assistance in training the Vietnamese pilots in making independent decisions in a complex situation...

The events that I have been relating have long become the property of history, but the experience of the application of aviation in the skies of Vietnam has not lost its significance today for the further development of air force tactics. That is why its study and theoretical and practical utilization is important.

FROM THE EDITORS. We intend to continue to feature a series of materials in upcoming issues that will cover in detail the topic of the participation of aviation in local wars. Next time—the Near East.

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