SOVIET LIFE

SPACE: DISCOVERIES, MYSTERIES, HYPOTHESES

April 1981 • 75 cents

A TRIBUTE TO YURI GAGARIN (1934-1968) ON THE 20TH ANNIVERSARY OF THE FIRST MANNED SPACE FLIGHT

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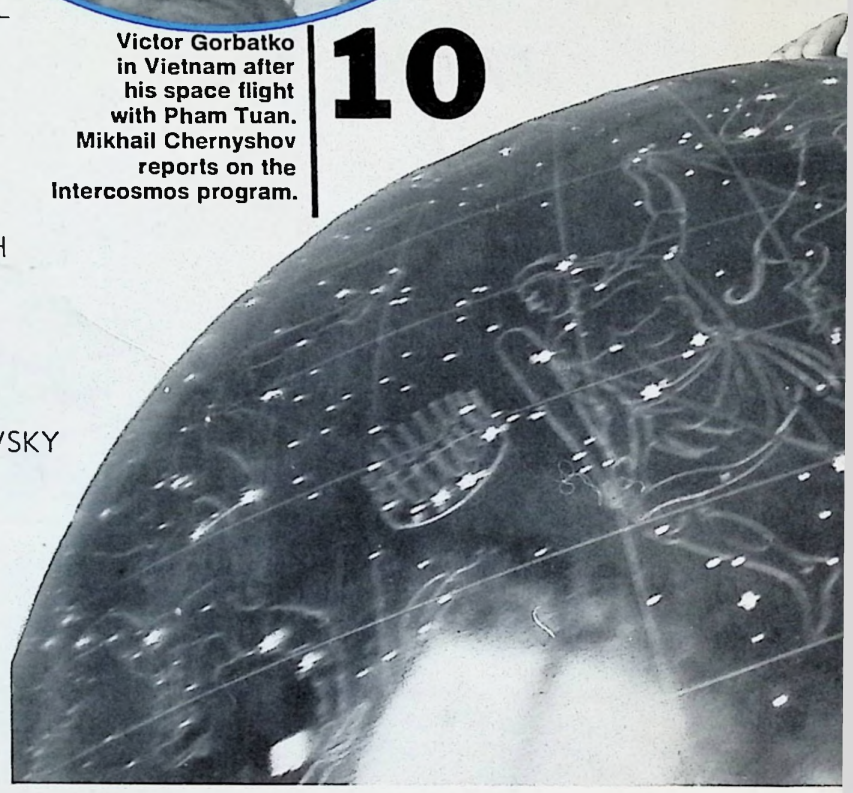

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Front Cover: A portrait of Yuri Gagarin. Monuments were raised to him and streets renamed in his honor. *Drawing by Anatoli Iar-Kravchenko.*

LETTERS TO THE EDITOR

I did indeed enjoy the December issue of SOVIET LIFE, especially since I could relate it to my personal experiences and impressions of Soviet Armenia from my five visits there.

I think the issue was very well done. The subjects were rather complete and accurately report current life in Soviet Armenia.

Jack Medzorian
Bedford, Massachusetts

I have very much enjoyed reading your publication, but most of all I like the gorgeous pictures of your people, countryside and culture. I hope that diplomatic relations between the USSR and the USA will improve in the future.

Forgive me, I am not much on athletics, but I certainly enjoy the photos of the ballet (home of the world's greatest ballet!), folk art and landscapes. Thank you for the beautiful photos.

Charlotte W. Lowder
Columbia, South Carolina

I spent one month in the Soviet Union this past January (with my university) and found SOVIET LIFE good preparation for my trip. It gave me greater understanding of your country before I left and brings back good memories when I get each new issue. While I disagree with the ideology of your country, I still find your magazine to be very informative and useful.

B. D. Wein
Greenville, South Carolina

As a former editor and student of the graphic arts, one can appreciate the fine color plates and printing in your magazine, as well as the stories that present your fine country. The readers of SOVIET LIFE must wish to view these interesting scenes someday as a tourist. CONGRATULATIONS!

W. J. Curn
Steubenville, Ohio

Enjoy your magazine very much and consider it my only real source of information on the Soviet Union. I pass it on to others.

R. V. Bauguess
Naches, Washington

30 Nikolai Zheleznov interviews cosmonaut Valeri Ryumin, on the right, about his record-breaking 185-day flight with Leonid Popov, on the left.

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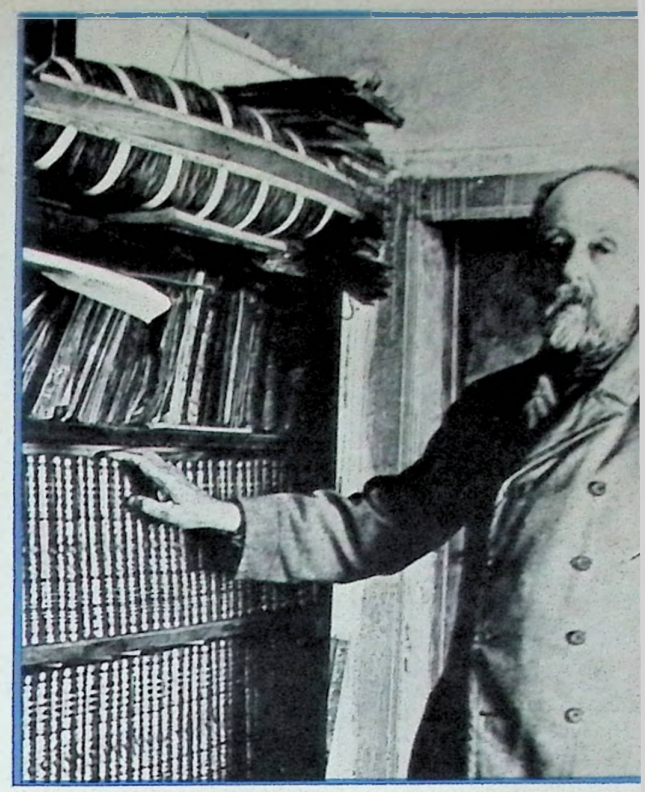


EDITOR'S NOTES

I WAS a member of the group of journalists who accompanied Yuri Gagarin on his two-week tour of India back in 1961. The man who ushered in the space age visited New Delhi, Lucknow, Calcutta, Bombay and Hyderabad.

India, in general, is known for its hospitality, but the colorful and moving tribute and the sea of joyous faces welcoming the first cosmonaut were a rare sight. Gagarin visited projects built with Soviet assistance. He was given a warm reception by Jawaharlal Nehru and Indira Gandhi.

As I said, all this happened years ago. I was fortunate to meet Yuri Gagarin later, but those first encounters in India have always remained the most vivid impressions for me. If I were asked to give a brief profile of this trailblazer in outer space, I would say it in three words: talented, humble and kind-hearted. He was a person of natural gifts from the very midst of the popular masses and, of course, a son of his country and his society. I recall him saying after his historic orbital flight that the offensive on space did not begin on April 12, 1961, when a human saw the expanse of the universe for the first time, and not even on October 4, 1957, when the first satellite was sent up from Earth. It all began with the shot fired by the cruiser *Aurora* and the assault on the Winter Palace, in other words, he meant the Great October Socialist Revolution.

Yuri Gagarin is no longer with us. But his fellow cosmonauts have gone far, far ahead, both into space and in enlarging the framework of cooperation in its exploration. And yet so much still lies ahead in that great frontier where Yuri Gagarin made the first step.

We miss Yuri Gagarin, but his immortal feat will stay with us forever, as well as his breadth of mind, his goodness and his unceasing desire for mutual understanding.

That famous Gagarin smile will always remain in our vision as the symbol of the inevitable triumph of good-will, reason and peace.

SPACE

RESULTS AND PROSPECTS

THE WORLD'S FIRST manned space flight by Yuri Gagarin in April 1961 opened a new page of history. In the 20 years that have passed since then, research in near-Earth space has enriched science and has yielded appreciable practical results.

This issue, with a portrait of the first cosmonaut on the front cover, deals with the contribution made by the Soviet Union to space research.

Those people who have been fortunate enough to see the Earth from outer space know that our planet—our common spaceship—is quite small compared to the infinite expanses of space. Thanks to them, we now view in a new light our responsibility for the preservation of peace on Earth.

Thus, the docking of the Soyuz and Apollo spacecraft remains more than a memory of a spectacular scientific and technological experiment. It made an outstanding contribution to understanding between the Soviet and American people and demonstrated the possibility of fruitful cooperation for the benefit of humankind. That event is recalled in an article titled *Space and Détente* on the next page.

In the early years after the Revolution, when the Soviet Union was going through the throes of reconstruction after World War I and the Civil War, the Council of People's Commissars under Lenin's chairmanship deemed it necessary to provide Konstantin Tsiolkovsky with material aid. The ideas of that scientist, who is now universally recognized as the father of modern rocket and space research, were so profound and covered so much that experts are still drawing inspiration from them. Read about this in a report from the annual symposium held in Kaluga, the home town of Tsiolkovsky.

Also this month SOVIET LIFE takes you to a Young Pioneer Palace on Lenin Hills in Moscow where youngsters are actively engaged in space research. And you'll meet science-fiction writers who discuss the question: Are we alone in the universe?

While this issue was being prepared, space exploration continued. New crews were sent to the Salyut orbiting station to perform new experiments.

The road into space may be unknown, but it is definitely the road to which the future of civilization is connected.

SPACE AND DETENTE

By Alexei Vasilyev
Candidate of Science (Technology)

"TOM STAFFORD stretched out his hand to me. There it was—a handshake in space! Meanwhile, Kubasov was busy filming it. Tom invited us in as naturally as he would at the doorway of his home in Oklahoma," said Alexei Leonov, describing the first international meeting in space. Leonov was commander of the Soviet crew that took part in the joint Soviet-American Soyuz-Apollo Test Project.

Looking back on that summer of 1975, one can't help reliving the joy and excitement that seized everyone—even people who had nothing to do with the space flight. The flight, which was excellently carried out, was important not only because it solved the problem of guaranteeing the safety of manned space flights and not only because outstanding scientific and technical experiments were performed, it was also important because it marked a new stage in international cooperation in the study of space for the interests of peace and all humankind. Discussing the significance of the joint flight, UN Secretary General Kurt Waldheim noted that the docking of Soviet cosmonauts and American astronauts in space convincingly demonstrated the desire of both countries to work for progress and was an inspiring factor in the UN's efforts to ensure the use of space for peaceful purposes.

It is evident that the Soyuz-Apollo flight—the very fact of cooperation—was a result of a change in the international situation, a change from confrontation to a policy of cooperation between the Soviet Union and the United States. It should be noted, however, that although large-scale joint programs, and particularly programs in space exploration, are a result of détente, they in turn work for détente by furthering the growth of mutual trust, improved understanding and expanded contacts between people. In this context, I would like to recall the trips made by the members of the crews and their families in September and October 1975 to various cities in the Soviet Union and the United States. Residents of Moscow, Leningrad, Kiev, Volgograd, Novosibirsk, Sochi and Tbilisi gave the space heroes rousing welcomes. They were greeted with equal enthusiasm in Washington, Chicago, Omaha, Salt Lake City, Lake Tahoe, San Francisco, Los Angeles, Nashville, Atlanta and New York.

All the meetings, talks and news conferences that were held along the way—both planned and spontaneous—revealed mutual likes and helped to solve many knotty problems in a friendly and relaxed atmosphere. Soviet newsman Mikhail Rebrov remembers that at one meeting Alexei Leonov was asked if space exploration doesn't cost too much.

"Of course it does," the cosmonaut replied. "You know, most likely the Queen of Spain wasn't all that eager to finance Columbus' expedition either. But she did risk giving him money. And who knows when America would have been discovered had she been too cheap!"

In his greetings to Leonid Brezhnev, Gerald Ford, who was president of the United States at the time, wrote that the flight had proved that cooperation in space, involving the efforts and contributions of more than one country, is not only feasible but desirable as well. He expressed the hope that the Soyuz-Apollo flight would be only the first step in continuing American-Soviet cooperation in the conquest of space.

A Long and Hard Road

The Soyuz-Apollo flight was one of the peaks of Soviet-American cooperation. The road leading to it was long and hard. The fact that space research is so very costly induced Soviet and American scientists working in the field of space technology to seek joint solutions to many organizational and technical problems from the very start. The first agreement that provided for a number of joint Soviet-American experiments in space was signed by the USSR Academy of Sciences and NASA in June 1962. However, despite the significance and considerable scientific interest of these experiments, one cannot but note their extremely limited scale, which clearly did not correspond in scope with the programs being carried out in both the Soviet Union and the United States at that particular time.

Real progress in the development of Soviet-American cooperation came in 1970 and 1971 and was undoubtedly linked with the general "warming up" of the international climate. A number of meetings were held at that time to discuss cooperation in space research and increasing the safety of flights. The preparatory stage ended with an agreement, signed on May 24, 1972, concerning cooperation in the exploration and use of outer space for peaceful purposes. This agreement provided for a number of Soviet-American experiments in space and the development of joint means for the converging and docking of spaceships and stations. Equally important were the obligations taken by both sides to further international efforts in the solution of legal problems arising from the exploration and use of outer space for peaceful purposes.

This agreement was an important landmark in the history of world space flight; it initiated work on preparations for the joint experimental flight of the Soyuz and Apollo spaceships. Up until then there had been no other example of such intensive joint work on the part of groups of scientists from two countries. To give the reader an idea of the scope of this work, I only need to say that between May 1972 and June 1975 more than 20 meetings were held in Houston and Moscow, as well as 11 joint tests, 6 training sessions for both crews and 6 training sessions for the staffs of the mission control centers. The number of jointly developed technical papers topped 1,500.

The entire world followed the flight closely. Television and radio broadcasted up-to-the-minute reports from both space centers and mission control centers. Millions of people held their breath as they watched the spaceships dock and the two American astronauts, Thomas Stafford and Donald Slayton, pay their first visit to the Soviet ship. The well-coordinated work of both crews and the calm, businesslike atmosphere helped the crews to cope easily with the slight technical failures that they discovered. Leonov and Kubasov fixed a problem in their television system, while Stafford and Slayton repaired the command module's hatch.

"We all learned to understand each other's 'Ruston,' as we jokingly called our mixed Anglo-Russian language," recollected Alexei Leonov. "Though our 'Ruston,' a term we coined by combining the words 'Russian' and 'Houston,' caused a lot of problems for the translators and technical personnel. In the final count, I'd say we overcame the 'language barrier.' But what is much more important is that our common aims, the friendly atmosphere that prevailed up in space, the coordinated work of the ground services and the interest shown by the whole world in our flight helped us complete our tests."

Of the numerous experiments carried out in space, several were really unique. One, for instance, was the observation of an artificial eclipse of the Sun. The Apollo blocked the Sun while a picture of the Sun's corona was taken through the window of the Soyuz. This experiment called for an extremely precise orientation of the docked ships and the well-coordinated work of the two crews.

American scientists suggested a series of technological experiments involving the electric furnace aboard Apollo. These included making use of weightlessness to produce superpure materials and new alloys. In the course of the experiments, ampoules with samples of materials prepared by Soviet metallurgists were heated in the furnace. The unanimous conclusion of specialists was that the experiments were an important step toward developing a promising new branch of industry—space technology.

The results of other experiments were of considerable interest to spe-

"It is my sincere desire that in the continuing quest for knowledge of outer space our nations can work together to obtain the greatest benefit to mankind."

John F. Kennedy
April 12, 1961

cialists as well. Some were conducted jointly in the fields of physics and biology, and others were performed independently.

From Bilateral to Multilateral Programs

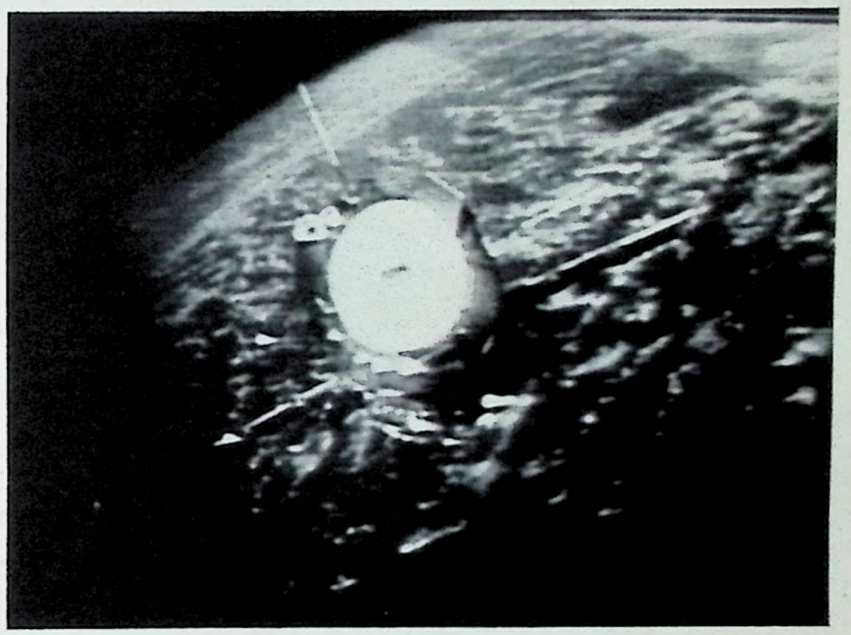
After the Soyuz-Apollo flight, Soviet-American cooperation became more routine. The development of space flight, however, and the expansion of the field of its practical use did its work, and instead of bilateral programs, multilateral ones began to be implemented. Even before the Soyuz-Apollo flight, the Soviet Union and the United States took part in a multilateral program of meteorological observations conducted under the aegis of the UN World Meteorological Organization. In 1976 another international program was incorporated into it—that of using satellites for communication among ships at sea, carried out by INMARSAT, an international organization whose members are a large group of countries with developed navigation systems. An agreement is in force on carrying out rescue operations in the northern latitudes, in which, besides the USSR and the USA, France and Canada participate. This shows that countries with differing political systems and social orientations can strive to expand the use of scientific and technical achievements, including those of space development, in the interests of all of humankind, as well as strive to develop cooperation and lessen tension.

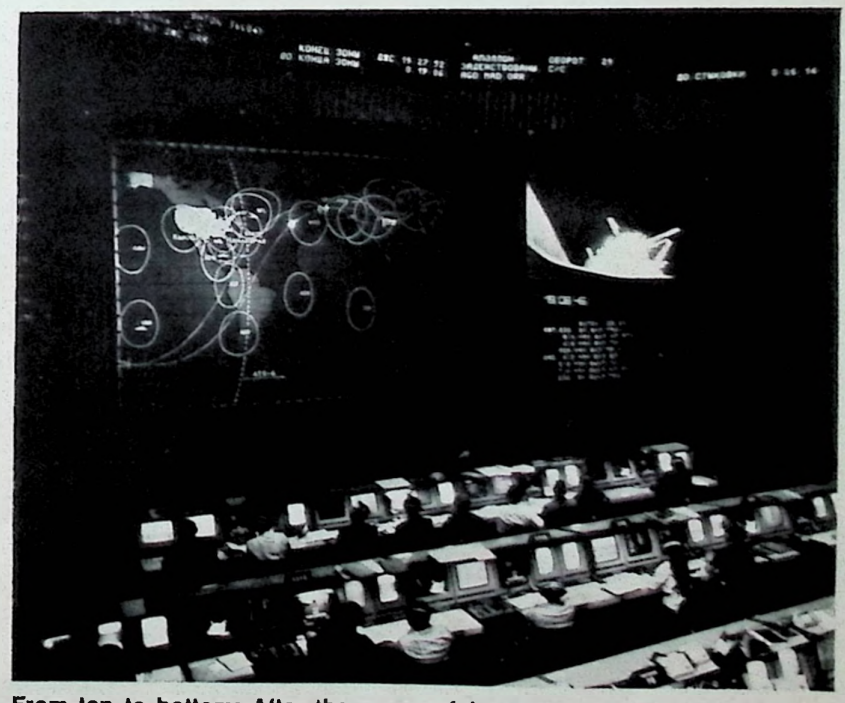
A convincing example of fruitful cooperation in space research is the history of Soviet-French programs. Soviet rockets launching French satellites, joint scientific research, French instruments installed on board Soviet spaceships for investigating Venus and, finally, French cosmonauts Patrick Baudry and Jean-Loup Chretien training for a flight on board the Soviet space station are the major stages in Soviet-French cooperation that began in the mid-sixties.

The Coming of the Second Space Age

Astronautics now stands on the threshold of a new space age. Soviet scientists have created the Progress automatic transport vehicle and carried out the docking of the Salyut-Soyuz-Progress complex, thus approaching a solution to the problem of setting up large structures assembled in space. Soviet experiments involving lengthy stays in space are known throughout the world. Cosmonauts Leonid Popov and Valeri Ryumin spent a record 185 days on board the Salyut space station. It is quite clear from these experiments that near-Earth space stations are gradually becoming a workplace for researchers and engineers. On the other side of the globe American experts are in the final stage of testing a space transport system that can be used over and over again, called the space shuttle. Soviet engineers and scientists have followed this long-term program with great interest.

Today astronautics faces ever new problems. At the top of the list are questions involving the development of new technological processes and the establishment of large structures to be assembled in space, space power plants and the investigation of the planets. These will be solved much more efficiently if the world doubles its efforts to solve problems that affect humankind as a whole. It is essential for everyone to understand the close connection between international cooperation in space development and measures to consolidate and develop international détente. This is precisely the foundation of the Soviet approach to global problems, a component part of which is the development of space. As Leonid Brezhnev said at the World Congress of Peace Forces held in Moscow back in 1973: "Peace is not only a question of security. It is also the most important prerequisite for solving the most crucial problems of modern civilization. And herein lies the very future of humanity." ■

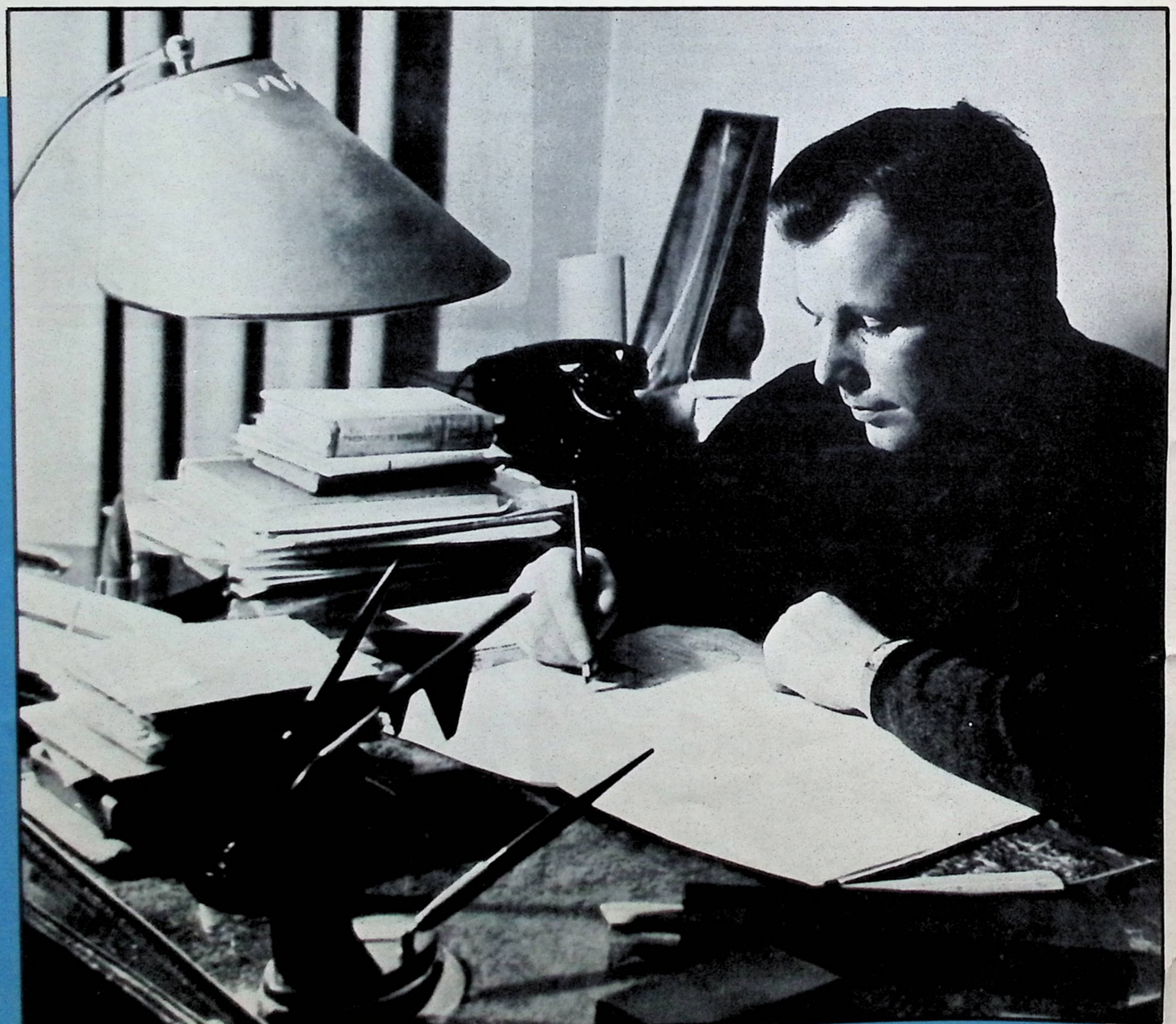




From top to bottom: After the successful completion of the joint Soviet-American Soyuz-Apollo Test Project in 1975, members of the crews were received in the Kremlin by Leonid Brezhnev. The middle picture was taken from a television screen. After undocking, the Soyuz 19 (center) moved away from the Apollo. The artificial solar eclipse experiment was performed, and the crews docked their crafts for a second time. The teams made four visits to each other's spacecraft and performed seven joint experiments. Bottom: At the Soviet Mission Control Center outside Moscow. On the screen at right, the Soyuz and Apollo spacecrafts are rendezvousing before docking.

YURI GAGARIN

This month marks the twentieth anniversary of man's first flight into outer space. Few events in the history of civilization could be regarded on a par with that flight. What was cosmonaut Yuri Gagarin like? We invited journalist Yuri Dokuchayev to answer that question. His credentials for the job are impressive. He has lived for several years in Stellar Town, home for Soviet cosmonauts. For seven years he was a personal friend of Gagarin. Dokuchayev has delved through memories, files and tapes and interviewed Gagarin's wife and colleagues specially for this issue.



Lights would burn late into the night in the Gagarin home while Yuri would be writing. Journalists who knew him said that if he had not become a cosmonaut, he would have been a writer.

Moscow, April 12, 1961: As news of man's first flight into space was being broadcast in every language, people poured into Red Square with hastily prepared posters.

THE PRESS CONFERENCE, one of the first given by Gagarin, was over. An American reporter elbowed his way into a group of Soviet colleagues and launched into a harangue: "Damn it! I can well believe that you've designed that spaceship and figured out its orbit. But how did you manage to design such a man?" Ticking off his fingers one by one, he began to list Gagarin's assets: "He's clever. Charming. Well educated. An athlete. Brave. He has a prince's family name and . . . the classic biography of a Red! Where did you get him?"

I wholeheartedly agreed with his description of Gagarin's attributes. As for his biography, it is quite common. He was born the son of a peasant. He grew up during World War II, attended a seven-year school, then a vocational school and later a technical school. From boyhood he dreamed of becoming a pilot. He got his first training at a flying club and subsequently graduated from a flight school. There are thousands of similar stories in this country. I might also note in passing that many Russians bear the names of princes not because they are kin to nobility, but for the simple reason that their ancestors were serfs of the Princes Gagarins, Golytsyns, Saltykovs and Potemkins.

Although Gagarin was an open, easy-going man, he was not the kind of person who could be sized up at first glance. His enchanting smile, that voice with its wealth of modulations, his penetrating mind, his frankness—that is about all that was constant in him. Other traits were constantly being perfected and changed.

His responsiveness and flexibility were perhaps his most valuable assets. They determined, by and large, his fate in life. He became a professional in a field where there had been no professionals before. In outer space exploration the unknown and the unexpected are always lying in wait. Being on the alert to meet the challenge—this is where his mobility and dynamism came in so handy.

Gagarin's ability to play down his exceptional gifts was still another great asset. I discussed this quality with one of the first mentors of Soviet cosmonauts, Colonel-General Nikolai Kamanin, Hero of the Soviet Union. "Don't forget," he told me, "that when Yuri lived and worked among us, we never thought that his life would be so short and that we, who knew him well, would have the task of putting together bit by bit everything that made his life so interesting and meaningful."

The General's remark inspired me to write a book about the first man to go into outer space.

Yuri with his wife Valentina. His flight was an act of heroism on her part too.

It was Eugene Karpov, the man responsible for training the first group of cosmonauts, who described to me the meeting of the state commission that was to appoint the commander of the Vostok spaceship for the first manned flight into outer space.

The commission made its choice: Yuri Gagarin.

"Dozens of eyes were trained on him," Karpov recalled. "At first he looked as though he did not believe it. Was it possible that he was entrusted with such honor and responsibility? He gulped for air, like he was short of breath. I was sure that one of the gray-haired scientists, designers, engineers or doctors at the meeting would go up to Gagarin, embrace him and bless the chap in a fatherly way: 'Up you go, young man!' But no- ▶

"Yuri personified the eternal youth of our people," said Sergei Korolyov. "He combined within himself in a most happy blend the attributes of courage, an analytical mind and exceptional industriousness."

Continued on page 22

Leonid Brezhnev presented to Yuri Gagarin the Order of Lenin and the Golden Star of Hero of the USSR.

In March 1957 Gagarin graduated with distinguished honors from the Air Force Academy as an engineer.

Yuri was feted everywhere he went. Here he speaks to participants of the 2nd International Moscow Film Festival.

Gagarin traveled to many countries on good-will missions. Here he is in Paris, September 1963.

Yuri posed with Valentina Tereshkova, the world's first woman cosmonaut.

Yuri Gagarin's mother, Anna Gagarina, rests under her son's portrait.

PHYSICIANS FOR NUCLEAR DISARMAMENT

"We shall require a substantially new manner of thinking if mankind is to survive." Albert Einstein

PHYSICIANS for Social Responsibility (PSR), a Boston-based group formed in 1962, held a two-day symposium at Harvard's Science Center last year to evaluate the medical consequences of nuclear weapons and nuclear war. After the symposium, PSR took out a full-page ad in the New York Times *listing the awesome aftermath of nuclear war. The ad was signed by an impressive number of American medical experts from various colleges and universities.*

Then last December in Geneva physicians from the Soviet Union and the United States met to launch a joint effort to prevent nuclear war. After the meeting the group called on doctors throughout the world to speak out against nuclear war and for nuclear disarmament. They also decided to form a new organization called International Physicians for the Prevention of Nuclear War (IPPNW) and to hold its first congress in March 1981 in the United States.

The first IPPNW congress was held on March 20-25 at Airlie House, a quiet lodge in Virginia's rolling countryside. More than 100 doctors from nine countries—Canada, France, Great Britain, Israel, Japan, the Netherlands, Norway, Sweden and West Germany—besides the Soviet Union and the United States attended.

The Soviet Union sent 11 prominent physicians to the March meeting, among them Dr. Yevgeni Chazov, a member of the USSR Academy of Sciences, a member of the Presidium of the USSR Academy of Medical Sciences, director general of the National Cardiological Research Center and president of the National Cardiological Society; Angelina Guskova, a department head at the Institute of Biophysics of the USSR Ministry of Health; Mikhail Ilyin, a member of the USSR Academy of Medical Sciences, chairman of the National Commission for Radiological Protection and director of the Institute of Biophysics of the USSR Ministry of Health; Mikhail Kuzin, a member of the USSR Academy of Medical Sciences, vice president of the National Surgical Society, a member of the scientific committee of the International Surgical Society and director of the Vishnevsky Institute of Surgery; and Marat Vartanyan, a corresponding member of the USSR Academy of Sciences, deputy director of the Institute of Psychiatry of the USSR Academy of Medical Sciences and vice president of the National Society of Medical Genetics.

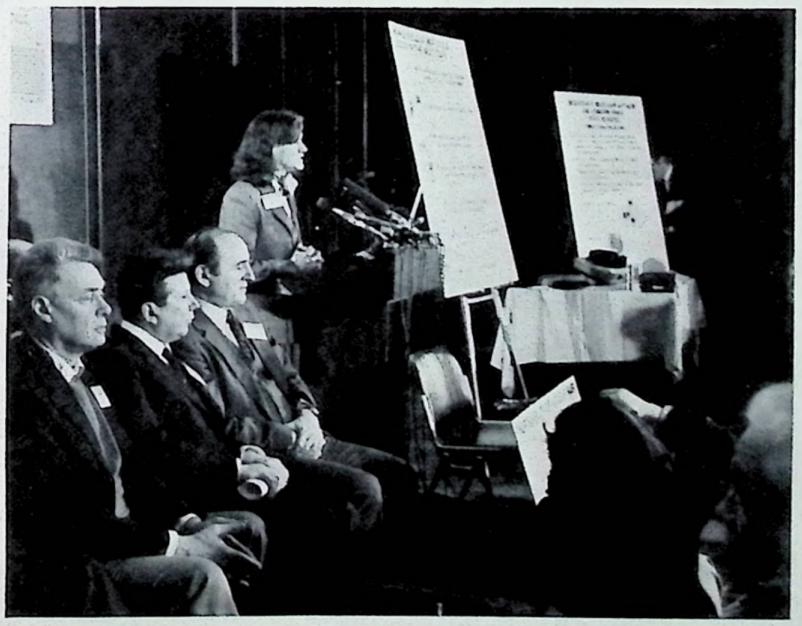
Dr. Chazov and Dr. Bernard Lown from the United States chaired the March meeting. Lown, a professor of cardiology at the Harvard School of Public Health, is president of International Physicians for the Prevention of Nuclear War.

The congress issued three appeals: one to the President of the United States, Ronald Reagan, and to the President of the Presidium of the USSR Supreme Soviet, Leonid Brezhnev, one to the heads of all governments and to the United Nations and one to the physicians of the world.

At a news conference at the International Club in Washington, D.C., on March 24, doctors representing the delegations answered questions and proffered opinions.

Academician Yevgeni Chazov, director general of the National Cardiological Research Center in Moscow: Life and nuclear war are incompatible. It is our task as doctors to tell our patients that. If you don't think about nuclear war, if you don't do something to prevent a nuclear war from happening, it could be a catastrophe. The human race could be wiped out.

Before I got on the plane to come here, I knew that I was going to be meeting colleagues, old friends and other doctors. I knew that our way here would not be strewn with roses. I expected it to be difficult, and I thought perhaps there would be some people who would not understand us. Since I've been here in the United States, though, I have received a number of letters addressed specifically to me. The people who sent them come from various social and religious groups. But all of them welcomed me and hailed our movement. They said we are doing the right thing and that we are on the right path. Yesterday I received a very simple telegram from New York that moved me deeply. It said, "My children and I thank you very much."



Photographs by Lyudmila Pakhomova

Dr. Patricia Lindop of England addresses a news conference at the International Club in Washington, D.C.

My friends and colleagues told me that some people in this country are saying that Soviet physicians do not want the Soviet public to be aware of the dangers of nuclear war. To this I say that I recently made a statement, which lasted about one hour, that was televised to 20 million viewers.

There is no single threat more grave than that posed by the danger of nuclear war and the arms race. We have looked very carefully into all the available medical data concerning the possible consequences of a nuclear war. I am firmly convinced that the only way to save humanity is to ban nuclear weapons.

Our movement is only in its infancy. But it is gaining wider support not only in the Soviet Union and in the United States, but also in other countries, particularly of Europe.

We physicians, as the professional group that is the most influential in our constant struggle for the life and health of the people of the world, as the most knowledgeable about the tragic consequences of a nuclear war, can make a big contribution to the cause of preventing it. Our patients trust us, they entrust their health and their lives to us. And in keeping with our professional honor, in keeping with the Hippocratic Oath, we have no right to hide from them the danger that now looms in the world.

Dr. Bernard Lown, professor of cardiology at the Harvard School of Public Health: The one major unique feature of our group is that we are not politicians; we are physicians. We have been

Continued on page 64

INTERCOS

Ever since 1957–International Geophysical Year–when the first satellite was put into orbit, the Soviet Union has been developing cooperation with other countries in space research. In 1967 Intercosmos–the Council for International Cooperation in the Exploration and Use of Outer Space–was formed under the USSR Academy of Sciences to coordinate efforts. Mikhail Chernyshov describes key areas of work below.

THE INTERCOSMOS program is 14 years old this month. In April 1967, nine socialist countries—Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Rumania and the Soviet Union—decided to combine efforts in space research. In 1979 Vietnam joined the program. From the beginning this organization's work was aimed at studying near-Earth and interplanetary space and applying the practical knowledge gained.

A total of 20 research satellites have been put into orbit over this period within the framework of the Intercosmos program. The Vertical high-altitude geophysical rockets and several different types of weather satellites have also been launched. The results of the first joint research have confirmed that space technology can successfully tackle many of the applied tasks. For instance, instrument observations over the satellites in flight not only helped study the upper layers of the atmosphere, but also were efficiently utilized in geodetic survey. Mongolia now has a first-class geodetic network thanks to information supplied by satellites.

At the beginning of the seventies scientists engaged in the Intercosmos program developed laser range finders that ensured higher accuracy of geodetic measurements from outer space. These instruments were used for metro construction in Prague, Czechoslovakia. About that same time an international satellite communications system called Intersputnik was put into operation. It made possible long-distance radiotelephone and telegraph communications between the participating countries and the exchange of television and radio broadcasting programs. In early 1980, in only two months' time, Soviet and Vietnamese specialists completed the assembly of a land-based receiving and transmitting center in Vietnam that linked that country to the Intersputnik communications system.

Over the past few years the study of geophysics from outer space has gained momentum. A system of instruments consisting of a camera operating in six bands of the spectrum and a topographic camera has been assembled aboard the Salyut 6 orbital station for photographing the Earth. Some time later the Spektr-15 spectrograph was placed on board the station. Observations of the Earth were a basic part of the work program for all six international crews operating aboard the station between 1978 and 1980.

Needless to say, the Intercosmos member countries have varying industrial and scientific potentials. The latest two international crews aboard the Salyut 6 station included pilot-researchers from Vietnam and Cuba, countries relatively new to space exploration. However, one of the key features of cooperation is that it stimulates the development of the main branches of science and technology. The assistance of scientists from the Soviet Union and the other socialist nations helped Cuban and Vietnamese specialists work out many research programs for manned space flights.

At the request of Vietnamese specialists, the geophysical program has been expanded as much as possible. Photographs taken from aboard the Salyut 6 station will be used in Vietnam to compile maps and charts vital for geological survey, irrigation and afforestation work. The photos will also be used to determine the exact boundaries of flooded areas and to monitor sea pollution by river discharges. The latter work is of utmost importance for fishing. Similar work was carried out for Cuba in the neighboring waters of the Caribbean.

The technological experiments for the Soviet-Vietnamese joint flight were prepared by organizations in the German Democratic Republic, the Soviet Union and Vietnam. As a result of a series of experiments dubbed Halong, the crew produced samples of semiconductor materials. In the course of the flight of the USSR-Cuba crew, the cosmonauts not only performed the usual tests on space hardware, but also experimented with sugar crystallization in weightlessness. Specialists believe that their research and experiments with yeast breeding can be of great practical value for Cuba's food industry.

Cosmonauts have also carried out medico-biological research. During the flight of the Soviet-Vietnamese crew abroad the Salyut 6 station, the crew observed the growth of a fern that is widespread in Southeast Asia, in weightlessness. This plant is a little nitrogen factory. Like clover or leguminous plants, it improves the yield of other crops and fertilizes the soil. Cuban medical workers have designed special footwear that increases the load on a person's foot and proposed that it be tested in outer space. The footwear may prove to be an effective means against flatfootedness on Earth, too.

The special significance of international crew flights within the Intercosmos program is that not only do the participating countries continue research begun by others, but also they contribute new ideas and their own experience. Results of flights are shared by all participating countries.

Eight graduates of the Yuri Gagarin Cosmonaut Training Center—from Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland and Vietnam—have already been up in near-Earth orbit with Soviet cosmonauts.

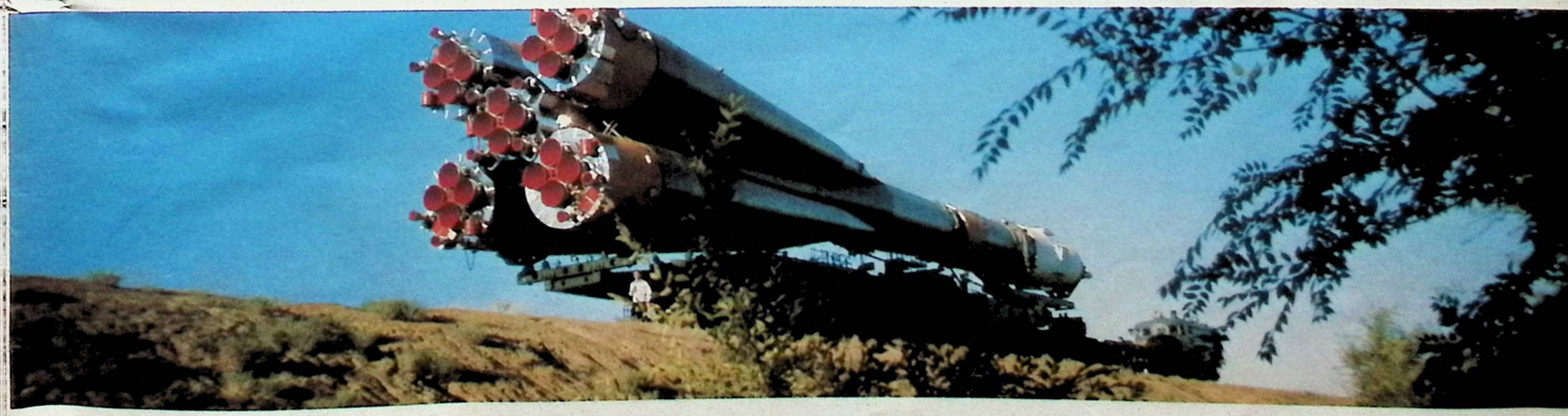
In 1979, when Vietnam began to take part in the Intercosmos program, two of its men, Pham Tuan and Buy Thanh Liem, were chosen as candidates for training for an orbital flight.

"From the very start," Alexei Leonov, deputy chief of the Cosmonaut Training Center, told me, "both candidates had to overcome a formidable number of difficulties. There wasn't much time for training. True, we already had quite a lot of experience in conducting such training and that made the task somewhat easier. Another thing, I think, that helped was that they had the guidance of veterans like Victor Gorbatko and Valeri Bykovsky. Both men have been in the cosmonaut group since 1960 and have mastered just about every type of spaceship. By the time the Vietnamese began their training, Gorbatko had already made two space flights, and Bykovsky had made three."

Pham Tuan and Buy Thanh Liem had to learn theoretical subjects that were entirely new to them, subjects like space navigation and celestial mechanics. They studied the construction of the spaceship and the carrier rocket and improved their knowledge of Russian. It was especially ▶

Another international crew: Valeri Bykovsky from the Soviet Union, on the left, and Siegmund Jen from the German Democratic Republic. Splash down, at right, for Yuri Romanenko from the Soviet Union, on the left, and Arnaldo Tamayo from Cuba. Center right: Only the beginning of welcome home celebrations for Romanenko and Tamayo. Bottom: On the way to the launching pad.

MOS: ORBITS OF COOPERATION



At Mission Control Center backup pilots experience the range of feelings of crew members up there in space. Below: Valeri Bykovsky from the Soviet Union, the last man in the row, and Buy Thanh Liem from Vietnam.

difficult for them to master space terminology, but both men coped with the task. Both crews completed their preflight training with high marks.

"While we were in the Soviet Union," Pham Tuan said, "we constantly felt the warmth with which we and our families were treated. In Stellar Town we were always given special assistance by the methodologists, the scientific and technical personnel and, of course, our instructors, Victor Gorbatko and Valeri Bykovsky."

"I was very lucky to have a partner like him," Gorbatko stressed. "Pham Tuan proved to be a very capable student. His diligence and persistence enabled him to get ready to carry out not only his own flight, but also a wide-scale scientific program."

Preparations for the Soviet-Cuban flight took more time, all in all, two and a half years. The principal participants in this expedition were Yuri Romanenko and Arnaldo Tamayo Mendez. Romanenko joined the cosmonaut group when he was 26. In the 10 years that he's been living in Stellar Town, he's become a first-class cosmonaut and an ace at space engineering. In 1977 Romanenko and flight engineer Georgi Grechko set out on a 96-day orbital mission. It was Romanenko's first acquaintance with the Salyut 6 space station, and the meeting was preceded by very substantial scientific training.

"I met the two Cubans, Arnaldo Tamayo and José Armando, soon after I returned from space," Romanenko told me. "At first it was no more than a casual acquaintance, since they were going through general space training with other candidates from different countries. We began working together in September 1979, when two Soviet-Cuban crews were formed. Yevgeni Khrunov was assigned to head one of them, and I the other.

"My partner was Arnaldo Tamayo. He was clearly an experienced pilot and a good engineer. By the time he arrived in Stellar Town, he had already logged 1,400 hours of flight on planes of several types."

"Early in 1978," explained Tamayo, "a special commission was organized in Cuba to select candidates for a space flight. Just about every pilot in the country took part in the competition. My friend José Armando and I were the lucky ones.

"Space engineering is very different from aeronautical engineering, so we had a tough time at Stellar Town. The theoretical subjects were the most difficult, and of course not everything works as it should on simulators. But the experience of my commander helped a lot. He worked on the panels like a true virtuoso, and that encouraged me to push myself harder too."

"One of the major factors in our success," Romanenko put in, "was Arnaldo's single-mindedness and his amazing ability to keep calm. Work in the close confines of a spaceship demands a cool head. It was only on the soccer field that we permitted ourselves to let go.

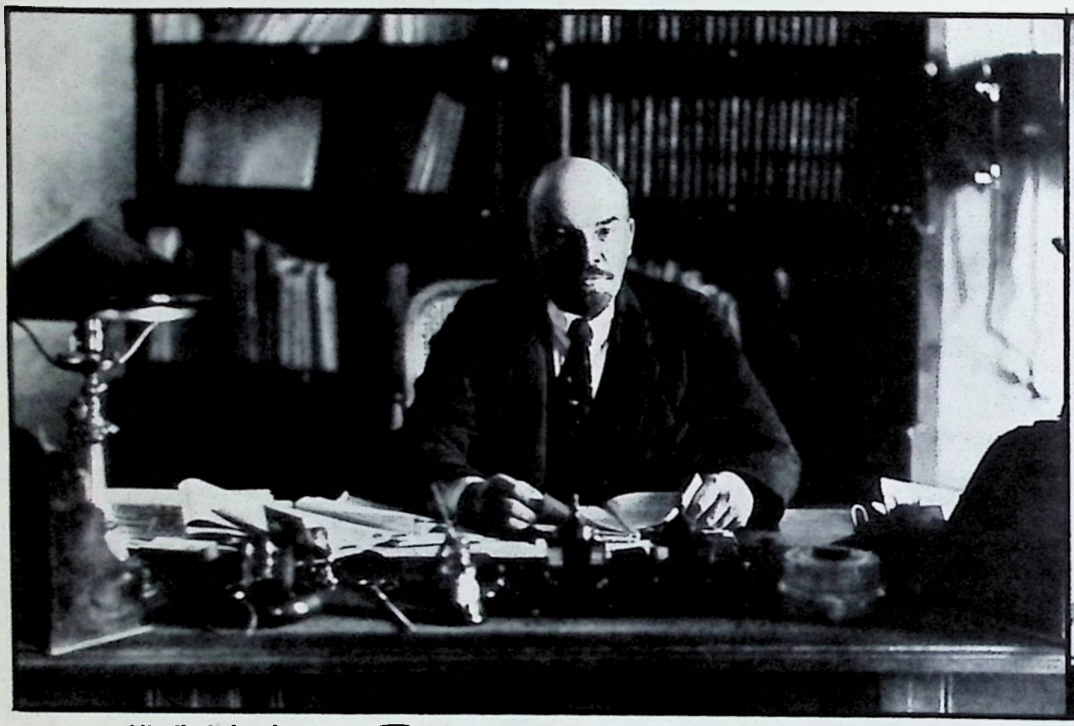
"According to the program, everyone undergoing training studied six days a week, eight hours a day. But we never counted the hours. If something didn't go quite right, we'd sometimes stay in the classroom or on a simulator till midnight. The last three or four months, when the examinations began, were especially hard. But everything turned out OK in the end. The final evaluation commission termed our training excellent.

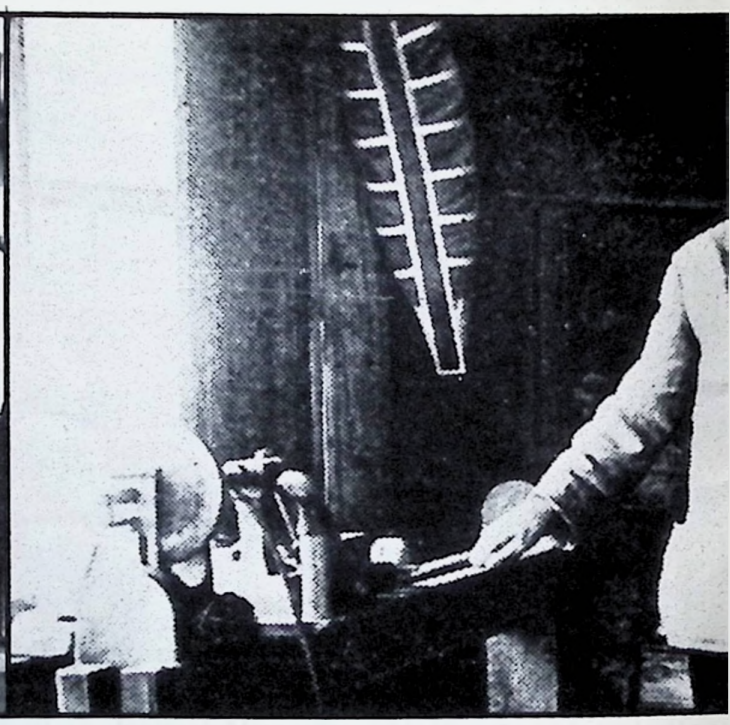
"During our training together, we became fast friends. For me, working with Arnaldo was a special pleasure because Cuba is a place I'm very interested in. I had a chance to visit the island and meet college students, schoolchildren and workers. I could see the tremendous successes the republic has achieved in social, economic and cultural development. And the Cubans gave me a really warm welcome."

"The Soviet Union and Cuba," Tamayo said, "are entirely different when it comes to climate. I knew from books, for instance, that there was such a thing as snow, but the first time I actually saw it was in the Soviet Union. It wasn't easy to get used to the Russian winter, and it wasn't easy to master the fine points of the Russian language. But I finally did manage to make it with a little help from my friends. Thanks to the assistance of the Soviet Union, Cuba was able to send a man into space before many of the great powers. It is very, very important that international flights not only serve science, but also help to consolidate peace and strengthen friendship among peoples." ■

Arnaldo Tamayo, standing on the left and waving, is welcomed home to Cuba after a joint Soviet-Cuban space flight. Everywhere he went the picture was the same—streets thronged with cheering crowds, flowers and smiles.

LENIN AND TSIOLKO





Vladimir Lenin in his Kremlin study. 1922 photo. Above right: Konstantin Tsiolkovsky in his workshop. Here he made models of rockets and air balloons as well as performed aerodynamic experiments. This photo was taken sometime in the twenties.

ON A FALL day in 1920 the famous English science-fiction writer H. G. Wells sat in Lenin's Kremlin office and talked with the leader of the Russian Revolution. Wells had not made the trip to Moscow out of idle curiosity. As he himself noted after the Bolsheviks' Revolution in 1917 and the establishment of their state, he had immediately felt that something new and unprecedented in history had taken place. It had seemed to him that it was precisely in Russia that a little part of the global planned society of which he had dreamed was coming into being.

And he had wanted to see it all with his own eyes.

He came to Russia and saw a cold, poor, starving nation. But what about the grand design for the future that Lenin outlined to him? "I cannot see anything of the sort happening in this dark crystal of Russia," Wells wrote of his talk with Lenin, "but this little man at the Kremlin can; he sees the decaying railways replaced by a new electric transport, sees new roadways spreading throughout the land, sees a new and happier communist industrialism arising again. While I talked to him, he almost persuaded me to share his vision."

But after he returned to London, Wells wrote a book titled *Russia in the Shadows* and called Lenin the "dreamer in the Kremlin." Even he, a fantasy writer, lacked the imagination to perceive the future of a people who had thrown off the shackles of autocracy and had done away with the exploitation of people by people once and for all.

During this same time, in the small town of Kaluga near Moscow, another man, a mathematics teacher named Konstantin Tsiolkovsky, dreamed of no less fantastic things. He dreamed of flights to other planets, of settlements around the Sun, of the general happiness of people who would master the wealth and energy of the universe.

"Our planet may be the cradle of reason," he wrote, "but one cannot live in a cradle forever. Humankind will not stay on the Earth forever, but, in a search for light and space, will first timidly penetrate beyond the atmosphere and then conquer the entire near-Sun space for itself."

What Tsiolkovsky was working on seemed a futile venture and a waste of effort to those around him. The people of Kaluga looked upon him as a crank. Yet in spite of poverty, the wall of misunderstanding and the scoffing, the scientist remained loyal to his dream all his life.

"The chief aim of my life," he used to say, "is to make something useful for people, not to spend my days in vain, to take humankind if only slightly forward. For this reason I have shown interest in everything that gave me neither bread nor strength. But I hope that my work, maybe soon and maybe in the distant future, will yield society mountains of bread and an immense source of power."

The purposefulness of these two men—Lenin and Tsiolkovsky—was striking. Their capacity for work was staggering.

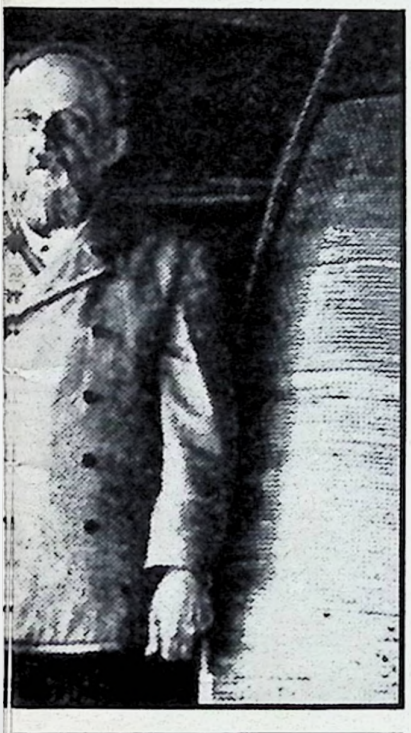
In the Siberian village of Shushenskoye, at the British Museum in London, in a czarist prison, in Munich, in the Polish township of Poronino and in the libraries of Paris and Geneva, Vladimir Lenin studied philosophy, history, the natural sciences, economics, military art and international relations. He imbibed an enormous wealth of knowledge and used it to serve the aims of the Revolution. Lenin personified the outstanding characteristics of a proletarian revolutionary: a mighty intellect, an all-conquering will, a hatred for slavery and oppression, a revolutionary zeal, an internationalism that was consistent, a boundless faith in the creative abilities of the masses and a tremendous talent as an organizer.

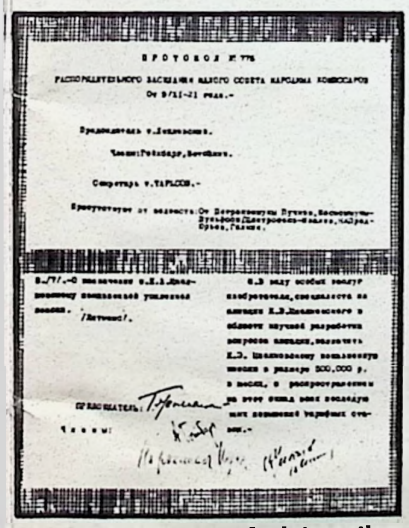
That was why during his talk with H. G. Wells he saw much farther and deeper than the celebrated science-fiction writer.

Lenin is no longer with us. But we still enjoy the fruits of

/SKY

Writer Igor Yudin takes a closer look at these two great men of whom the human race will always be proud. Some of their contemporaries regarded them as dreamers, but time has confirmed their predictions. The purposefulness of these two men was striking, their capacity for work was staggering.





An interesting historical document that testifies to the care of the government for the great scientist. Protocol No. 776 grants Tsiolkovsky a monthly pension. The document is signed by Lenin.

his work. He founded a party that led the masses to a storming of the autocracy and after the 1917 October Revolution devised a strategy and tactics for planned industry, the development of agriculture and higher living and cultural standards for all Soviet people. Guided by his party, the Soviet people in the years of World War II defeated nazism, which had brought humankind untold suffering. Lenin also founded the world's first state of workers and peasants, which is now a consistent champion of peace, democracy and socialism. Following his behests, the peoples of the USSR have in a historically short period of time turned a poor Russia into a powerful, highly developed country.

The thoughts and views of Lenin, his political and revolutionary experience are contained in his enormous literary legacy. He left scores of books and pamphlets and thousands of articles, reports, speeches, letters and notes.

Lenin proved so deeply able to understand and express the needs of his age that even today his ideas and his works are a powerful weapon in the hands of the champions of democracy and social justice. From the works of Lenin millions of people all over the world draw inspiration and strength for a revolutionary struggle.

The first Soviet artificial Earth satellite demonstrated what colossal potential the new social system possesses. And the first manned space flight confirmed that the launching of the satellite had not been a chance or an isolated success, but a logical result of the development of the world's first socialist state.

Twenty years ago, after Yuri Gagarin's flight, a Western newspaper wrote: "They in the Soviet Union, naturally, will say that the manned space flight is a triumph of the communist system. . . . Well, perhaps this is true!"

Yes, it is true. True because without the October Revolution and without the victory of socialism, Russia would have remained a third-rate peasant state and a prison house of nations. The world also would have looked entirely different than it does now. And, of course, a different fate would have been in store for the ideas of the Kaluga dreamer—Tsiolkovsky. Nonrecognition and total oblivion, the lot of many scientists and inventors in czarist Russia, would have awaited him.

The Soviet Government saw tremendous potential in Tsiolkovsky's works. It encouraged and supported the scientist and created the conditions for fruitful work for him and his students. The scientific legacy left by Tsiolkovsky to Soviet power became a great treasure of Soviet space science. Today this legacy is being creatively assimilated and developed.

"Before the Revolution," wrote Tsiolkovsky, "my dream could not have come true. It is only the October Revolution that has brought recognition to the works of a self-taught person; it is only Soviet power and the party of Lenin that have given me effective help. I was able to feel the love of the masses, and this gave me the strength to continue my work. . ."

Though Tsiolkovsky was already over 60 at the time of the October Revolution, he experienced a surge of creative power. The number of papers that he wrote attests to this. Whereas before the Revolution there were only 130 of them (a mere 50 were published, and then with his own money), in the years of Soviet power the number exceeded 600.

The ideas of space exploration put forward by Tsiolkovsky strike us by the boldness of thought and the accuracy of prediction. Many of these ideas have already been realized. Near the end of his life, in an address to his followers, Tsiolkovsky wrote:

> This has been a menial, risky and boundlessly difficult task so far. It calls not only for extreme effort and a gift of genius, but also for many sacrifices.
>
> Interplanetary travel cannot even be compared with flying in the air. The latter is child's play in comparison with the former. . . .
>
> But how beautiful that achievement of the future will be. The conquest of the solar system will give us not only an energy and life that will be two billion times more abundant than terrestrial energy and life, but also a still more abundant expanse.

Tsiolkovsky was not a revolutionary in life. His interests were confined to science, technology, invention and philosophy. There were very serious reasons for this: his deafness, the lack of friends and community ties because of this and financial insecurity.

But he was a genuine revolutionary in science. He was the founder of modern astronautics, a scientist and inventor in the field of aerodynamics and rocket dynamics and the theory of the plane and the dirigible. He was the first to substantiate the possibility of the use of rockets for interplanetary travel. He found rational ways for developing astronautics and rocketry and discovered a number of important engineering solutions for the design of rockets and liquid jet engines. His original talent manifested itself not only in his classic works in the field of the natural sciences and technology, but also in his lesser-known works on the general problems of science, ethics and philosophy in which he analyzed the "eternal questions of life": the nature of death, the meaning of life, the essence of good and evil. In his writings he expressed thoughts that are very close to the communist world outlook. And of course, it was by no accident that his oldest daughter took an active part in the revolutionary movement.

At the beginning of the twentieth century, few people could believe that the ideas of the two great visionaries—Vladimir Lenin and Konstantin Tsiolkovsky—would someday become a reality, that backward Russia would turn into an industrially developed country, that it would be from here that the first artificial Earth satellites and the first manned craft would be sent into space.

Space flights require perfect organization and the use of gargantuan production capacities as well as cooperative effort in science and material production. The exploration of space also presupposes broad international cooperation in the future because the results of these studies are the possession of all the people of the world.

Characterizing the Soviet Union's program for space research and development, Leonid Brezhnev has stated:

"The Soviet Union regards space investigations as an immense task of learning and putting to practical use the resources and laws of nature in the interests of the working person, in the interests of peace on Earth. We firmly and consistently stand for space to be used only for peaceful purposes. The results of Soviet space experiments benefit all humankind. This is our contribution to world scientific and technological progress. . . . We are the advocates of an international cooperative effort in space exploration." ■

THE COSMOD

This photo autographed by cosmonaut Alexei Leonov is only one of the many keepsakes and mementos exhibited at the Young Pioneer Palace on Lenin Hills.

What do today's youngsters who were born in the space age think about space research? Can a teenager's hobby become one's life work? Why do young people who are already loaded down with piles of homework from school forego movies, television and soccer practice to hurry over to Lenin Hills for a club meeting? Olga Bednyakova spent a day at the Cosmonautics Club of the Young Pioneer Palace in Moscow to find answers.

MOST PEOPLE usually talk about weather when there is nothing else to discuss. However, I must begin with the weather. On that fall afternoon it was hard to tell the time of day and year. A mixture of rain and snow was falling from the sky. A heavy mist blanketed Moscow, hiding the panorama of the city, which should have been visible from where I was in Lenin Hills. Even the sports facilities in Luzhniki, the site of the recent Olympic Games, which is situated right across the way, were clouded over.

I don't know about you, but I don't like low clouds. They give me a sense of claustrophobia. That old Russian saying—"I wish you a clear sky over your head"—has not only a figurative but a direct meaning as well.

Then the sense of isolation disappeared, and I found myself in a crowd of youngsters all going in the same direction toward the Palace of Young Pioneers and Schoolchildren. Its bright lights were beckoning.

Real Space Simulators

Fifteen minutes later the commonly known constellations were flashing over our heads. Along with the junior members of the Cosmonautics Club, I began to search for the stars Alpha Centauri and Beta Orioni. Oksana Davydenkova, head of the group (all in all, there are 17 groups in the club), told us about the design of the telescope, the visible spectrum and other interesting things.

Then Sergei Rudenkov, head of the club, led us from the planetarium to a hall with rotating chairs, centrifuges, and the like.

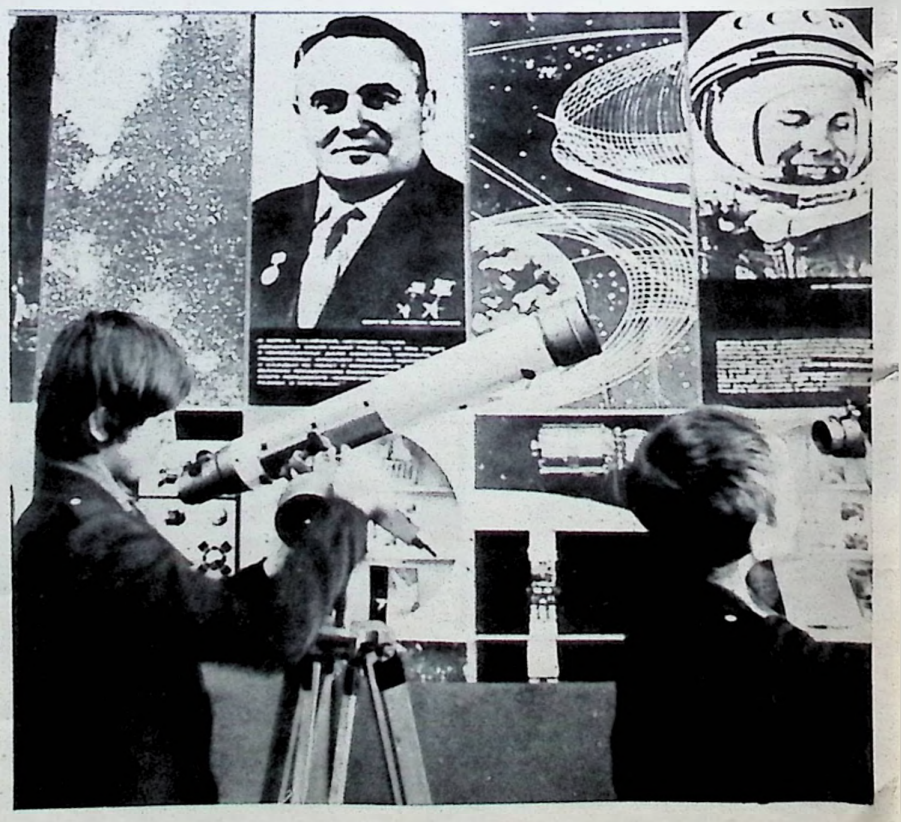
At the same time former test pilot Leonid Mikhalev was conducting a special training session with members of a unit of young pilot-cosmonauts. The senior students appeared quite confident while they worked on the real space simulators. These sessions are held under close medical supervision. Twice a year all the children are examined at a medical center and sports facility. They are also carefully observed by young space "doctors" from the club.

More Than a Hobby for Many

With each passing year flights into space are becoming a more common thing. So far over 100 people have been in near-Earth orbit. But remember, this represents only 100 for all of humankind.

Very few men and women ever become cosmonauts, and this will probably remain true for the near future. Do the members of the club realize that perhaps only one or two of them will become interstellar pilots? Yes, they do, but they still are just as enthusiastic about their hobby. They also realize that the cosmonauts of today and tomorrow have to be specialists in various branches of science and engineering. For this reason the club's program includes experimental design and research work and contests.

Oftentimes young would-be cosmonauts who are interested in research take on work in the astrophysics, space designing, space medicine or biology sections in addition to their regular classes at the club. I might mention that there are 50 different groups in the astronomy and astrophysics department of the Pioneer Palace. The department is a collective member of the All-Union Astronomy and Geodesy Society of the USSR Academy of Sciences. The youngsters' work is taken quite seriously. For example, recently a group traveled to Kazakhstan to observe the total eclipse of the Sun. ▶

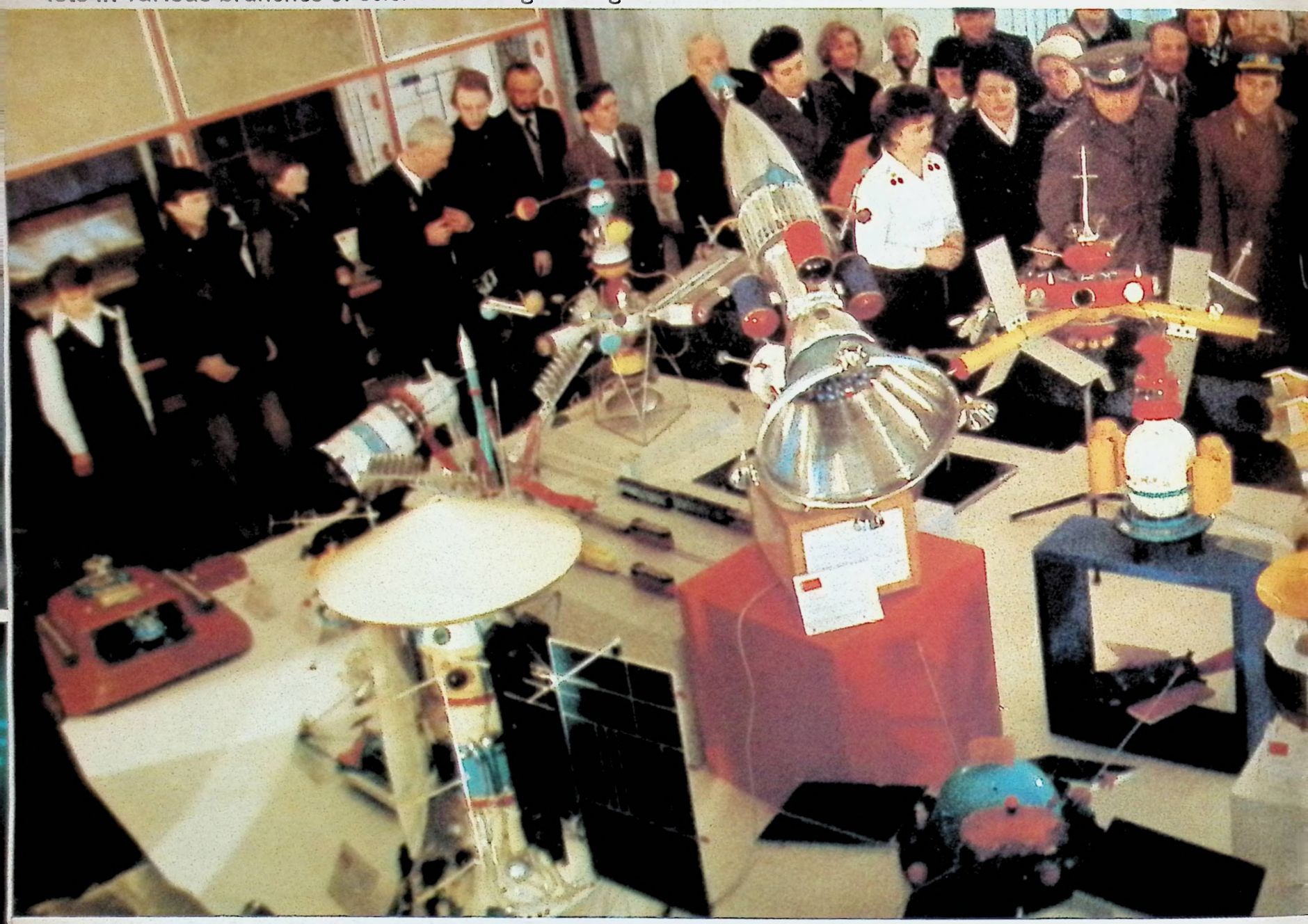


The telescopes have been checked and are ready for action.

ROME IN THE HEART OF MOSCOW

The monument to the pioneers of space erected in Moscow inspires these teenagers to keep on training.

Very few men and women ever become cosmonauts, and this will probably remain true for the near future. Do the members of the club realize that perhaps only one or two of them will become interstellar pilots? Yes, they do, but they still are just as enthusiastic about their hobby. They also realize that the cosmonauts of today and tomorrow have to be specialists in various branches of science and engineering.

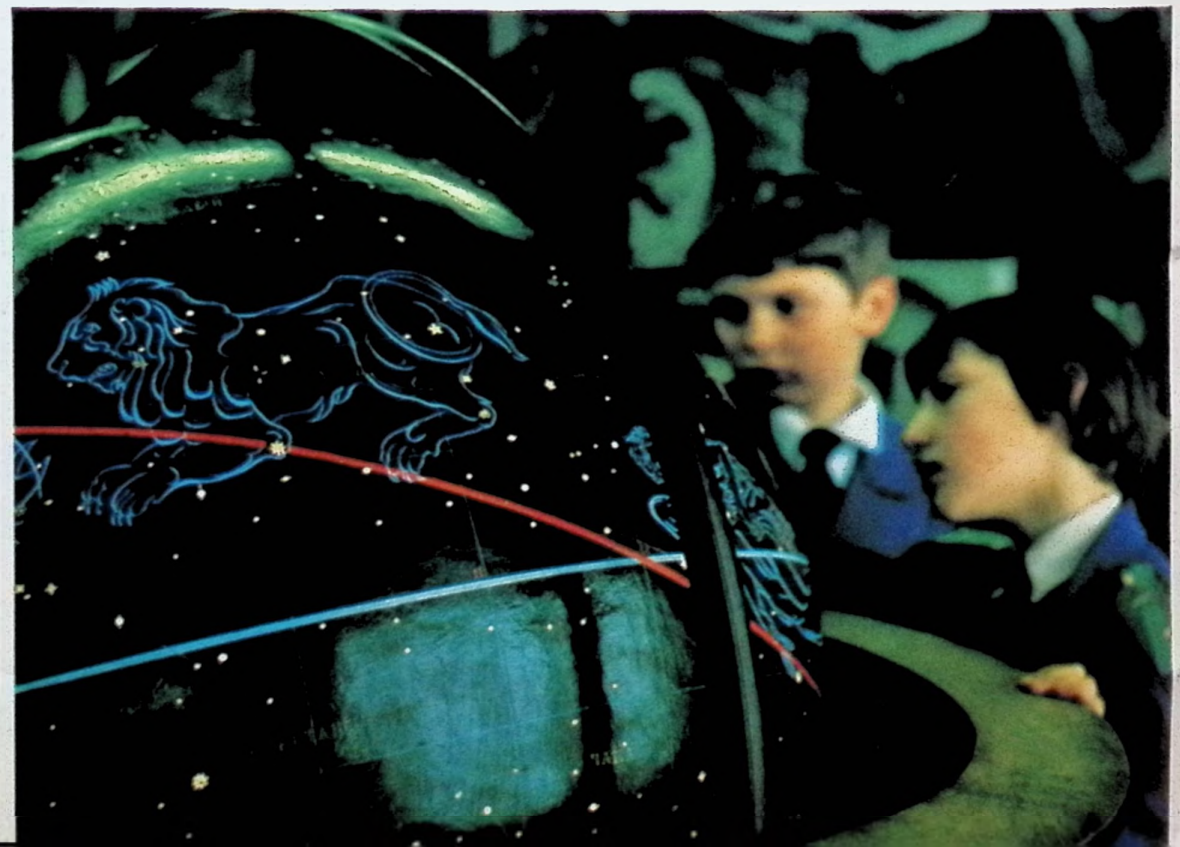


A display case in the club's conference hall contains works of former members. Complicated formulas from scientific papers are posted alongside a list of specialists who used to come here after school—a staff member of the Department of the Sun at the Shternberg State Astronomy Institute, and so on.

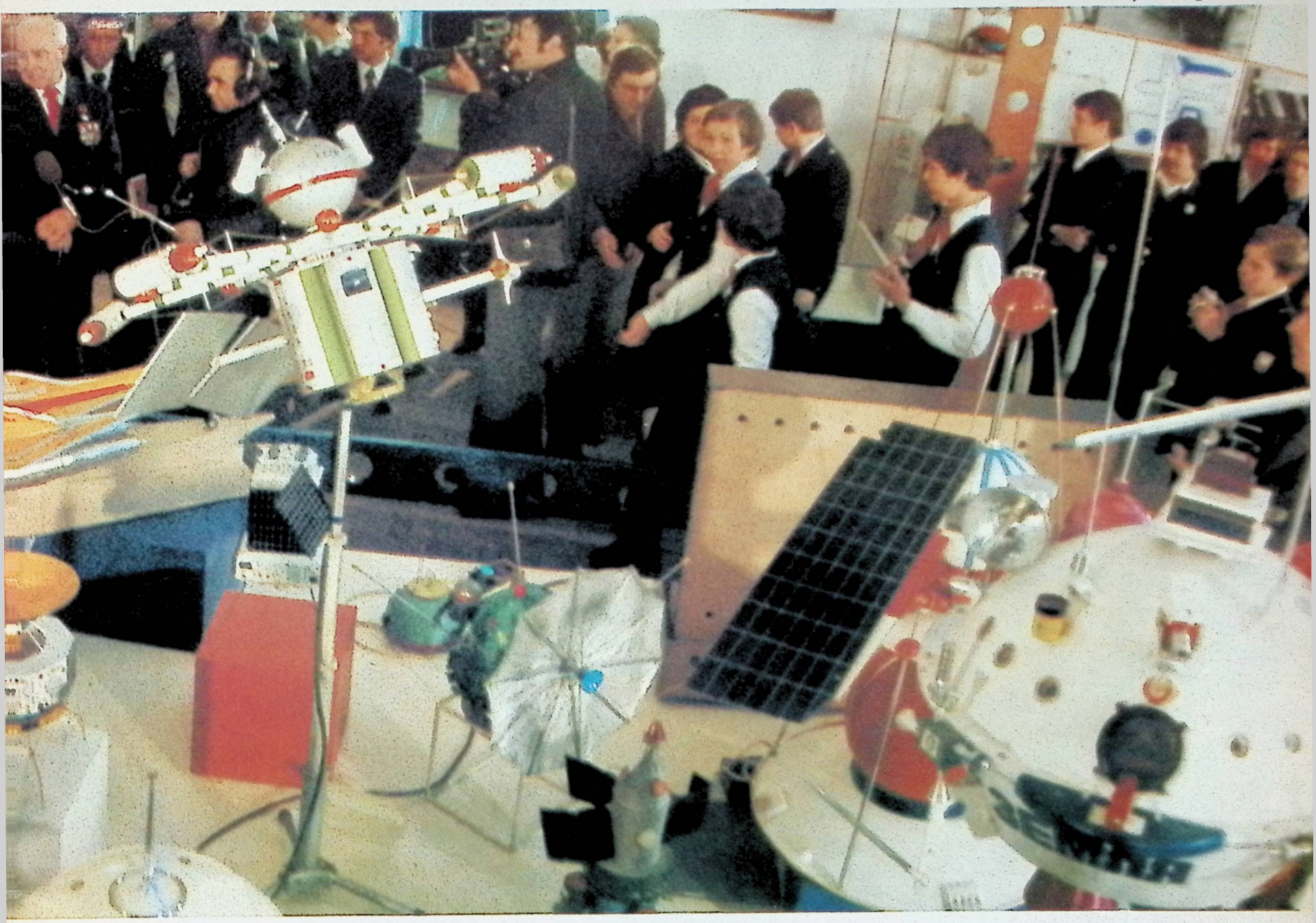
Although the club is 19 years old, even its very first members are young—only a little over 30. For example, Nikolai Sanko first came to the Pioneer Palace in 1962, when he was in sixth grade. He showed a special interest in the problems of infrared astronomy and participated in alpine expeditions to study the amount of vapor in the Earth's atmosphere. Today Sanko works at the Institute of Outer Space Exploration of the USSR Academy of Sciences.

Many children have found their calling at the Pioneer Palace on Lenin Hills. Many, but not all.

"Many of our former students come back to visit us," remarked Boris Pshenichner, head of the astronomy and astrophysics department. "Of course not all of them go on to devote their lives to space research. But they all appreciate the fact that here they learned to work together with other people and to value cooperation and support.



Cosmonauts never miss a chance to see orbital ships of the future designed by young space engineers.



Three, two, one—Blast off! His first launching of a space rocket. Facing page: A stellar globe is a learning aid for finding your way among the stars.

Naturally they are up on everything dealing with space exploration."

"I Want to Be a Cosmonaut Someday"

It was a shame to take up the youngsters' time. They have so much to do in their classes, which last an hour and a half and meet two times a week. So I asked those who wanted to fill in a short form only two questions: What do you like about your club? and Is there anything you want to tell kids in the United States?

While the members were filling out my questionnaire, I continued to peruse the club's exhibits: portraits of Gagarin and other space heroes signed with good wishes to future cosmonauts; a pinch of soil from the Baikonur Cosmodrome; books about outer space autographed by the authors; models of the Moon rover Lunokhod; and souvenirs from the participants of the Soyuz-Apollo project.

The questionnaire was answered by almost everyone. Here is what one of them wrote:

Victor Ryabov, ninth grade:"I've been dreaming of outer space since childhood, and I came here to find out more about it. I've learned a lot and have found many good friends. We are bound by our common interest, and we have a lot to talk and argue about. My friends and I devised the Ekran Project in our space design group and reported on it at the Tsiolkovsky forum in Kaluga.

"We are eager to establish contacts with American boys and girls who are enthusiastic about the exploration of outer space and to exchange opinions with them on the problems of outer space research."

Dreams and Reality

I said farewell to my hospitable hosts, went outside and gazed back at the palace. I thought back to 1960, when my friends and I, in tenth grade at the time, helped to clear the site of the future Pioneer Palace. At that time the word "cosmonaut" was not in common usage—it was six months before April 12, 1961.

Outer space is not just a dream for the children in the club. They are already beginning to explore it. It has become the center of their activities. I would like to believe that some of these youngsters will one day be known to people everywhere. ■

Top: Only seconds remain before the flight into the unknown. Bottom: Yuri Gagarin with his daughters Lena and Galya.

YURI GAGARIN

As the years go by, some events fade or lose their original impact on the memory of humankind. But the name of Yuri Gagarin will remain fresh and live on as the world's first explorer of the mysteries of space. As American astronaut Frank Borman said, Gagarin was one of the world's great sons, a courageous pioneer in whom we will always take pride.

The first cosmonaut with the chief designer of the Vostok orbital spaceship, Academician Sergei Korolyov.

Continued from page 8

body wanted to appear sentimental and that constrained them. Gagarin pulled himself together and blurted out, 'Thank you for the great trust. The mission will be fulfilled.' "

Although the choice of the commission may have come as a surprise to Gagarin, many of his friends in the cosmonaut group expected it.

The morning of April 12, 1961, was the day of the launching. Gagarin proclaimed a dashing, "Off we go!" Descriptions of the launching and Gagarin's preflight speech made banner headlines all over the world.

Yuri not only rose above our planet, but raised all of us on Earth to the challenge that had once seemed beyond human capabilities. The tribute of gratitude paid to him from men and women around the world expressed the new respect they had gained for their own selves and their faith in human dignity. We all changed during those 108 minutes of Gagarin's flight. We grew stronger, and the stars no longer seemed so far away.

In the minds of many, the penetration of outer space was associated with Yuri's smile. Intelligence, courage, love for his fellow human beings, spiritual strength, a sense of responsibility for the fate of those who live on Earth and a heroic capability to be the first to cross the frontiers of the known—all went into that smile.

Before the launching, Gagarin exclaimed: "I wish I could embrace you all, those I know, those I do not know, those far away and those near... "

Where did such love come from? There is no doubt that it was rooted in his high moral principles.

Keeping the faith in his fellow human beings did not come easy for Gagarin. As a child he witnessed the atrocities of the Nazis who occupied his native village. Gagarin's mother cut down the rope and saved the life of his younger brother whom a Nazi had hanged "as a joke."

Yuri's childhood was marred and blotted out by the war. He was not the only cosmonaut to live through all this. Georgi Dobrovolsky escaped from death row in nazi-occupied Odessa. When he was only 16, Konstantin Feoktistov pleaded with the commanding officer of an army unit to take him on as a scout. He produced useful information several times before SS men caught him near his native Voronezh. He faced a firing squad, was shot at and escaped by some miracle, getting away with only a wound. When night fell, he crawled out from under the bodies of the noncombatants shot by the Nazis and somehow managed to reach Soviet-held land. Many cosmonauts lost their fathers during the war.

Gagarin knew all this. From his own experience he had learned how much the Soviet people had suffered.

How strong and noble one's moral immunity against everything black and evil must be to go up to cosmic heights with a smile of peace and kindness on one's face after such experiences! And Gagarin's smile captivated everyone who saw it.

The leading political figures of the world, writers and scientists hailed Gagarin as the "symbol of the space age," "the pride of science," the "legendary son of Earth," the "First Citizen of the Universe." His name was placed along with those of Columbus and Magellan.

The first outer space flight stirred memories and recollections. I recall Jules Verne and his fantastic Columbiad. However, there was no Russian passenger on board that spaceship. I'm sure Verne never dreamed that the Russia of his days would one day make such gigantic strides forward and become one of the advanced nations of the world.

The writer's niece sent the following telegram to Yuri Gagarin:

"Monsieur, I am Jules Verne's niece, and in that capacity I wish to convey to you my admiration for the feat you have performed. You have made the dream of Jules Verne come true. If he were alive, he, without doubt, would now be at your side, sharing the joy of your country. Bravo!"

Outer space proved to be a good medium for promoting international cooperation, the ideas of which are upheld by the Soviet Union in all fields of human endeavor. The realization of the Soviet-American Soyuz-Apollo project is an excellent example.

One needs a friend's shoulder in bad times. "Friendship is tested by deeds," Gherman Titov used to say. "When we future cosmonauts came together for the first time, it happened that the Gagarins and my family were next-door neighbors. Their oldest daughter Lena, a toddler at the time, was born up North, where Yuri had served with an Air Force unit. And my wife Tamara was expecting her first child. That drew our families closer to each other. Our child died shortly after it was born. Yuri offered genuine support. Without being mawkish or heaving sentimental sighs, he simply behaved like a truly close and real friend.

"I was grateful to him and, though I did not know him very well at the time, began to like him a great deal. But then I realized that to like him a great deal or to like him a little simply did not apply to Yuri Gagarin.

"In time I felt that if one had to find a model of a happy, cheerful, witty, extremely honest and openhearted man absolutely devoid of any scheming, Yuri Gagarin would unmistakably fit the bill.

"I remember someone asking Valentina, Gagarin's wife, if there was anyone her husband had disliked. She was at a loss as to what to say. After giving the matter some thought, she confessed that she couldn't think of anybody."

Cosmonaut Andrian Nikolayev recalls: "The very first moment we met, I knew that Gagarin liked me. Yuri was a man of many moods; sometimes he looked concerned or cheerful, sometimes he was excited by the goings-on or calm when everything ran on schedule. But never, not even for a fraction of a second, would he lose the kindness and decency that filled him to overflowing in his dealings with other people. Nor would he ever express his displeasure with someone behind his or her back. Never.

"I was at the cosmodrome when the state commission made its selection and assigned Yuri Gagarin to the first spaceship. I felt as though that flight had been entrusted to me. And, I dare say, I was even more concerned about his success than about my own when I was launched into outer space."

Cosmonaut Boris Volynov shared with me his experiences during the first months with the cosmonaut group. ▶

YURI GAGARIN

His travels around the world after his flight into space exceeded many times the length of the path Gagarin traveled in the Vostok craft. Here the red carpet is rolled out to welcome him home to Vnukovo Airport in Moscow in April 1961.

"Once I got to know everyone, I soon realized that I was back among members of the pilots family. The optimism of the young people and their ability to enjoy life spiced the routine of our life. Constant joking around and harmless practical jokes—all the things that went with Air Force life—were brought along by the boys to the group from the wings and squadrons they had served with. As a rule, the ringleader behind all this fun was Gagarin.

"Yuri was witty, ingenious and always ready with a new practical joke. His ability to change so completely and so rapidly distinguished him from everyone else. There he was the mischief-maker and the cutup and then suddenly the serious-minded Gagarin. He knew how to time his jokes; but he planned even the most simple ones with great detail and enthusiasm. But he always made sure that no one would get hurt and that no one would take offense. The next day he would sit for hours on end poring over his textbooks. Nobody would have tried to distract him from his studies because we all knew it would be useless. He would only smile and say matter-of-factly: 'There's a time for work, and there's a time for play.' His power of concentration was the envy of us all. Even after he became our senior, he managed to stay on an even, friendly footing with all of us and still be a demanding leader.

"Yuri had a rare gift for meeting people and establishing a rapport almost at once. He was an extremely sympathetic person and would appear in the most unexpected situations and at the right moment, too, to help others out. He was always ready to extend a helping hand to a friend in need. And, incidentally, to raise their spirits as well.

"I had just gotten an apartment when my family joined me in Stellar Town. Tamara, my wife, was at a loss about what to do. We didn't have one piece of furniture; only a few carpets that were lying rolled up in the corner of the room. I had just returned from a long training session, and the rugs were all that I had time to buy that day. And then the doorbell rang. A smiling Gagarin stood in the entrance.

" 'When is the housewarming party?' he asked, and without much ado he decided it would be that day.

"Tamara threw up her hands. We didn't even have a table and chairs.

"No well-prepared dinner party has been as much of a success as the housewarming in that empty apartment. 'Well begun is half done,' Yuri joked with a smile. And he was right. Before long our apartment was a home.

"About a year later we were ready to make our first test. Some of us were posted at the cosmodrome, others were at the communications stations to stay in touch with Gagarin, the pilot of the Vostok spaceship.

"Why was he chosen for the mission? At the time, I couldn't come up with a short, quick answer. But now I can: because he was the best man for the job.

"Let me tell you a little about our reaction to the events of April 12," Boris Volynov continued. "During all those months of preparation for the flight, we never gave a thought about how the world and the country would react to one of us flying off into orbit. We were prepared for any trials, and our thoughts and hopes were focused on practical flight-oriented matters. What happened after the flight was something we had never anticipated.

"When I saw Gagarin at the welcoming ceremony in Moscow's Red Square, hundreds of thousands of people in the city were cheering him. I knew that in spite of his ability not to lose self-control, Yuri was a bit overcome by this nationwide celebration. I'll never forget his smile—happy, but somewhat guilty and shy—when he saw us, the future cosmonauts, in the crowd. He thrust himself forward and, it seemed, was about to shout something to us."

Boris Volynov was right about Gagarin's state of mind during those moments. Some time later Yuri himself admitted: "It's true, I was afraid to address thousands of people, to see their astounded, joyous faces. I was ready for the trials of outer space, but I wasn't prepared to meet that sea of faces."

In May 1961, cosmonaut Alexei Leonov told me, "Yuri invited me to go along with him to the editorial office of *Pravda*.

"We went by car. On the way we had to go through the village of Medvezhie Ozera. Somehow the local kids heard that Gagarin was passing through the village, and there they were, lining the street with bunches of lilacs in their hands. It seemed as though the whole village had burst into blossom. Everyone was in high spirits.

"Gagarin had been invited to meet with the editorial board of *Pravda*. The board members asked us to give an account of the flight. Although I thought that I knew Yuri quite well, I listened to his recital with wonder. That was probably his first off-the-cuff public speech—the first after his flight. The way he spoke!

"And then I thought," Leonov went on, "it is not for nothing that he is the first among us. If he had not become a cosmonaut, he would have been a topnotch steelworker, teacher, scientist, whatever; he would have been the best. In short, he was a very clever, talented and brave man."

I met Valentina Gagarina, Yuri's wife, several times after his death. But I could never get up the courage to go up to her and ask her to talk to me about her husband. I couldn't forget the look on her face when she met the members of the press after his death, and I was so afraid of hurting her feelings. But it so happened that Valentina Gagarina yielded to our requests and spoke to us about Stellar Town. Gagarin and Stellar Town were so closely linked in most people's minds that he was jokingly called the Mayor.

"I traveled a great deal with my husband," she said, "we visited numerous foreign countries. We were always greeted warmly and cordially on those trips. Yuri was surrounded by love and received a lot of attention. Stories about him filled the papers, and the press recorded everything he did. He had to make many public appearances and meet people, but he was always longing for Stellar Town. Usually on the third or fourth day of a trip he would say: 'I'm homesick.'

"He dreamed of turning Stellar Town into a single complex, so that the

official and service quarters, the residential part, the forest and the lakes would form one flowing harmonious whole.

"He loved his work at Stellar Town. He was an early riser and would exercise first thing each morning. No matter how crammed and tight his daily schedule was, he always found time to play with the girls, to inquire what their moods were and what their plans for the day were.

"Yuri read a lot. He liked to buy new books for our family library and meet writers. He had long talks with them and was most interested in what inspired them and their new works.

"Yuri did not regard himself as an erudite person, though nature was lavish in endowing him with an insatiable thirst for knowledge. As I said, he was an avid reader, and he grasped things quickly. He had an extraordinary capacity for work, a good memory and a broad background in science, technology and literature. All of this was the result of his perseverance, his temperament and skillful organization.

"I do not know and I cannot explain how he managed to do everything that he took on. He was a member of the parents committee, head of the training commission of the Water-Skiing Federation, a member of the Central Committee of the Young Communist League, chairman of the USSR-Cuba Friendship Society, a deputy of the USSR Supreme Soviet, as well as an author and frequent guest on radio and TV programs.

"He rarely exhibited any tension or stress and was always well prepared to meet his audience. He gave a lot of thought to his speeches and to the subjects that he discussed with scientists and workers. Yuri's smile was bolstered by thoughts, ideas and respect for his fellow human beings.

"Yet at times he seemed agitated and uneasy. He was a very sincere man. And when things went bad for him, he didn't pretend that everything was OK. When he was feeling low, he didn't pretend that he was feeling cheerful. He was always frank when he didn't agree with something or somebody; and he would tell his friends and acquaintances to their face what he thought about them. He didn't do it to offend or humiliate, but to help them.

"Numerous books have already been written about Yuri. And no doubt more will be published. I still get many letters. They are friendly, sympathetic messages inspired by concern for our family. Writers, composers and artists have written to me. Some ask for an interview, some request information about Yuri. Many people have asked whether I plan to write a book about my husband. For the time being, the answer is No. Yuri's early death is still an open wound. To write "he was"—well, that's impossible. To treat him as someone from the past is to put salt on a wound that has not healed.

"Through the years I have come to understand Yuri much better, but I will be frank and admit that there was something in him that still remains a mystery to me. Is it possible that that enigma drew me to him?

"A bronze monument to Yuri can be seen from a window in our apartment. He holds a bouquet of flowers in his hand, as though he were trying to hide it behind his back. Yuri always brought home with him high spirits, joy and optimism. We miss him so much. But fate has no mercy. Never again will he burst into our apartment with his boisterous rumbling laughter and fill the rooms with vitality, cheerfulness and optimism in a way no one else can match.

"He loved Stellar Town; he considered it his own native place and laughed when they called him Mayor. Everything dear to him has been dear to me."

The first meeting of Soviet and American space experts was held in Moscow in October 1970. There the cornerstone of the Soyuz-Apollo Test Project was laid. The grand finale came in July 1975. Soviet cosmonauts Alexei Leonov and Valeri Kubasov and American astronauts Thomas Stafford, Vance Brand and Donald Slayton took part in it.

The world at large hailed the venture not so much because enormous technical problems had been overcome, nor because the language barrier had been conquered by both crews, but because of the desire of the Soviet Union and the United States to work together in outer space for the good of peace.

The project called for joint training sessions of the cosmonauts and the astronauts, as well as exchanges between experts of the two countries. The Soviet cosmonauts visited their American counterparts and the American astronauts returned the visits.

Neil Armstrong, the first man to walk on the Moon, said Gagarin "had called the rest of the cosmonauts and astronauts to follow him into outer space." Neil visited the Cosmonaut Training Center in Moscow and made a good impression on everyone who met him there. "A modest and brave man" was the consensus after he left.

This is the entry Armstrong made in the Distinguished Visitors Book in Gagarin's office at Stellar Town: "It is a great honor for me to be able to sign this book at the Museum of Yuri Gagarin, the man who led our adventures into space."

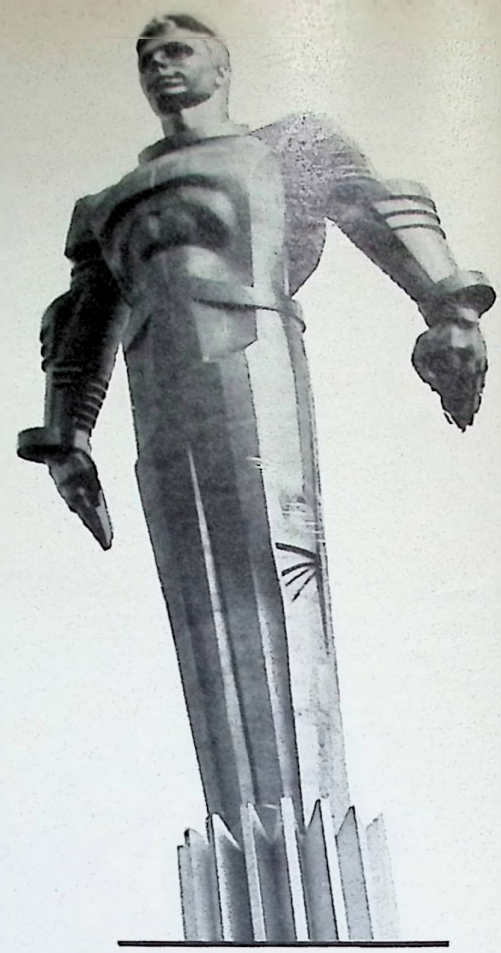
Armstrong was clearly moved when he was introduced to Valentina Gagarina. While he was on the Moon, he had left medals with the images and names of dead American and Soviet outer space pioneers, including Gagarin and Komarov among others.

And there she was—calm, erect, a bit pale—Valentina Gagarina. Neil took a few steps toward her and without saying a word bent and kissed her hand. Then he straightened up. Tears were streaming down his face.

Frank Borman called Gagarin one of the greatest men on Earth, a brave pioneer who will always hold a high place in the history of humanity. Thomas Stafford said that Gagarin's flight has opened to the world absolutely new and boundless vistas for outer space exploration and penetration into the mysteries of the universe.

I would like to think that the words of these American astronauts are more than just an expression of mutual respect by men who share the same calling in life. Those who followed Gagarin into space and had a chance to see our blue planet from outer space, those who saw with their own eyes how beautiful it is and at the same time how small, couldn't help but share a common brotherly concern for our Earth and its destiny. ▶

YURI GAGARIN



It was with thoughts of future space missions in his mind that Yuri Gagarin took off in a jet on his last, tragically interrupted routine training flight on March 27, 1968. Another pilot was also killed in the crash. The first cosmonaut's ashes were placed in a niche in the Kremlin wall. After his death the town of Gzhatsk, near his birthplace, was renamed Gagarin.

Now the last talk. This one is with Colonel-General Nikolai Kamanin. "Let's face it, when you are engaged in something absolutely new and unknown," the General recalled, "your attention is focused mainly on the results and the objects of the project rather than on the people involved in it.

"Let's try even for a fraction of a second to imagine ourselves at Gagarin's side at the very edge of the Earth. It is 7 A.M. Moscow Time; the calendar says April 12, 1961. There are 120 minutes to go before the end of the countdown. The unknown looms ahead. Yuri makes his pre-launching speech, which will be printed in every newspaper and broadcast by every radio station throughout the world. There are almost 600 words in it, but I will quote only 10 here: '. . . And if, nevertheless, I have decided to make that flight. . . .'

"He had made up his mind. To do what? Let us ponder that point.

"People, they say, are the crowning glory of creation. Nature has done a marvelous job in designing us. However, we can withstand only so much in range of temperatures, pressures, in a strictly defined combination of chemical components, under the conditions of reliable 'magnetic' links with our planet. And within a strictly limited speed range of our movements.

"Gagarin's flight on that morning of April 12, 1961, took him beyond most of these limits. All the preliminary calculations and training, to be quite frank, only roughly envisaged and simulated the true conditions in outer space that he was exposed to. Thus, there was no solid base to be sure of the ultimate success of the venture. How would a human system react to such a complete change? And more important, how would the senses interact with the mind in outer space?

"Gagarin had to do more than just make up his mind to perform the flight. He couldn't afford even the do-or-die approach. If Gagarin had died on that day, the space age would have been closed to humankind if not forever, then at least for many years to come. He simply had to come back safely, despite all the unknown dangers lying in wait. To overcome everything and come back at any cost! And to conquer no more and no less than the unknown!

"Only a self-control that no other person has ever been called upon to exhibit in the face of challenge or adversity could help out. To control both one's mind and one's senses—people had never been able to do it before that morning of April 12, 1961. The late American theoretical physicist J. Robert Oppenheimer said in this connection that he could either make a decision and act or start thinking about the motives behind his intentions, his own traits, assets and shortcomings and try to decide why he acts thusly and not the other way around. Each line of action has a place in our lives, but it is clear that one eliminates the other.

"Only a person capable of overcoming the limitations involved in the either-act-or-think alternative could have become the first cosmonaut. Yuri Gagarin was unique in his ability not to blink even for a fraction of a second in the face of danger and, at the same time, to act with thought about what he was doing. It was that ability that fostered his determination before launching and confirmed that we had made no mistake in choosing Yuri for the mission.

"I foresee an objection. What about the test pilots who are occasionally caught in air-crash situations? True, they think and act at the same time and usually come out victorious. But in this case practice, experience, highly developed and extraordinarily keen intuition back up the pilot and side with him. But in Gagarin's case all these advantages were conspicuous by their absence. There was nothing and no one to borrow them from.

"Now let's follow Gagarin around the world after his flight. With him let us plunge into the sea of millions of men and women welcoming him home. Let's walk down the red carpets with him in front of endless honor guards and attend a succession of official functions in scores of capitals and cities throughout the world. Then let's hold in our hands the awards conferred upon Yuri from a wide range of different countries.

For recreation he enjoyed water skiing, early morning fishing or hunting in the nearby woods. Center: Vladimir Komarov. Right: Nikolai Andrianov.

"Heads on the shoulders of much more mature people have been known to start swimming as they become intoxicated with success. Yuri never allowed the glory to get the best of him. By his deeds Gagarin proved that he never forgot that only part of the fame was his. He realized that the flight that immortalized his name would never have materialized had it not been for the workers, scientists, designers, had it not been for Sergei Korolyov.

"Fame for Gagarin was a gift of fate, and a heavy burden, too. He always sought to bring in line the gratitude of the people of the world with his everyday conduct and the performance of his duties. He had the most profound love and respect of his colleagues." ■

SPACEMAN NO. 100

AS THIS ISSUE was going to press, on March 12 the Soviet Union launched the Soyuz T-4 spacecraft with two men aboard, flight commander Vladimir Kovalyonok and flight engineer Victor Savinykh. According to the flight program, the Soyuz T-4 will link up with the orbital complex Salyut 6-Progress 12.

This is Savinykh's first space flight. He was born in 1940 in the village of Berezkiny in Kirov Region. After graduating from the Perm Technical School of Railroad Transportation in 1960, he worked at the Sverdlovsk railroad in the Urals and later served in the Soviet Army. In 1969 he graduated from the Moscow Engineering Institute of Geodetics, Aerial Photography and Cartography and went to work in a design office. He devised equipment for spacecraft and took part in flight control for a number of missions before he became the hundredth person to go into space.

Scientists'Opinions

COMMUNICATION WITH EXTRATERRESTRIAL INTELLIGENCE (CETI): IS IT POSSIBLE?

Joseph Shklovsky, corresponding member of the USSR Academy of Sciences: For centuries scholars and philosophers in different fields believed that the cosmos was "totally" inhabited by rational beings. I would like to stress the word "believed" because it is only within the past three decades that our knowledge of the nature of the universe has increased to a degree that makes it possible to place the age-old question of the existence of extraterrestrial rational life on a scientific footing. Today we are witnessing the transition of scientists' views and moods from the "adolescent" stage of optimism to a more sober and dispassionate analysis of the problem.

It is becoming more and more clear that the birth of life in a corner of the universe most suited for the purpose (and such places are remarkably few) is extremely rare. To be quite frank, we are unable, even now, to explain the origin of life on Earth.

And even less probable is the evolution of life born somewhere in the universe into a rational one, that is, into an extraterrestrial civilization. Having once entered the technological era (we have to allow for such development for at least a small number of the civilizations), they would very soon, in a matter of some thousand years, have developed the resources of their planetary system and would not have escaped our powerful modern optical telescopes and radio telescopes. However, astronomers have not observed any "cosmic miracles" in the sky so far.

Hence, we may conclude that the number of civilizations technologically more developed than ours is next to nil in our galaxy. It is quite possible that civilization on Earth is unique not only in our galaxy but among a whole group of galaxies. It is paradoxical that 2,300 years after Aristarchus of Samos we are observing a return to the geocentric, or more exactly the anthropocentric, system of the universe.

Vsevolod Troitsky, corresponding member of the USSR Academy of Sciences: I believe that intelligent and rational life is not an accidental phenomenon that has emerged due to a fortunate convergence of favorable circumstances. But the dominating concept that intelligent life is being born in the universe all the time on planets suitable for the purpose, independent of the general evolution of the universe, arouses doubt. It is more probable that life originated in many parts of the universe where conditions were favorable at a definite moment of its evolution. Life did not originate either before or after that definite moment but merely evolutionized toward reason in unison with the rate of the evolution of the universe. If that is so, we should date the beginning of the origin of life four billion years back from the present because we know exactly the time when life originated on Earth.

That suggests a number of conclusions regarding the present state of the population of the galaxy; it is the first time that the speed of the evolution of living matter toward reason, its possible decline, and so on have been included in estimating population. Furthermore, the theory makes us conclude that even if the life span of the civilizations is limitless, their number in the galaxy is limited because of the absence of very old and very young civilizations. This concept is more in accord with our present-day experience and explains, among other things, the absence of the colonization of Earth and the absence of "cosmic miracles" connected with space engineering activity.

Nikolai Kardashev, corresponding member of the USSR Academy of Sciences: There is no doubt that there are many civilizations in the universe. The main obstacle in finding them is that it is difficult for us to imagine their appearance and behavior if they are a billion, a million, a thousand or even a hundred years older than we are. And the universe, with its present forms of heavenly bodies, is anywhere from 10 to 20 billion years old. The search for humanoid associations close to our technological level of development is a naive delusion that holds no promise of success.

Boris Panovkin, Candidate of Science (Technology): The problem of extraterrestrial civilizations is still a purely theoretical one. Up till now, we have not discovered any extraterrestrial civilizations to serve as objects of our study. The very assumption of the existence in space of rational beings resembling humans remains an assumption, a hypothsis and nothing more. The hypothesis in its most widespread form maintains there may exist civilizations in the universe surrounding us which could enter into informational contact with us, and which, having surpassed us in development, could even influence our future existence. We can hardly regard the hypothesis, in its present form, to be a correct one. It fits with the traditional "common sense" approach rather than the level of modern science. In my opinion, it would be preferable from the broad scientific point of view to assume that the Earth's civilization is unique in the sense that there are no other communities in the universe that could enter into direct or "informational" contact with us.

Therefore, one should view the radio astronomic approach to the search for extraterrestrial civilizations as theoretical and partly a game: We assume that the "necessary" extraterrestrial civilizations do exist, and so we discuss concrete problems of exploration related to astrophysics, radiophysics and cybernetics.

The principal cognitive result of this theoretical task is to discover the laws that should guide us in our activity in space.

So how should we regard the statements by those scientists who as good as promise to establish contact with extraterrestrial civilizations in the near future? Obviously as "superfluous" theoretical output and excess optimism, which is natural when a new branch of science is being born.

Professor Nikolai Petrovich, Doctor of Science (Technology): The problem of extraterrestrial civilizations (ETC) now ranks among the most difficult problems based on the hypothesis of the existence of other rational beings somewhere in space. Is it possible to confirm or reject this hypothesis on the basis of theoretical calculations? I say a thousand times No!

Movement along the "inanimate-animate-rational" chain depends upon a million factors that undoubtedly contain elements of chance and do not lend themselves to precise calculation.

OUR CREWS

While they all have different personalities, each cosmonaut has come through the tests of will and persistence, knowledge and courage with flying colors. A commemorative panel of marble tablets with the cosmonauts' names and the dates of their flights has been built among the slender white birches and thick pines in the center of Stellar Town. Some of the tablets are blank, awaiting the names of new Soviet space explorers.

Yuri Gagarin, *Vostok 1, Apr. 12, 1961.*

Boris Yegorov, *Voskhod 1, Oct. 12-13, 1964.*

Alexei Yeliseyev, *Soyuz 5, Jan. 15-18, 1969; Soyuz 8, Oct. 13-18, 1969; Soyuz 10, Apr. 23-25, 1971.*

Gherman Titov, *Vostok 2, Aug. 6-7, 1961.*

Konstantin Feoktistov, *Voskhod 1, Oct. 12-13, 1964.*

Yevgeni Khrunov, *Soyuz 5, Jan. 15-18, 1969.*

Andrian Nikolayev, *Vostok 3, Aug. 11-15, 1962; Soyuz 9, June 1-19, 1970.*

Alexei Leonov, *Voskhod 2, Mar. 18-19, 1965; Soyuz 19-Apollo 18, July 15-21, 1975.*

Georgi Shonin, *Soyuz 6, Oct. 11-16, 1969.*

Pavel Popovich, *Vostok 4, Aug. 12-15, 1962; Soyuz 14-Salyut 3, July 3-19, 1974.*

Pavel Belyayev, *Voskhod 2, Mar. 18-19, 1965.*

Valeri Bykovsky, *Vostok 5, June 14-19, 1963; Soyuz 22, Sept. 15-23, 1976; Soyuz 31-Salyut 6, Aug. 26-Sept. 3, 1978.*

Georgi Beregovoi, *Soyuz 3, Oct. 26-30, 1968.*

Anatoli Filipchenko, *Soyuz 7, Oct. 12-17, 1969; Soyuz 16, Dec. 2-8, 1974.*

Valentina Tereshkova, *Vostok 6, June 16-19, 1963.*

Vladimir Shatalov, *Soyuz 4, Jan. 14-17, 1969; Soyuz 8, Oct. 13-18, 1969; Soyuz 10, Apr. 23-25, 1971.*

Victor Gorbatko, *Soyuz 7, Oct. 12-17, 1969; Soyuz 24-Salyut 5, Feb. 7-25, 1977; Soyuz 37-Salyut 6, July 23-31, 1980.*

Vladimir Komarov, *Voskhod 1, Oct. 12-13, 1964; Soyuz 1, Apr. 23-24, 1967.*

Boris Volynov, *Soyuz 5, Jan. 15-18, 1969; Soyuz 21-Salyut 5, July 6-Aug. 24, 1976.*

Vladislav Volkov, *Soyuz 7, Oct. 12-17, 1969; Soyuz 11-Salyut 1, June 6-30, 1971.*

Vitali Sevastyanov, *Soyuz 9, June 1-19, 1970; Soyuz 18-Salyut 4, May 24-July 26, 1975.*

Valentin Lebedev, *Soyuz 13, Dec. 18-26, 1973.*

Vladimir Aksenov, *Soyuz 22, Sept. 15-23, 1976; Soyuz T-2-Salyut 6, June 5-9, 1980.*

Vladimir Dzhanibekov, *Soyuz 27-Salyut 6, Jan. 10-16, 1978; Soyuz 39, Mar. 22-30, 1981.*

Nikolai Rukavishnikov, *Soyuz 10, Apr. 23-25, 1971; Soyuz 16, Dec. 2-8, 1974; Soyuz 33, Apr. 10-12, 1979.*

Yuri Artyukhin, *Soyuz 14-Salyut 3, July 3-19, 1974.*

Vyacheslav Zudov, *Soyuz 23, Oct. 14-16, 1976.*

Alexander Ivanchenkov, *Soyuz 29-Salyut 6, June 15-Nov. 2, 1978.*

Georgi Dobrovolsky, *Soyuz 11-Salyut 1, June 6-30, 1971.*

Gennadi Sarafanov, *Soyuz 15, Aug. 26-28, 1974.*

Valeri Rozhdestvensky, *Soyuz 23, Oct. 14-16, 1976.*

Vladimir Lyakhov, *Soyuz 32-Salyut 6, Feb. 25-Aug. 19, 1979.*

Victor Patsayev, *Soyuz 11-Salyut 1, June 6-30, 1971.*

Lev Demin, *Soyuz 15, Aug. 26-28, 1974.*

Yuri Glazkov, *Soyuz 24-Salyut 5, Feb. 7-25, 1977.*

Leonid Popov, *Soyuz 35-Salyut 6, Apr. 9-Oct. 11, 1980.*

Vasili Lazarev, *Soyuz 12, Sept. 27-29, 1973.*

Alexei Gubarev, *Soyuz 17-Salyut 4, Jan. 11-Feb. 9, 1975; Soyuz 28-Salyut 6, Mar. 2-10, 1978.*

Vladimir Kovalyonok, *Soyuz 25, Oct. 9-11, 1977; Soyuz 29-Salyut 6, June 15-Nov. 2, 1978; Soyuz T-4-Salyut 6-Progress 12, Mar. 12-( ), 1981.*

Yuri Malyshev, *Soyuz T-2-Salyut 6, June 5-9, 1980.*

Oleg Makarov, *Soyuz 12, Sept. 27-29, 1973; Soyuz 27-Salyut 6, Jan. 10-16, 1978; Soyuz T-3-Salyut 6, Nov. 27-Dec. 10, 1980.*

Georgi Grechko, *Soyuz 17-Salyut 4, Jan. 11-Feb. 9, 1975; Soyuz 26-Salyut 6, Dec. 10, 1977-Mar. 16, 1978.*

Valeri Ryumin, *Soyuz 25, Oct. 9-11, 1977; Soyuz 32-Salyut 6, Feb. 25-Aug. 19, 1979; Soyuz 35-Salyut 6, April 9-Oct. 11, 1980.*

Leonid Kizim, *Soyuz T-3-Salyut 6, Nov. 27-Dec. 10, 1980.*

Pyotr Klimuk, *Soyuz 13, Dec. 18-26, 1973; Soyuz 18-Salyut 4, May 24-July 26, 1975; Soyuz 30-Salyut 6, June 27-July 5, 1978.*

Vitali Zholobov, *Soyuz 21-Salyut, 5, July 6-Aug. 24, 1976.*

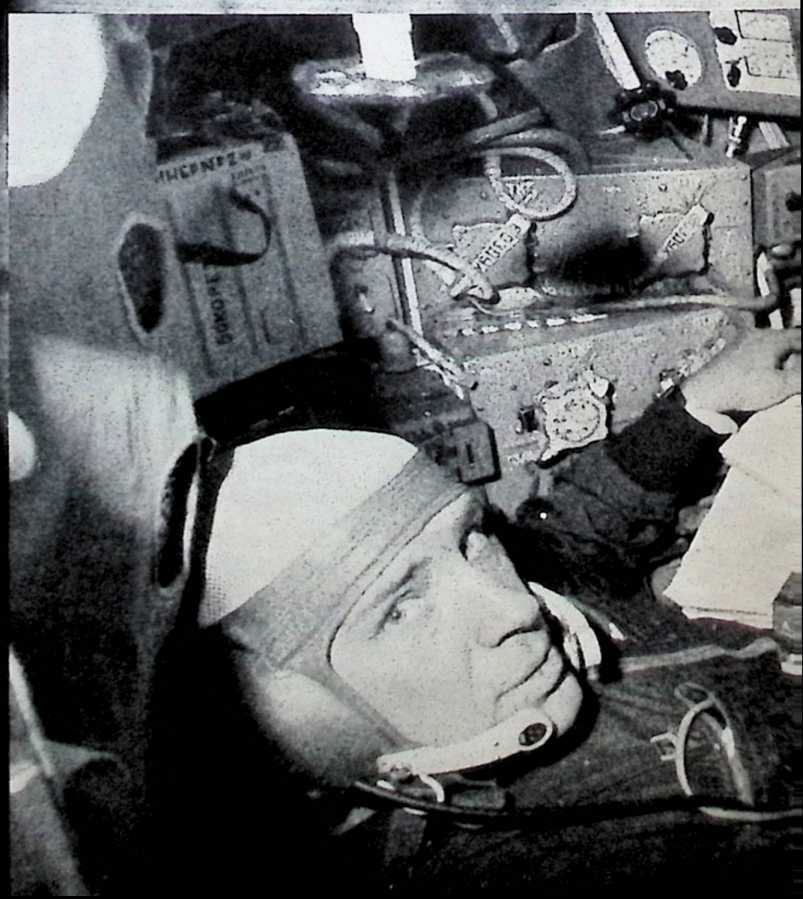
Yuri Romanenko, *Soyuz 26-Salyut 6, Dec. 10, 1977-Mar. 16, 1978.*

Gennadi Strekalov. *Soyuz T-3-Salyut 6, Nov. 27-Dec. 10, 1980.*

(For information on the Soviet Union's newest cosmonaut, please turn to page 27.)

HALF A YEAR

AWAY FROM

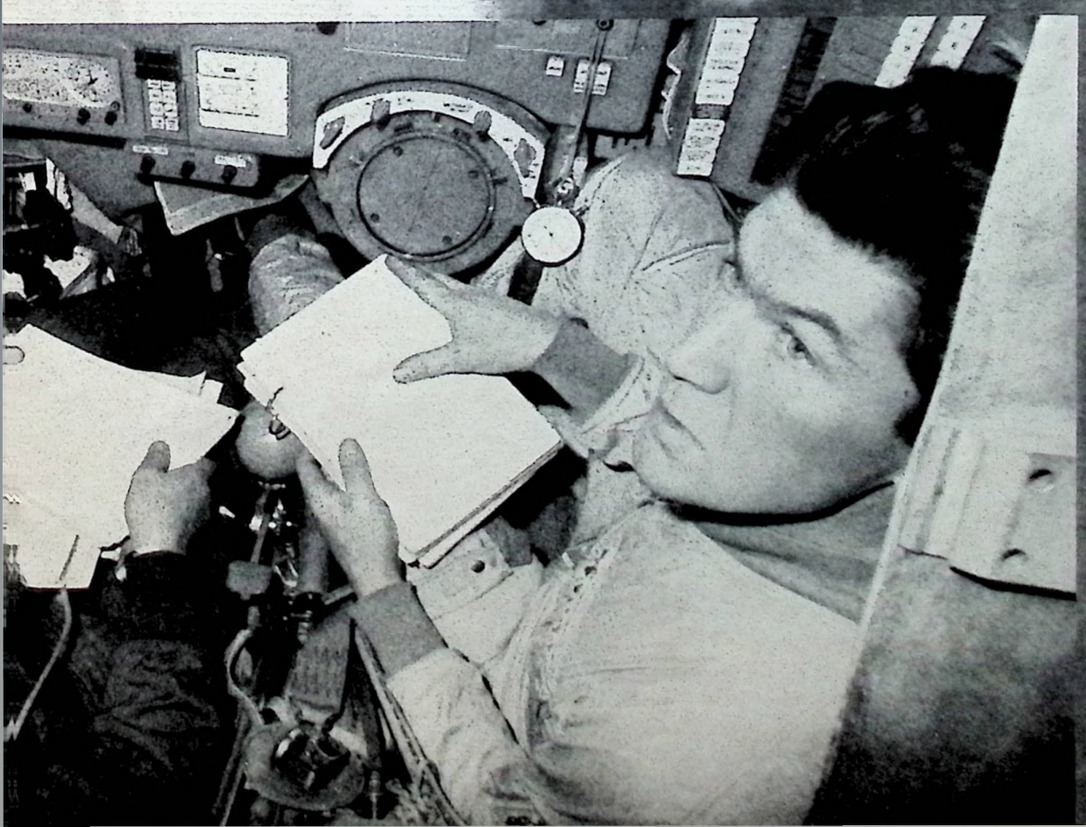


Just like this, side by side, Valeri Ryumin, on the right, and Leonid Popov worked aboard the Soyuz 35-Salyut 6 research complex for 185 days. They passed the hard test not only in physical and technical preparedness, but also—and this is the main point—in psychological compatibility.

EARTH

BREAKING ALL SPACE RECORDS

Space shakes up the human body like a cocktail. Apart from the physiological stress, coming back from weightlessness to gravity is accompanied by pronounced emotional euphoria. Cosmonauts readily agree to talk, replaying with pleasure their impressions of space and recalling details of their extraterrestrial life and work that a week later may seem naive, trifling or even ridiculous. Valeri Ryumin, a 41-year-old Moscow engineer who has spent 360 days in space within the last two years, proved to be no exception. These excerpts from the diary of the first long-term resident of space and notes of conversations with him at Baikonur Cosmodrome were kindly given to us by Nikolai Zheleznov, a 15-year veteran of the press space pool.



TWO TIMES Valeri Ryumin left the Earth in spring and returned in the fall. For two consecutive summers he didn't walk in the woods, didn't swim in a river, didn't see his son off to camp during vacation.

What is the price of these deprivations? During a long flight doesn't a cosmonaut develop a sense of being hopelessly separated from the conventional world? Doesn't he protest against the fact that his terrestrial person has been split into two?

"Such psychological problems," says Valeri Ryumin, "have been invented by journalists as they try to maintain their readers' interest in space at the same level it was during the days of Gagarin's first flight or Armstrong's landing on the Moon. Unfortunately, sensations today are born with an evening issue of the newspaper and die with the morning issue, or vice versa. The formula of 'who, what, where, when and a little why' satisfies most people in this age of constant information overloads.

"As far as the 'price' of being away from the Earth for so long is concerned, matters are much simpler here. A polar explorer, leaving the mainland for a year, 'pays the bills' in advance, by psychologically preparing himself to replace his warm home with ice, and summer sunlight with the polar night. It seems to me that cosmonauts are no exception. The greater the challenge, the more I have to do it. This was exactly how I explained it to my seven-year-old son Vadim before I left the Earth. He didn't ask me why.

"As for there being another me, I do feel that I am another person when the rocket blasts off from the Earth and loads increase and it seems I am leaving the planet forever and that there is no power that could bring me back. But then the ship goes into orbit, and through a porthole I see the Earth floating beneath, and that sense of isolation is no longer there. If another me existed at all, it did not stay on the Earth but took the shape of my colleague during the flight, Leonid Popov.

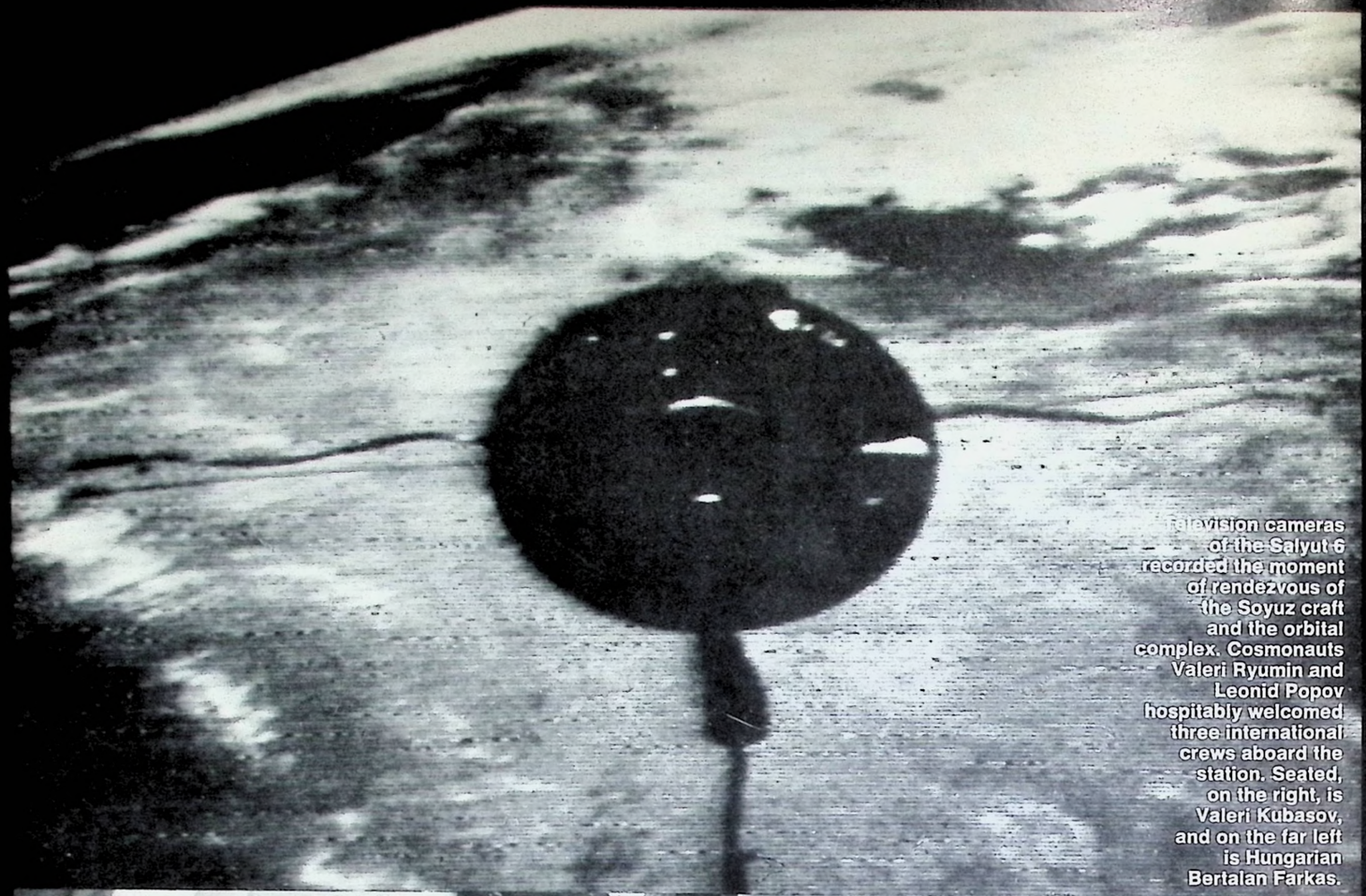
"Entering Salyut, which was to be both our home and our office for six months, we told each other: 'We are brothers. I am you and you are me.' Not once in all those six months did we break our oath. Had it not been so, each of us would obviously have felt very much alone in orbit."

Weightlessness: Do We Take the Offensive Or the Defensive?

On the second day after his return from the record-breaking space flight, Ryumin appeared on a tennis court. In the morning we saw him acting as a referee, and in the evening with a racket in his hands. Leonid Popov, the commander of the expedition, willingly accepted Ryumin's style of speeded-up re-adaptation.

Perhaps no other space crew has demonstrated such a fast "return" to the conditions of the Earth's gravity so far. What is the explanation? A strong will or the logical result of a well-planned medical system?

"The individual physical and psychological makeup of a cosmonaut," says Ryumin, "certainly plays an important role in one's successful adaptation to weightlessness and then re-adaptation upon return to Earth. I recall a remark made by one of our cosmonauts, Andrian Nikolayev, a man of undeniable courage and calm. After an 18-day flight in a Soyuz spaceship he confided to me that when he reached the landing site, he felt as though his legs had turned into a tail. It seemed as though he had no use for them any more, he said. In the early years of space flights, when cosmonauts were simply crammed into a space capsule, both Soviet and American medical experts saw only one way to combat the unfavorable effects of weightlessness. They combined intensive equilibrium training before ▶



Television cameras of the Salyut 6 recorded the moment of rendezvous of the Soyuz craft and the orbital complex. Cosmonauts Valeri Ryumin and Leonid Popov hospitably welcomed three international crews aboard the station. Seated, on the right, is Valeri Kubasov, and on the far left is Hungarian Bertalan Farkas.

takeoff with light medication during flight. Alas, the results of these measures were hardly encouraging. Today space doctors no longer ponder the question of whether they should take the offensive or the defensive. Their strategy, which, by the way, we very strictly observed in our flight, is that the body should be constantly 'reminded of the Earth' and that its systems, especially the cardiovascular system, should be able to endure extreme changes in environment.

"After getting out of the Earth's gravity and learning to swim like a fish and deriving a genuine sensation of pleasure from this, it's not easy to fasten yourself each day into a gymnastic apparatus or a veloergometer. Those daily jolts to the heart, vessels and muscles lasted two hours. Our work on the veloergometer alone was rated by specialists as the equivalent of a skier's expenditure of energy on a five-kilometer ski run. We received a similar load from exercise on a running track and from working in special suits that put stress on the back and leg muscles."

Does Anyone Ever Become Ill in Space?

Surprisingly, not one of the cosmonauts who participated in the four major expeditions in Salyut 6 (96, 140, 175 and 185 days) ever complained of a minor ailment, a cold or toothache for that matter. What is this—one of the phenomena of space sterility or a reaction of the body to the extreme conditions?

"However strange it may seem," Ryumin commented, "it is a fact. I spent a year outside the Earth [175 and 185 days] without the slightest hint of even a mild cold. Down here on Earth, too, we run across numerous examples of how the body mobilizes its reserves in a critical situation. For example, mountain climbers ascending a peak never catch a chill even when they get badly frozen. The sterility of the closed medium in which we worked, of course, did its bit in that our first-aid kit remained unopened. Yet, I would venture to say that the protective systems of the body in such extreme conditions are constantly in the position of a cocked gun and are ready to fire at any moment."

But this subconscious thought, that is, you can't afford to get sick, must have caused a heavy nervous strain on you, even though it could not be noticed in your work. How did you alleviate this stress?

"Just about the same as on Earth. We relaxed either by frequently changing our routine tasks or by listening to music. But it was the visiting expeditions that gave us the major psychological support. We hosted the crew that came round to us with a test program in the new Soyuz T spaceship and helped to carry out a large number of scientific experiments during the expeditions which included Hungarian, Vietnamese and Cuban cosmonauts.

"As a final argument in support of the theory that work is the best cure for anxiety and depression, I would like to cite data from the report of the fourth major expedition. In half a year Popov and I sent back to Earth more than 4,500 photographs of different areas of the land and the ocean, plus about 40,000 spectrograms of interesting phenomena in the atmosphere and on the Earth's surface. In addition, we obtained 250 specimens of new materials—semiconductors, alloys and coatings—using the technological facilities of the station. One modest but important triumph for space biologists was that for the first time we were able to grow the *Arabidopsis*, a plant, from seeds up there in orbit."

From Salyut and Skylab to Stellar Town

Valeri Ryumin's name is coupled with the Salyut 6 station not only because he spent nearly a whole year in this orbital complex, but also because the young engineer was one of the leading developers of the project of the first orbital station in the design bureau under Academician Sergei Korolyov. During each Salyut launching he represented the design bureau at the space center and was a deputy to the chief engineer for the station. I asked him about the prospects for the use of orbital stations in space research for the next two decades as he saw it from the perspective of his latest experience.

"The expeditions of the American Skylab and the first five Salyuts have convinced engineers that manned orbital platforms will become the highway of future progress in aerospace and penetration into the depths of the universe. But stations of this type were limited in their capabilities. Having just one docking system prevented such operations as refueling in orbit, visiting expeditions and rescue work in space.

"The launching of Salyut 6, equipped with two linking units, one of which, apart from a common docking device, was also fitted out with communications and automatic refueling systems, marked an important step forward. Salyut 6 contributed several pioneering achievements to the history of space flights. Without them it would be hard to imagine qualitatively new advances in astronautics. I would say the first among them was the prospect of regular in-orbit refuelings of the station with the aid of shuttle craft. Over the years of work at the station, 11 Progress cargo spacecraft have delivered more than 20 tons of fuel, air, water, food, scientific instruments and individual units and devices for maintenance and repair work to orbit. During the last expedition alone 4 Progress crafts were unloaded, and a great deal of repair and maintenance work was performed on the life-support and control systems of the station. As a result, when Leonid Popov and I departed from the station on October 11, it was in a condition quite suitable for further operation."

Is it possible to work in space without a break for more than six months? Immediately after landing Leonid Popov replied in the affirmative. "A diversified program is the most important thing for a stable working climate in the station," he added. Ryumin seconded that statement.

"One hundred and eighty-five days is not the limit to the body's endurance," he said. "But then again, an increase in duration must be justified by a concrete objective. For example, if an expedition to Mars were now under preparation calling for an intermediate year-long expedition in near-Earth orbit, I would willingly join it.

"But obviously there is still a great deal to be done in near-Earth orbit before we can fly to Mars. Everything indicates that we will start out for other planets from near-Earth launching platforms, which will become the prototype of the first engineering settlements outside the Earth. Even now, for example, technical possibilities exist for the assembly of sophisticated space complexes in orbit on the basis of existing modules, which, along with scientific investigations, could conduct experimental work on the construction of interplanetary ships. Naturally, these projects will be developed parallel to the further study of planets with the help of automatic vehicles like the Soviet probes Mars and Venus and the American Voyager, whose mission in the vicinity of Saturn I would call one of the outstanding events of 1980 in unmanned space exploration."

From Baikonur Cosmodrome and Moscow

Before their joint space flight, Valeri Ryumin and Leonid Popov were close friends. Their families often spent weekends together, hunting or fishing.

EXTRATERRES
INTELLIGENCE
THE SEARCH CONTINUES

A LARGE scientific forum meets each year in Kaluga, the birthplace of Konstantin Tsiolkovsky, the father of astronautics. The symposium is attended by scientists working in a variety of fields—astrophysics, cosmology, astronautics, radio astronomy, biology, cybernetics and linguistics. The participants discuss ideas found in the enormous legacy left to us by Tsiolkovsky, report on the latest findings in outer space research and share their plans for future programs.

A symposium on "Tsiolkovsky's Ideas on Scientific Problems of Extraterrestrial Civilizations" was held within the framework of the latest readings. Tsiolkovsky was not only a theoretician on interplanetary flights, but also a versatile thinker who was very much concerned with the existence of extraterrestrial intelligence as a scientific problem.

Pessimism Replaces Optimism

The search for extraterrestrial civilizations as a modern scientific problem is more than 20 years old. Some theoretical and experimental results have already been gained in the field, and several hypotheses offered and substantiated.

By the time the Kaluga symposium opened, nine years had passed since the first Joint National Academy of Sciences-USSR Academy of Sciences Conference on Communication with Extraterrestrial Intelligence was held at the Byurakan Astrophysical Observatory in Armenia in 1971. Scientists arrived at optimistic conclusions then, believing that the prospects for making contacts with "brothers in intelligence" in outer space were good enough to launch several search programs.

A lot has changed in those nine years. Pessimistic notes have become more and more pronounced. In 1976 Soviet astrophysicist Joseph Shklovsky, a corresponding member of the USSR Academy of Sciences and one of the founders of research work on the problem, published an article in the journal *Voprosy Philosophii (Problems of Philosophy)* titled "The Uniqueness of Intelligent Life in the Universe as a Possibility." Among other things he wrote that ". . . the conclusion that we are alone, if not in the entire universe, then at least in our galaxy or even in the local galactic system, is substantiated at present no less convincingly, and, in fact, even more credibly than the traditional concept of the plurality of the inhabited worlds. . . ." This radical point of view is shared by other scientists, in particular by American physicist Michael H. Hart.

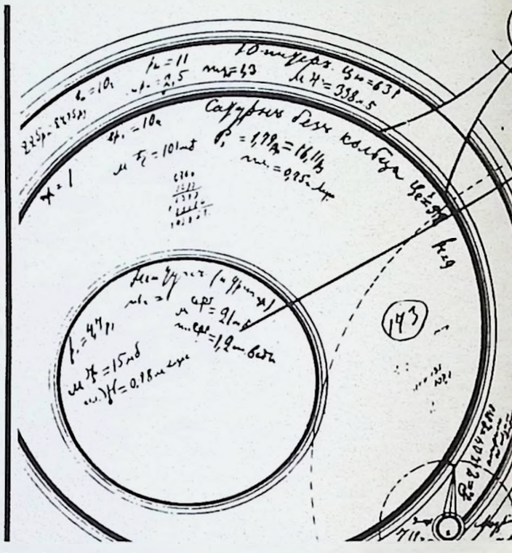
So what has happened? What was the basis of the concept that so irrevocably did away with this newborn line of scientific research? Is it possible that our search for other and different intelligent communities in the proximity of far-away suns will turn out to be no more than just another scientific curiosity of the twentieth century?

To begin with, the universe is silent. Throughout the years of careful search, nothing has been bagged by the researchers but radio sounds generated by colossal in scale but nevertheless most natural processes. Negative results have been obtained both by Soviet scientists from the Radiophysics Research Institute at Gorky working under Vsevolod Troitsky, a corresponding member of the USSR Academy of Sciences, and by American experts Frank D. Drake, director of the National Astronomy and Ionosphere Center (part of which is the Arecibo Observatory in Puerto Rico) and Goldwin Smith Professor of Astronomy at Cornell University; astronomer Benjamin M. Zuckerman at the University of Maryland; and chemist Bryan Palmer at Henderson State College. They carried out a detailed survey of the sky with the purpose of detecting unnatural radio signals from the 600 stars closest to us.

Very little, true enough, has been done so far. The observations have been short in duration and, by and large, rather sporadic. Nor has an over-all strategy for the search been worked out as yet. Way back at the Byurakan symposium American astrophysicist Carl Sagan, who has since played key roles in the Mariner, Viking and Voyager missions, stated that at least a million stars have to be probed to have even the most slender chance of success.

But there is more than just the silence of outer space that lies at the heart of the uniqueness-of-the-Earthlings concept. Michael Hart believes that space in the vicinity of the majority of stars is in general void of any ecosphere, that is, of regions suitable for sustaining life, and wherever these are present, they are remarkably narrow. Shklovsky points out that the Sun with its "retinue" of planets is most probably a rare exception in the stellar world. He says that the possibility of the emergence of life on a planet and of the evolution of such life into an intelligent civilization, particularly into a technologically advanced one, is extremely small.

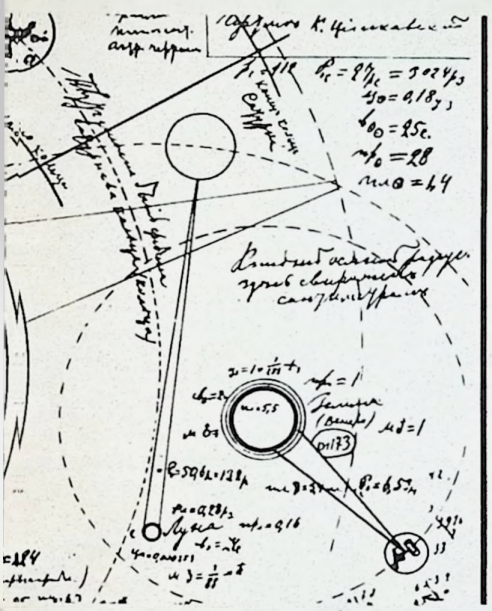
Still, the basic argument advanced by Shklovsky, Hart and the Englishman Freeman Dyson, a theoretical physicist at the Institute for Advanced Study of Princeton University, is that there is no evidence that highly developed outer space civilizations have ever tried to make use of and colonize our stellar system. Dyson asserted that if a technologically advanced society really existed in our galaxy, the results of its activity would be evident. However, there is nothing in our galaxy that suggests a technologically developed society. If a great number of such societies did exist, at least one of them would probably strive for and attain domination. Shklovsky goes even farther: "Inasmuch as a certain part of the terrestrial-type civilization, after overcoming numerous crisis situations, is bound to resort to unlimited expansion, logically we can only conclude that the number of such civilizations in the local system of galaxies is either insignificant or, most probably, amounts to nothing."

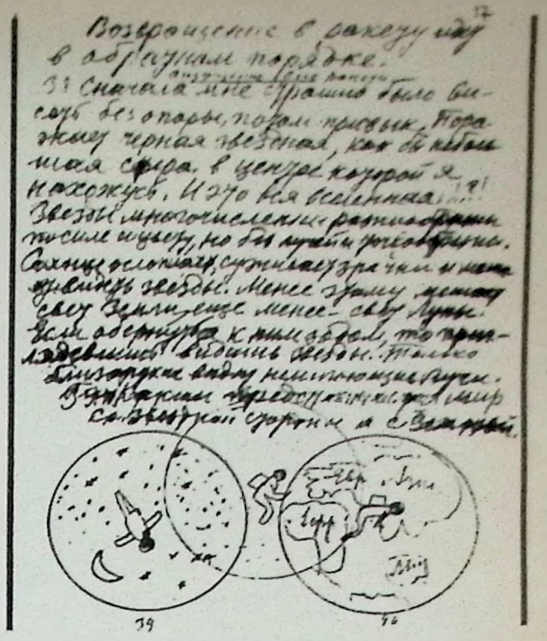


Boris Panovkin, a Soviet scientist who is also studying these problems, notes that "individual forms of the existence of matter should not necessarily produce analogues of life and intelligence 'corresponding' to these forms. Nor can we rule out the rise of 'singular' self-organizations in definite material contexts. Environmental characteristics make the rep-

TRIAL

So far we have only skimmed the surface of the possible objectives of and motives for contacts between cosmic civilizations. One might assume that at present we would be content with experimental evidence of the existence of other intelligence in outer space, writes Leonard Nishkin, an engineer. That would be one of the most exciting events in all history. But then what? he asks in this electrifying discussion. Indeed, then what?





Drawings by Konstantin Tsiolkovsky, who maintained that once human beings were put into orbit around the Earth, everything else, including travel out of the solar system, would be relatively simple. Far right: Tsiolkovsky's impressions of the Earth from outer space.

etition of such a process highly improbable."

The Crusade Against Pessimists

Although such views are gaining new adherents, most of the scientists who took part in the debate at the 1980 Kaluga symposium rejected them. They called attention to a certain simplification in such negative concepts, especially since we are now able to see more and more clearly the grand scale and the remarkable versatility of outer space studies. They affect almost every area of human endeavor. The weak points of the "uniqueness" hypothesis were cited at the symposium as follows: The knowledge we have today does not allow us to formulate how outer space civilizations develop; there are no physical criteria for defining the "artificiality" of the phenomena and processes observed in outer space; the totality of our knowledge and observation data, scarce and insufficient as it is, gives us no grounds to consider the Earth and the solar system to be unique bodies. Have not all similar concepts proved absolutely wrong in the past? The Earth is not the center of the universe and neither is the Sun, lost as it is among billions of other stars in the back of the beyonds of a gigantic stellar system. Nor is our galaxy anything exceptional amid similar formations.

The experts have also pointed out the unreasonableness of extrapolating the present trends in the development of our civilization when attempting to imagine the activity of such complex and supercomplex systems as outer space civilizations are bound to be. Leonid Leskov, Doctor of Science (Physics and Mathematics), asserted that the possibility of the "expansive" development of these civilizations on a galaxy scale was, in general, questionable. Investigations with the use of systems dynamics have caused him to believe that interstellar flights cannot make any significant contribution to the development of civilizations. He says that they are not part of the main roads of progress. Referring to the analysis of the optimal relations within the classical science-technology-production triad, he postulates that civilizations cannot attach any significant hopes to the use of stars for their economic activity. Moreover, he speculates, one might assume that civilizations attain the maximum possible levels of development and the upper reaches of the state of intelligence almost instantaneously (by cosmic standards), though at the present stage of our knowledge we cannot suggest anything definitive about the nature of their activity. Attempts to detect by observation the spin-offs of the activity of such forma- ▶

tions have so far proved futile.

There are other reasons to explain the absence of expansion of other civilizations into our galaxy. If intelligent societies are numerous enough and if most of the ecological nooks and crannies have already been taken up by them, the expansion of any such society would inevitably result in conflicts with the interests of other cosmic communities. And self-destruction, naturally enough, cannot very well be expected to be the objective of a highly developed society.

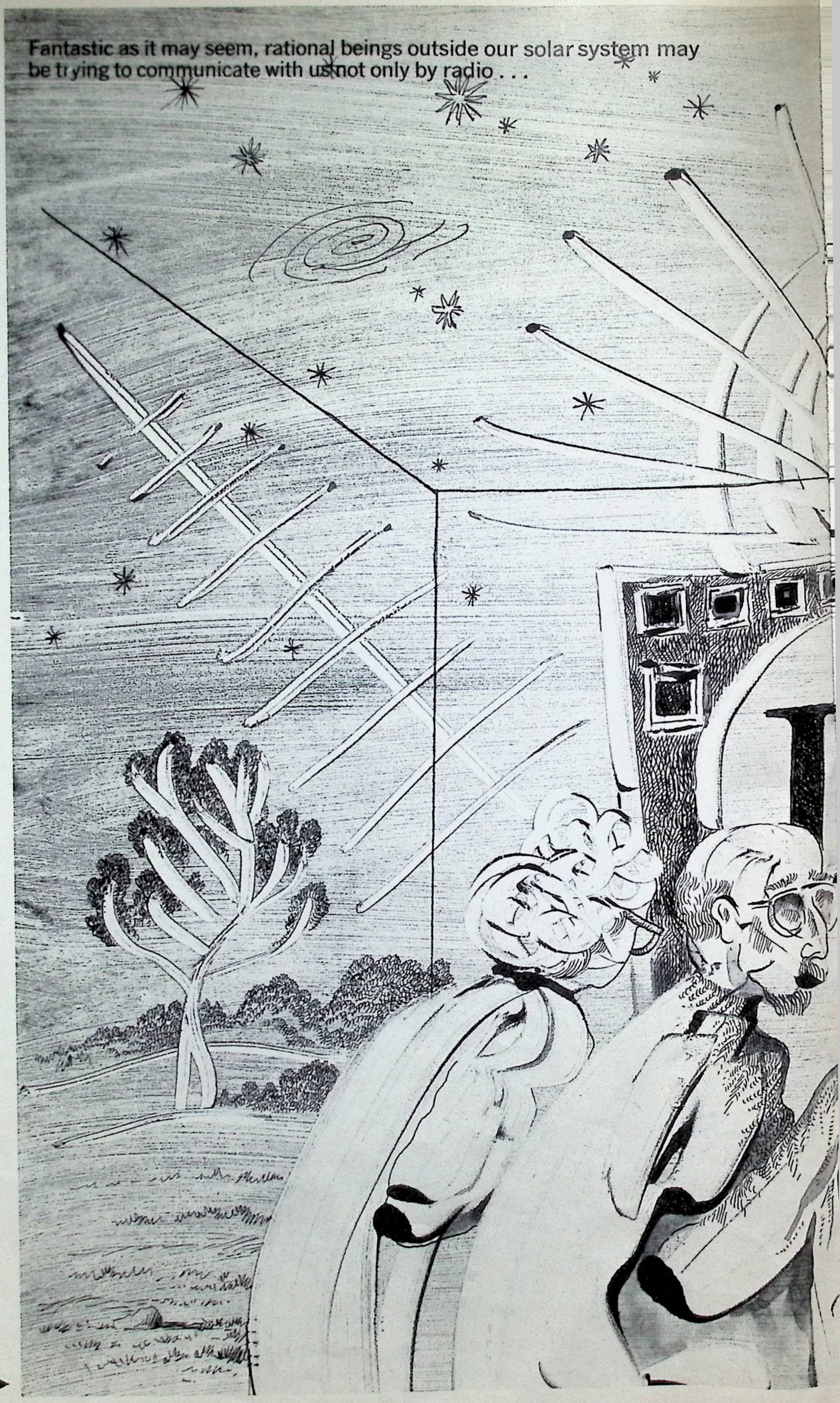
The Troitsky-Drake Debate

The center of attention at the Kaluga symposium was a paper "On the Galaxy Population Subject" presented by Vsevolod Troitsky. To determine the number of civilizations in the galaxy, Troitsky used as a starting point a hypothesis absolutely different from the assumption upon which Drake's well-known formula is based. Drake started with the premise that life in the universe is arising uninterruptedly as planets with conditions suitable for sustaining it are being formed.

Troitsky proceeds from the hypothesis that life (that is, the cell capable of reproducing itself) could appear simultaneously in the entire universe at a definite stage of its development on those planets where by that time the necessary environmental conditions had already emerged. Life had not originated before that moment, nor did it arise at a later stage. Given definite time and space characteristics, its beginning was a natural and inevitable development.

Proceeding from this hypothesis, Troitsky arrived at fundamentally new conclusions about the spread of "intelligence centers" in the universe. Thus, for instance, it follows from Drake's formula that with the passage of time the growth in the number of civilizations is endless. And if civilizations are immortal, old and new formations exist simultaneously. If, however, each one is doomed to end, the number of civilizations varies proportionally with the span of their lives. Troitsky's approach suggests that numerically civilizations do not grow without any bound (there is a certain limit), even if they do not die. If, on the other hand, the number of "intelligence centers" is limited, then some time in the future they will all pass away, and the universe will again, as in the time of its "youth," return to a lifeless state.

Calculations proceeding from Drake's formula are based on the assumption that civilizations originate after a period of chemical and biological evolution and that the rate of star formation determines both the population ▶




DZ-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z-Z
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Drawing by Ruben Varshamov

of our galaxy and the growth of it.

According to Troitsky's estimates, stars forming now are "late in coming." Life will never originate on their planets. In those places, however, where it has already appeared (simultaneously with our terrestrial life), civilizations are only just emerging. . . . Thus, there are no old and "experienced" civilizations capable of making use of the galaxy; they simply do not exist. In the limiting case we, in general, have overtaken everybody and are the only ones who seek contacts. However, this solitude is temporary, and we only have to wait for a few hundred thousand or a million years for company.

But such an extreme version is still highly improbable.

Most likely somebody has managed to achieve more than we have. That is why we, views to the contrary notwithstanding, should busy ourselves with the observation of detectable "outer space wonders." Though huge spaceships do not as yet crisscross the expanse of the galaxy, some civilizations could, for instance, have made use of their solar systems, having built there, as had already been suggested by Tsiolkovsky, "ethereal settlements." It is possible that they already have their own celestial body. Utilizing and processing such energy, they should re-emit it in the infrared band. The likelihood of this was suggested by Dyson. Then a sphere—a specific source of infrared radiation —may appear around the star in question. Distant galaxies, if characterized by processes of this kind, would be "specific" and distinguishable by higher levels of infrared radiation and the presence of a large number of giant stars. But so far there are no indications that "Dysonian civilizations" exist anywhere. But why not? Among other reasons, Troitsky points out that their absence might be explained in the following way: The creation of such spheres, as well as that of superpowerful beacons to announce to others the fact of their existence, would result in energy contamination of the environment and the upsetting of conditions under which protein life forms exist in such a civilization.

Intercepting Signals from Other Worlds

Still another approach to the problem was presented at the symposium by the author of this article. So far we have only skimmed the surface of the possible objectives of and motives for contacts between cosmic civilizations. One might assume that at present we would be content with experimental evidence of the existence of other intelligence in outer space. That would be one of the most exciting events in all history. But then what? What is the true sense of contacts between cosmic civilizations? No matter what the answer to that question is, we, in our hopes to hear the "voice of intellect" in the chaos of the radio noises reaching our Earth, assume that "cosmic" interchanges are a characteristic feature of the highly developed civilizations of the galaxy. Apparently such attempts would be provoked by very pressing needs, by the preference of these actions over other methods. Or, to put it another way, the contribution of the information exchanges to the development of a civilization must be measured against its own ways of gaining knowledge and found to be adequate or even more rewarding than other available means.

However, cognition through contact runs up against problems and dilemmas no less formidable than those on the thorny path of conventional science.

Without going into a discussion of the possible number of civilizations in the galaxy, I should point out the preposterously great distances that most probably separate the majority of such systems even if they are, by outer space standards, next-door neighbors. Evidently these distances even exceed such quantitative measurements as a thousand light-years. Under these conditions "talks" between civilizations can be ruled out. Too much time is involved for passing signals. This is important only when receiving and transmitting monologues. As in the case, for example, in our intercourse with ancient Greeks. Here we are dealing with a monologue of a harmoniously developed civilization that has reached us from the Hellenistic period of Greek history. As Nikolai Kardashev, a corresponding member of the USSR Academy of Sciences, made evident way back in 1964, for cosmic distances, such transmissions, however, require tremendous amounts of energy equal to the total power of the Sun's radiation.

The difficulties are indeed great when it comes to the interpretation, selection and use of genuinely "alien" information in the treatment of the results of the perception of the world by another cognizant subject whose structure might substantially differ from our own. Even if these distinctions are not so significant, but the development levels of the highly organized systems differ from each other, the obstacles in the way of a definitive interpretation remain formidable. As Norbert Wiener, the father of cybernetics, colorfully put it: Knowledge, logic, the totality of reasoning is not a completed picture, but a process. Intellect functioning within a framework of a more complicated system is bound to use a host of concepts and notions that simply do not exist in less advanced societies.

In such a situation, given a desire to set up "communication," a highly organized system has no other choice but to use a certain communications system for interstellar contacts. In the past the idea of an organized communications system and the presence of "The Galactic Club" was advanced by Ronald N. Bracewell and Nikolai Kardashev. It had been put forward even earlier by Ivan Yefremov, a Soviet science-fiction writer who in his novel *Andromeda Galaxy* named that nebula the Great Ring. Incidentally, it was Tsiolkovsky who first mentioned the "alliance of alliances" of cosmic civilizations.

We can assume that nobody sends out signals at random and that contacts are set up within such a system only by members who, by and large, are similar to each other. Highly directional communications channels are used for the purpose, which eliminate the greater part of the energy problems involved. Contacts within the system are regular, information is digested organically at the appropriate development stages and not prematurely, thus ruling out any possible negative results of its use. "Collective memory" might be a component of the system. In short, the advantages of organized communications links are more than evident, and they are bound to exist if, to be sure, intercivilization contacts are being practiced. The leading group of civilizations (forming part of the system) might have already come into being in the regions close to the central parts of the galaxy where the distances between intelligent communities are probably considerably smaller than in the spiral ramifications of the galactic discus. It would be best to look for the primary signal in the direction oriented toward the center of the galaxy or else along the galactic plane.

17 Suspicious Objects

One certainly cannot rule out the possibility that by looking for such signals in the radio wave band, we are looking in the wrong place. One might surmise that other civilizations use absolutely different channels of communication based on material properties yet to be discovered by us. But discussion of such problems would lead us too far astray from experimental knowledge and consequently from science in general.

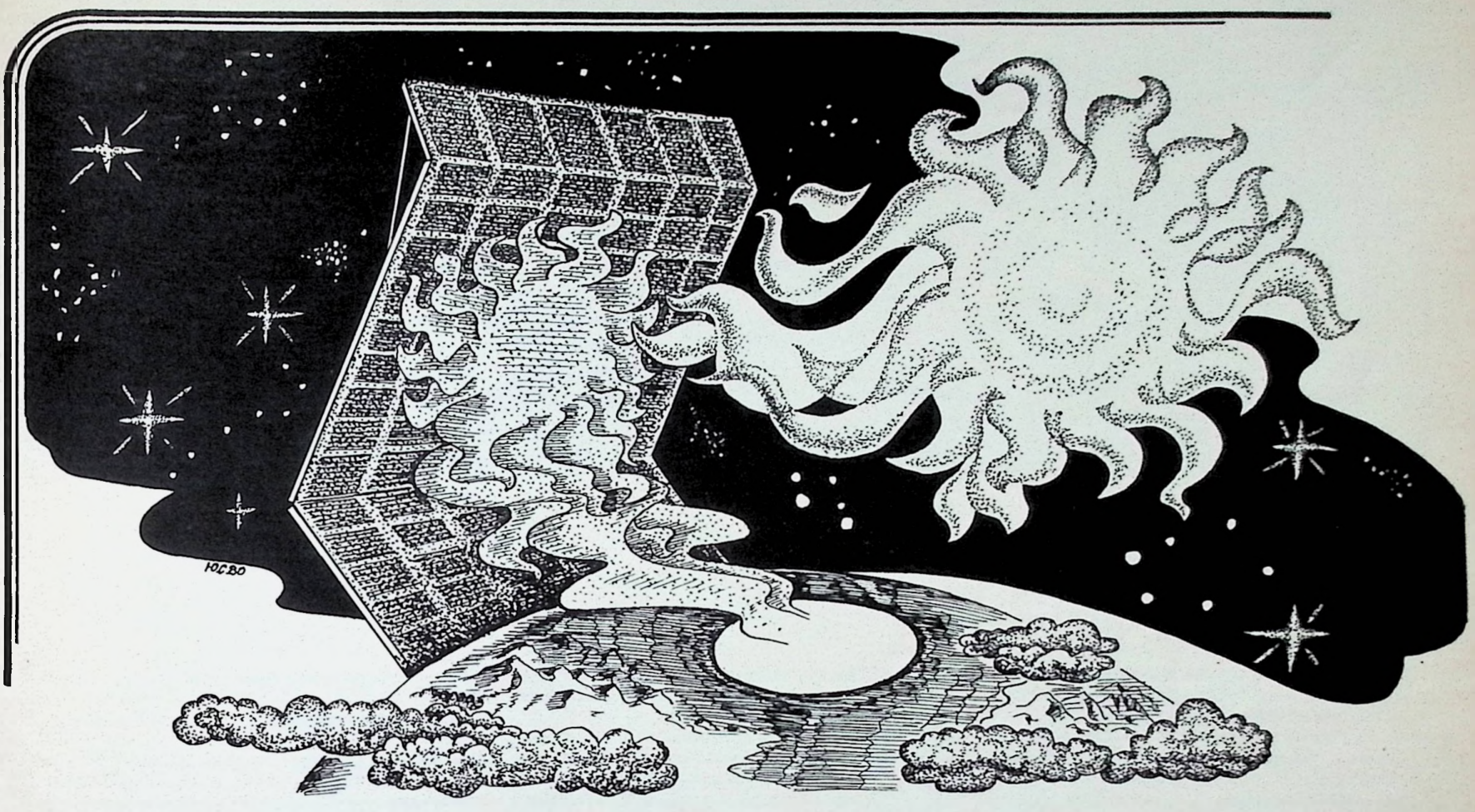
Some scientists believe that the optical band might be used for interstellar communication. Charles Townes dwelt on that way back at the Byurakan conference. The basic advantages of the optical channel are great information-carrying capacity and ease in arranging highly directional transmissions.

Several years ago Soviet scientists launched an extensive probe looking for signals from extraterrestrial civilizations in the optical band by using a gigantic six-meter mirror telescope. Seventeen "suspicious" objects were watched in 1979 with the help of a powerful azimuth telescope. The participants in the Kaluga symposium listened with close attention to the report on that study. Grigori Beskin, a researcher at the Special Astrophysics Observatory in the Caucasus Mountains, described those objects. Their spectrum is not linear but is, to use a special term, purely continuous. No lines of any chemical elements have been detected. These objects are also sources of powerful radio emissions with both radio and spectral fluxes alternating without any detectable regularity; they can change at time intervals ranging from hours to years. These characteristics may in principle testify to the artificial nature of these sources. Alas, no pronounced supernarrow laser beams, hoped for by the observers, were revealed in their spectrums.

The consensus of those taking part in the Kaluga symposium was that the search for extraterrestrial civilizations must be persistently continued with the help of the newest instruments and the latest theoretical findings. They were in agreement that establishing contact with an extraterrestrial civilization does not involve any danger to humanity. Heinrich Suchkin, a scientist from Gorky, informed the symposium of the program planned for the winter of 1980-81 at the Radiophysics Research Institute in Gorky. The active probe idea forms the basis of the project. Fourteen signals will be sent out to the nearest sun-like stars. The project, code-named Signal Echo, was the brain child of Soviet scientists Troitsky and Getmantsev.

There is no doubt that the quest for extraterrestrial civilizations not only stimulates the imagination and enhances scientific knowledge, but it also ensures important advances in technology. Thus, even if the search is not successful, it will justify the financial outlays involved. But what if it is successful and we succeed in making contact? ■

SPACE RESEARCH PAYS OFF FOR THE EARTH



Drawings by Yuri Sikorsky

Academician Vsevolod Avduyevsky takes a close look at developments in space research over the past 20 years and comes up with more than enough evidence to prove that it pays. He discusses the benefits for astronomy, the Earth sciences, industry, telecommunications, TV and radio.

THE EXPERIENCE of the last two decades has shown that it is possible to carry on a wide range of activities beyond the bounds of the Earth, installing various kinds of equipment, laboratories and, ultimately, whole factories up there. Rocket and space technology is producing a tremendous impact on the over-all scientific and technological standards of national economies and creating new lines of industry.

The penetration of outer space and the colonization of its near-Earth regions are already yielding great economic benefits and contributing to the advance of science. Space exploration has become all but a workaday business. There is probably no area of socially useful activity or economic sector where the achievements of space technology could not find application.

Global Dimensions

Industrial development, scientific and technological progress and population growth are inevitably tied up with the exploitation of natural resources, extraction of oil, coal and other minerals. A staggering amount of combustion products, carbon dioxide, carbon and nitrogen oxides and sulfur compounds is being discharged into the atmosphere. In some parts of the world forests are being destroyed. Rivers and the world ocean are being heavily polluted with oil and harmful chemicals.

The consequences of this activity on the natural environment can seriously upset the balance (for instance, the thermal balance) that the Earth still maintains.

The problems of protecting the environment are closely intertwined, being global in scope as they are. For example, the burning of large quantities of coal in Great Britain has the effect of adding to the amount of sulfides in the atmosphere over Scandinavia. A sulfuric haze has even been detected over the Pole.

Changes in the ice cover of the Arctic and Greenland and changes in the world ocean temperatures directly affect weather and precipitation in various parts of the globe. Unscientific use of land is capable of bringing on unchecked dust bowls or, on the contrary, swamps in places where there was once fertile land.

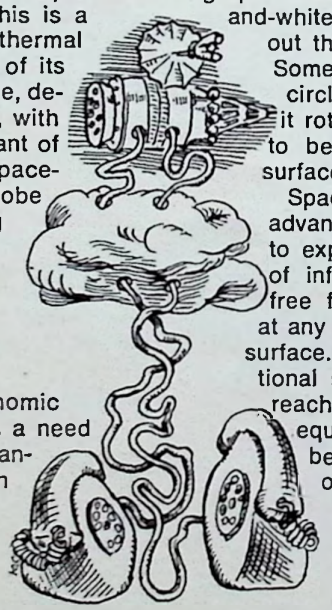
Only by establishing satellite systems for continuous monitoring of the atmosphere, the Earth's surface and the world ocean can all of these processes be brought under worldwide control and essential data be obtained for improving economic activity. Such systems make possible relatively rapid detection of geologically promising areas, prospective fishing grounds and areas for timber felling. In addition, they help identify water supplies in glaciers feeding rivers, as well as areas with varying degrees of humidity and pestilence. They can forecast harvests, and the like.

On the other hand, the same systems provide essential information on the biosphere throughout the globe and monitor the state of the environment, the composition of the atmosphere, the damage done to the ozone layer and the pollution of the ocean, as well as the conservation of forest ranges and fertile lands.

One must note, it is true, that worldwide environmental preservation measures are, unfortunately, still falling behind the rate of destruction. This is what satellite systems have been reporting with increasing frequency.

The development of satellite weather forecast- ▶

ing has helped make some progress in understanding the general fundamental principles behind climate formation on Earth. This is a complicated problem because the thermal condition of this planet as well as of its oceans and atmosphere is unstable, depending as it does on many factors, with solar activity being the most important of them. In any case, continuous space-based observations of the entire globe are an essential means of storing up the data required for devising improved techniques of weather forecasting.



Space Communications

Scientific, technological and economic information is snowballing. There is a need for increasingly fast-operating channels of communications along with the provision of telephone and telegraph communications and television to reach the planet's most distant points.

The strides in radio engineering are providing increasingly more opportunity in this sense. However, it is only through shortening electromagnetic waves that the overall volume of transmitted information can be expanded. For example, ultrashort waves can carry scores of television programs and thousands of telephone conversations at the same time. But such waves can be transmitted only within the limits of direct visibility. And here is where space research has come in handy—by enabling radio relay stations to be installed on board artificial Earth satellites to be kept within a zone of direct visibility of transmitting stations and customers.

A satellite communications system has been in operation in the Soviet Union for years. Satellites provide multichannel telephone and telegraph communications as well as relay black-and-white and color television signals throughout the length and breadth of the nation. Some artificial communications satellites circle the Earth at the same speed as it rotates round its own axis. They seem to be stationary relative to the Earth's surface at fixed points.

Space technology has reached such an advanced level that it is not unwarranted to expect the creation of a uniform body of information in the foreseeable future free for any subscriber to switch on to at any time and at any point on the Earth's surface. The creation of a system of navigational satellites appears to be well within reach, for instance. A subscriber to it, equipped with a portable device, will be able to contact it so as to find his or her bearings, map a course and gauge speed with a high degree of accuracy.

The Benefits of Weightlessness

Scientific and technological progress is out of the question without the development of new construction materials. Initial space flights suggested the idea of using new technology to this end.

Any alloy produced on Earth becomes laminated as it hardens because of the force of gravity. The expressly introduced admixtures do not spread throughout it uniformly. Besides, liquid substances are bound to contact the walls, polluted in the process, or even enter into chemical reaction with the material of the containers. In a weightless state, there is no natural intermixing of such components, and the melt can be stopped from contacting the walls of a container.

Crystal-like substances are widely used in every sector of science and technology. The very level of development of these sectors quite often depends upon the possibility of obtaining them. That requires a high standard of crystal quality. Yet their growing disturbs the balance of the distribution of atoms in the lattices, which goes far toward worsening the quality of the end product. A weightless condition enables the atoms in crystal lattices to occupy a fixed place. As a result, the quality of an almost defectless crystal can be multiplied scores of times, compared with the ordinary one.

The development of space technology involves an investigation of the behavior of matter in a weightless state or under low overloads. The first step in space technology has been to fit space vehicles with appropriate mechanisms and experimental laboratory facilities similar to those used on Earth. The Salyut-type stations have proved to be most appropriate to this end. Explorations started with the Salyut 5 station have been effectively carried forward on board the long-operating Salyut 6 station, as well as on short-sounding rockets during their brief stay in weightlessness.

Most of the space experiments have included crystal growing, particularly for the semiconductor industry. These have yielded many experimental high-quality semiconductor monocrystals, above all, those of germanium and silicon.

There have been interesting metallurgical experiments as well, especially those aimed at producing superconductive and magnetic materials. The alloys obtained vary widely by their specific weights. These would inevitably separate if left to harden here on Earth.

Technological experiments in outer space have proved the possibility of producing high-grade glass of varying types, notably, long transparent glass fiber with a weak light absorption, impor-

tant for optics. Work is in progress to make extra pure medical preparations.

The greatest range of opportunities occurs for the development of composite material that is known to be extensively applied in engineering, construction and domestic uses. This kind of material can be reinforced by superstrong thread-like crystals called whiskers.

Various research studies in physical engineering and technology in a state of weightlessness or under low overloads have stimulated further scientific investigation, notably the mathematical modeling of up-to-date technological processes.

Space technology is virtually in its infancy. Research and development studies in this field hold great promise. The economic effect derived from them will be quite high without a doubt. One can well look forward to qualitative results, that is, to making substances unobtainable here on Earth.

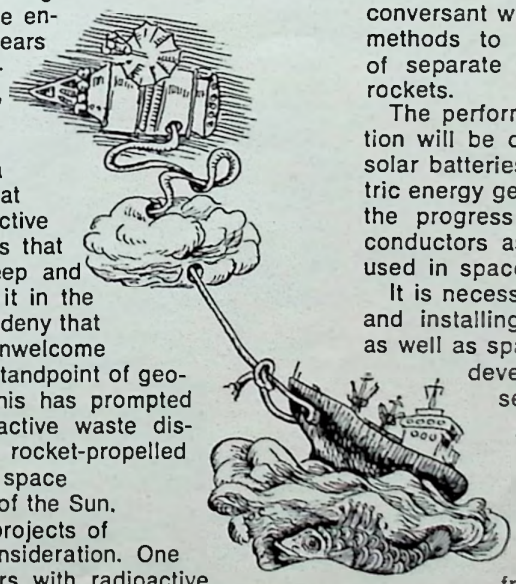
The Search for Energy

All of our food resources as well as those of coal, oil, gas and hydroelectric power without exception are, ultimately, the products of solar radiation. However, the Earth's atmosphere and clouds reflect some 40 per cent of the solar energy into space. The remainder is absorbed by the Earth's atmosphere and surface. A certain amount of heat is held by the surface for a time, being involved in its ecological cycle. But in the long run all the solar energy obtained is radiated into space. This is a more or less stationary thermal balance that the biosphere has adjusted itself to for millions of years.

But nuclear energy, produced from uranium, and the energy of thermonuclear reaction which physicists hope to obtain, have no direct connection with solar radiation. The bowels of the Earth also emit heat through the disintegration of radioactive elements or gravitational compression. However, we have not yet learned to utilize it properly.

The burning of fuel, especially coal, pollutes the atmosphere with carbon dioxide, sulfur oxides and other products that can eventually have disastrous consequences.

Unless the problem of controlled thermonuclear fusion is resolved, there will be nothing but breeder reactors using natural uranium-238 to provide most of the energy sources for years ahead. This prospect is, however, bound to be limited by the problem of disposing of a sufficiently great amount of radioactive waste. The point is that no matter how deep and well we may bury it in the ground, we cannot deny that it still remains an unwelcome impurity from the standpoint of geological hygiene. This has prompted the idea of radioactive waste disposal by means of rocket-propelled vehicles far out in space or in the direction of the Sun. There are a few projects of this kind under consideration. One is to put containers with radioactive waste into orbit at around 200 kilometers above the Earth's surface to be transported farther on by the engines of these containers, using the heat generated by fission fragments themselves.



It is noteworthy that there is the prospect of setting up high-altitude Earth-orbiting power stations beyond the atmosphere to transform solar energy into electric energy. To create a fairly big power station in space, it is necessary to unfold solar batteries hundreds of square kilometers in area at an altitude of 36,000 kilometers over the equator. For the surfaces of the solar batteries thus unfolded to have an acceptable weight, they must be as thin as possible. Unfortunately, that means rather low strength. The only feasible scheme appears to be to set up such a battery in space—in weightlessness.

This of course means that we will need people conversant with fundamentally new technological methods to assemble such structures out of separate components put into orbit by rockets.

The performance of a space-borne power station will be determined by the net efficiency of solar batteries and their weight per unit of electric energy generated. This heavily depends upon the progress of the industry producing semiconductors as well as on that of the hardware used in space technology.

It is necessary to develop ways of assembling and installing structures of ultralight materials as well as space welding. It is also necessary to develop methods of keeping the assembled structures at the required points of space in the required position. The hardest problem to resolve is that of using energy right in orbit or transmitting it back to Earth, for example, within the radio range of superhigh frequency by means of giant aerials.

It is difficult to visualize all the opportunities and advantages the penetration into outer space may yet offer to humanity. One thing is certain, and that is that the colonization of outer space is going to continue. There will be a growing number of space vehicles working effectively in near-Earth space for the benefit of science and national economies, and there will be more interplanetary stations in service to explore the solar system. ■

PERHAPS THE HARDEST PART IS WAITING

Six women talk about what it is like to be married to a cosmonaut. "I clearly understood what was in store for me," Larisa Yeliseyeva told an interviewer. "But at the same time I knew that if a person is working on space technology, a space flight would undoubtedly be the crowning achievement, provided one's health is good of course. All the reasoning in the world didn't help me, though, when Alexei made his flight. I took all three flights very hard. The most difficult part is when your husband leaves for the cosmodrome. It's probably a bit easier after the spacecraft is launched."

Alyona Romanenko: "I never tried to talk my husband out of being a cosmonaut, but I don't want the children to follow in his footsteps."

SVETLANA LEONOVA: Being a good wife is not easy no matter what your husband does. It's something you work on your whole life. Like the wife of a celebrated writer or, say, a popular actor, I'm always under public scrutiny. I have to be on my toes all the time and know when to move unobtrusively into the shadows.

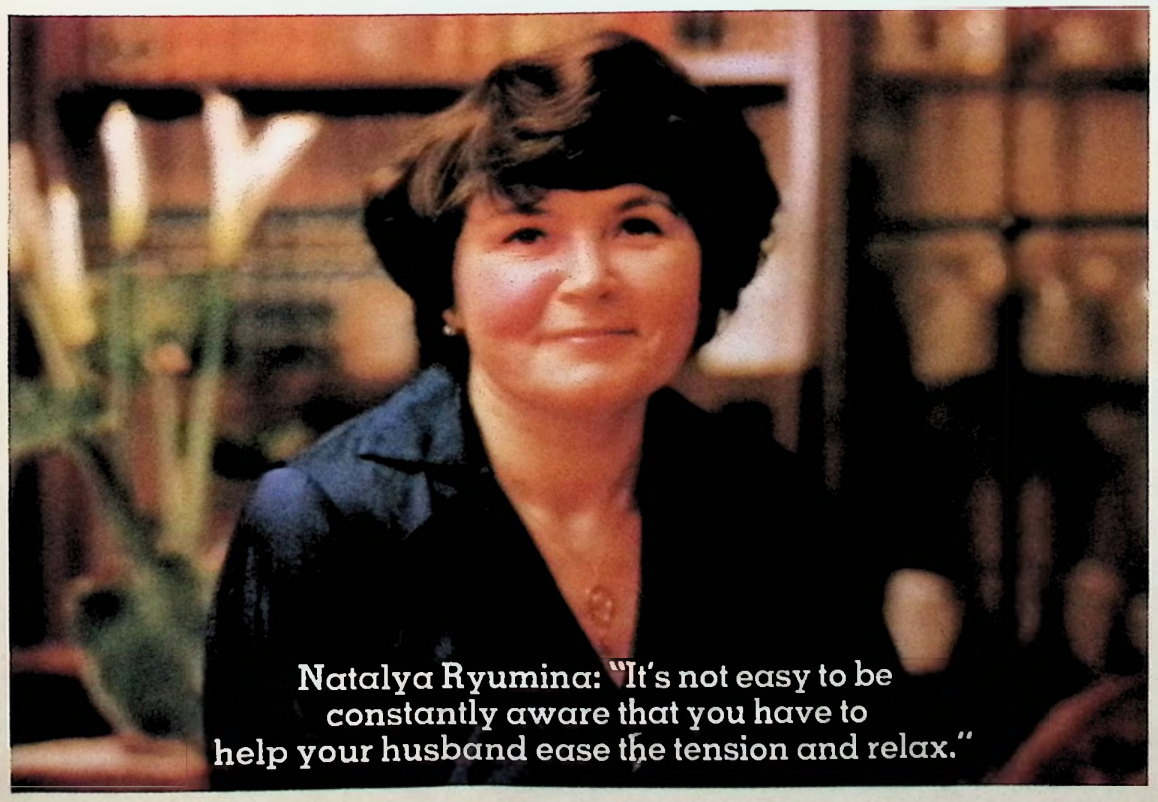
Alexei and I have been married for 21 years. I consider myself lucky that my husband is such an interesting person—and not only because he has an unusual profession. He cares about me.

All cosmonauts' wives have to wait for their husbands for long periods of time. We aren't the only wives who wait. The wives of seamen, the wives of polar explorers, geologists and builders wait too. I don't think there is anything special about that. I don't go for talk like "I was terribly afraid" or "I was so worried." Any new venture involves a certain amount of risk. But at the same time, it is unfamiliar and mysterious, which means it is interesting and fascinating. If a wife sees that her husband is completely dedicated to a new undertaking, if he gets complete satisfaction from his work and if he is happy with it, can she protest, get upset and be an obstacle in his way? Having a happy man around the house is a wonderful thing. It's a sign of your happiness together.

NATALYA RYUMINA: It's very difficult being the wife of a cosmonaut because the profession is so exacting and demanding. Not just the flight but each training session, of which there are a great number, is a physical and emotional strain on the cosmonaut. It's not easy to be constantly aware that you have to help him ease the tension and relax. When Valeri told me that he was about to become a member of the cosmonaut team, I cried and tried to dissuade him. Lucky for me, my mother was still living at the time. She was a wise woman, and she told me that I had no right to interfere.

And I didn't. However, if you should ask me now, after Valeri has spent a year in space on the past two flights and has become famous, whether I want him to continue flying, I would say No. I try to keep my opinion to myself though, because I can see how fascinated he is with his work and how much satisfaction it gives him. So I've learned to hope for only one thing—for him to carry out all his plans successfully.

Galina Kizim: "In the beginning, life in Stellar Town seemed dreadfully dull."



Natalya Ryumina: "It's not easy to be constantly aware that you have to help your husband ease the tension and relax."

People often ask me why I continue to work, what with having a cosmonaut for a husband, two children and a house to keep up. After all, I am an engineer, too. Incidentally, Valeri and I both graduated from the computer department of the Moscow Forestry Institute. We even studied in the same group. I'll never give up my work because being a cosmonaut's wife is not a profession.

GALINA KIZIM: I met Leonid Kizim quite by accident at a party at a friend's house. I was living at the time in the little town of Mytishchi near Moscow. This tall, good-looking pilot caught my attention. He told me about his profession, about the planes and about how wonderful it was to fly. When I married Leonid, I thought of him as a pilot, though by that time he told me that he was in the cosmonaut group and we would live in Stellar Town. Back then it seemed to me that cosmonauts were a special breed.

In the beginning, life in Stellar Town seemed dreadfully dull. I had worked in Moscow and had grown to love the crowds and the pace of city life. Stellar Town was always quiet. But I got used to it, especially after our son was born. I work in Stellar Town now.

Naturally, our son and I would like to see Leonid at home more often. But there's nothing we can do about it. Housework doesn't bother ▶

me. As for my job at the design office, I'll never give that up. It doesn't prevent me from keeping a well-ordered house where Leonid can relax. I'm not the only wife who tries to combine a home and a job.

LARISA YELISEYEVA: As far as family relations are concerned, it's just as hard to be the wife of a cosmonaut as it is to be the wife of any other well-known and very busy man. When Alexei told me he was going to take a test for the cosmonaut group, I wasn't overjoyed at the news. I clearly understood what was in store for me. But at the same time I knew that if a person is working on space technology, a space flight would undoubtedly be the crowning achievement, provided one's health is good of course.

All the reasoning in the world didn't help me, though, when Alexei made his flight. I took all three flights very hard. The most difficult part is when your husband leaves for the cosmodrome. It's probably a bit easier after the spacecraft is launched because thousands of other people follow the flight. I know that they, too, are concerned about Alexei, and that helps.

It is a rule in the family not to interfere with each other's plans. We always discuss our plans and decisions together. I'm always interested in Alexei's opinion about what I intend to do, and I suppose he's just as interested in my plans, but we never force anything on each other.

It is simply impossible to describe how I feel when I first see Alexei after a flight. To say that I experience great joy is like saying nothing at all.

I'm happy to say that my husband's profession does not affect family relations. Both of us are busy. I'm a researcher. I work on management problems. Alexei is busier than I am, so naturally most of the household duties fall on me. The fact that Alexei doesn't care too much about what I feed him for lunch and dinner is a big help. Though I must say he is quick to appreciate his favorite dishes when I take the time to cook them.

VALENTINA POPOVA: At the beginning there seemed to be no difference between the way we lived before and after Leonid joined the cosmonaut group. We had been married seven years before it happened, so I can make comparisons. We got married right after graduating from school and went to work at the same factory together. Then Leonid enrolled in flight school, and I started going to a technical school. After graduation we lived in Azerbaijan for two years. Then one day Leonid got an offer to move to Stellar Town.

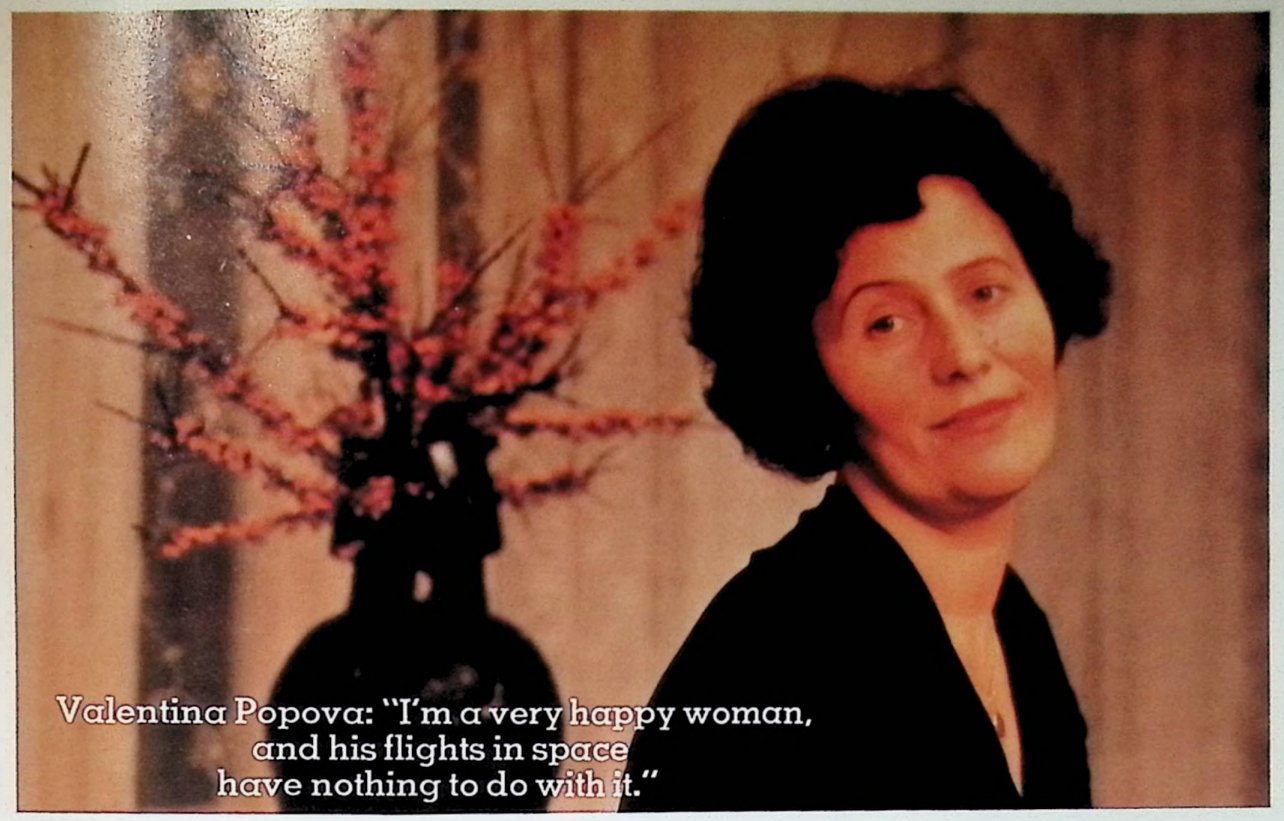
Before, I used to wait for Leonid to come back from flights. In Stellar Town I waited for him to come back from training sessions. That's how I lived until his first space flight. I tried to convince myself that it was just another long assignment, but I couldn't. On top of that, Leonid got the longest flight—185 days! Not a single one of the 185 days was an ordinary day in my life. I felt as though I had been set adrift. I'd go out into the street and see people talking and laughing, but I couldn't stop wondering how Leonid was doing out there.

Of course, life is so much simpler when Leonid is at home, especially since he's so handy around the house. Yelena and Alexei, our children, love to go out of town on weekends. We all like to go camping. No matter what the weather, we pitch a tent on a riverbank, and the men fish while Lena and I cook over the campfire.

I don't find it at all difficult to be a cosmonaut's wife. I'm a very happy woman, and his flights in space have nothing to do with it.

ALYONA ROMANENKO: It's hard to be the wife of a man who is so busy. There's all the housework to do and the children to take care of be-

Svetlana Leonova: "I consider myself lucky that my husband is such an interesting person—and not only because he has an unusual profession."



Valentina Popova: "I'm a very happy woman, and his flights in space have nothing to do with it."

"Before, I used to wait for Leonid to come back from flights. In Stellar Town I waited for him to come back from training sessions. That's how I lived until his first space flight. I tried to convince myself that it was just another long assignment, but I couldn't. On top of that, Leonid got the longest flight–185 days! Not a single one of the 185 days was an ordinary day in my life," commented Valentina Popova.

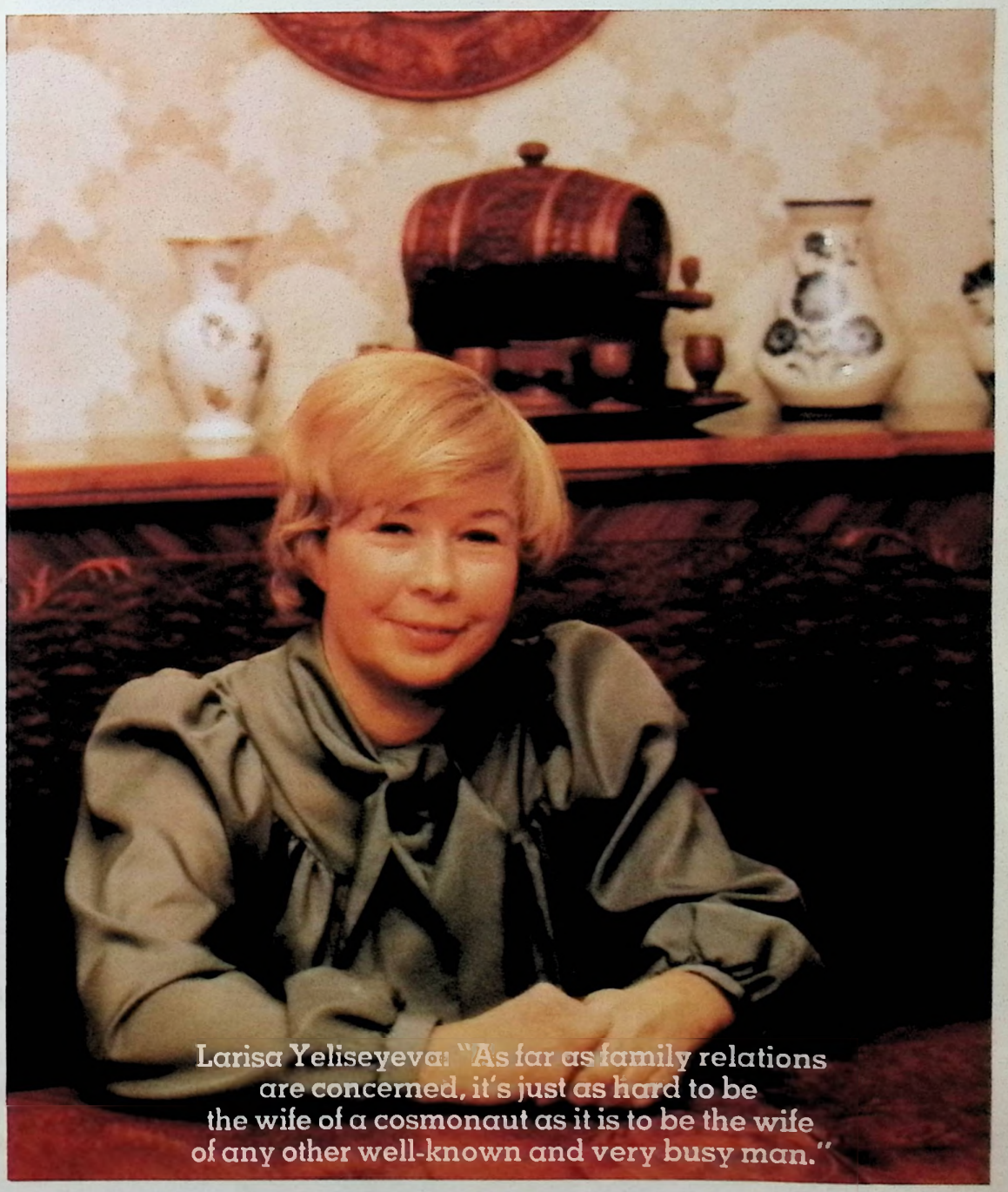
sides my own work. All the wives in Stellar Town have jobs.

I didn't marry a cosmonaut. I married an Air Force lieutenant. Yuri did his military service in a small town in the Ukraine while I studied music. I wanted to become a music teacher. I love children and singing. I was 18 at the time. Less than two months after we were married, Yuri was summoned to Moscow. He didn't even tell me what for. When he returned, he said we were moving to Stellar Town. That was in 1969.

Four years later, my husband was appointed a backup member in the Soyuz-Apollo flight crew. Then he started to train for his 96-day flight. Even on Earth we had never been away from each other for so long. And there I was all alone with two children. Our younger child, Artyom, was just a few months old. I regained my peace of mind only when I touched Yuri after he landed at Baikonur.

I took the second flight a little easier. It only lasted a week, and after that I knew exactly what being a cosmonaut's wife was like.

I never tried to talk my husband out of being a cosmonaut, but I don't want the children to follow in his footsteps. Of course Yuri wants to see them become fliers. He has already infected them with his love for the sky. Right now he is interested in underwater diving and so are they. Now when we go to the beach, I have to wait for all three instead of just one. But I don't complain so long as they return safe. ■



Larisa Yeliseyeva: "As far as family relations are concerned, it's just as hard to be the wife of a cosmonaut as it is to be the wife of any other well-known and very busy man."

Artwork by Valeri Belyakov
and Nikolai Smolyakov

HAVE WE BEEN VISITED BY ALIENS?

Visitors from space at the dawn of human history? This is one of the widespread myths of the century; it has nothing in common with scientific fact, asserts journalist Yaroslav Golovanov. He goes on to outline the numerous hypotheses regarding extraterrestrial beings.

THERE EXISTS the belief that at the dawn of humankind's history, spaceships piloted by beings from another planet whose inhabitants exceeded our level of civilization, visited Earth. This visit was reflected in ancient myths and legends. For instance, doesn't "the ascension into heaven" that we come across in many religions remind you of the launching of a spaceship? Then there was the tragic destruction of the cities of Sodom and Gomorrah. Doesn't that somewhat remind you of a nuclear explosion? The stunned inhabitants of Earth pictured these aliens in their primitive works of art. In prehistoric rock paintings in the Tassili-n-Ajjer area of southern Algeria, artists from among tribes then inhabiting the Sahara Desert portrayed people in space suits. On Easter Island in the eastern Pacific Ocean gigantic monuments cut from volcanic rock were erected to extraterrestrial beings. These aliens shared their knowledge with the islanders. The latter, however, were unable to understand and remember everything they said.

Information about Sirius, a star in the constellation Canis Major, has been preserved in the ancient legends of the Dogon, a small group of people living in isolation today in the Republic of Mali. How could the primitive Dogon know that constellations were divided into stars, planets and satellites?

The aliens who worked industriously and used sophisticated machinery have left traces of their activity that have been preserved to our times. In India they erected a column of pure iron (iron smelting was unknown to the ancient metalworkers). At Baalbek in what is now the Republic of Lebanon, they built a huge launching pad for their rockets. On the Nazca Plateau in Peru they had an airstrip paved with gigantic images of beasts, birds, insects and simple lines. These landmarks can only be distinguished from a great height. There are many other traces of aliens that we don't know about because we have become too accustomed to them, and undoubtedly there are still more that have not yet been found. Therefore, the existence of people from outer space who are our "brothers in intellect" can be considered proved.

The above is a brief outline of the hypothesis regarding extraterrestrial beings, the most popular piece of science fiction of the century, which has spread throughout the world wider than the great epidemic of spiritualism in the late nineteenth century.

The hypothesis of visitors from outer space became especially popular after Yuri Gagarin's flight in space. That's easy enough to understand. After all, people saw a man flying in space. So why couldn't another, a technically more powerful being, come to Earth from space? Accordingly, the first timid, fantastic articles appeared. In the Soviet Union it was writer Alexander Kazantsev and scientists Matest Agrest, Edward Fyodorov and many others who popularized the idea of visitors from outer space. "Facts" that allegedly confirmed these visits began to pile up. Meanwhile, abroad, a great number and variety of publications —from the strictly scientific to the totally absurd—appeared. Among authors of the latter, George Adamski was particularly notorious. His books gave accounts of his encounters with aliens and his travels with them in flying saucers to Venus and Mars. At that time it was still unknown that the surface temperature of Venus is between 250 and 480 degrees centigrade.

However, the popularity of the alien beings reached its peak thanks to the tireless energy of Erich von Däniken, the son of a West German clothing manufacturer, a former office worker, ship steward, hotel and restaurant manager and presently a millionaire, who resides in a villa near Zurich. This "specialist on ancient gods" has flown around the world in search of traces of aliens. The results of his travels are the books *Reminiscences of the Future, Back to the Stars, Sowing in the Cosmos* and *My World in Pictures,* which have been translated into 26 languages. The movie *Reminiscences of the Future* (*Chariots of the Gods?* in English), based on the book, was a sensation. It has been shown the world over.

Nuclear Explosion or Volcanic Eruption?

Misinterpretation of the facts is the main "scientific method" of supporters of the myths about extraterrestrial beings. They take facts and make them fit a hypothesis. What does the launching of a spaceship have to do with an "ascension into heaven?" Why should the destruction of Sodom and Gomorrah be identified with a nuclear explosion and not with a more probable natural catastrophe? If they insist on an explosion, then why should it be a nuclear explosion and not a volcanic eruption like the one on the Kamchatka Peninsula in 1964, when Shiveluch erupted with a force equal to 2,000 atomic bombs? Or the eruption of the Santorin volcano in the Mediterranean Sea in 1500 B.C., which was a hundred times more powerful? I think the scientifically grounded hypothesis that the eruption of Santorin destroyed the ancient civilization of Atlantis is far more interesting than the invention of a nuclear explosion. Moreover, what kind of a "highly advanced" alien civilization was it if its representatives, having arrived on a planet inhabited by creatures obviously less developed, started destroying them with nuclear explosions?

It was the French archeologist Henri Loth who started all the talk about aliens being represented in the rock paintings of Tassili. In his book *In Search of the Tassili Frescoes,* published in Paris in 1958, Loth wrote: "In and of themselves the pictures are very primitive. There is a double oval in the center of a round head. That is the appearance we usually ascribe to Martians. The Martians! What a title for a sensational news story!" The archeologist was simply making a joke, but the joke fell on fertile ground. Immediately a ritual mask was passed for a hermetically sealed helmet and the horns on it for antennas. People no longer want to remember that in his book Loth wrote that the figures in the paintings are easily understood as representative of religious rituals and that the decorations on the figures of the "round heads" are reminiscent of tattoos popular among the tribes of the Upper Nile and Central Africa today.

Loth could not definitively date his "Martians," but he believes that the oldest were made not earlier than 7,000 years ago. As for Easter Island, most scholars believe that it was settled 800 years ago. So when was it exactly that extraterrestrial beings visited the Earth? Why did they change from "round heads" into "long ears?" Any inquisitive person, even someone without access to a special library, can learn who, when, why and how the "long-eared" ones were immortalized in stone by simply reading Thor Heyerdahl's popular book *Aku-Aku.* Very well, even if we agree that there were visitors from space, why did they wear space suits in Tassili and not on Easter Island? What could there be of interest for the inquisitive aliens studying terrestrial reason on a tiny, wild island lost in the vast ocean while there existed the civilizations of ancient Egypt, China, India, the Byzantine Empire and Greece? They could have easily landed in Rome, Paris, Kiev or Novgorod. ▶

The Cult of Sirius

Information about the extraordinary astronomic knowledge of the Dogon is the last chapter in the story about visitors from outer space. The famous French scholar on Africa Marcel Gruillol and his assistant Germaine Diterlain devoted many years to studying the Dogon, a very interesting African tribe inhabiting the Bandiagara Plateau. These people managed to avoid the influence of Christianity and Islam and preserved their own social organization and culture. In papers published later, the scholars spoke, among other things, of the cult of the star Sirius B, a little white dwarf (invisible to the naked eye) which together with the bright Sirius A constitutes the Sirius binary star system. Moreover, the Dogon knew the planets of the solar system and even four of Jupiter's satellites. These facts about the Dogon did not attract much attention until a number of science-fiction books giving a very free interpretation of the astronomic knowledge of the Dogon appeared. In his book *The Sirius Mystery*, published in 1978, Robert Temple matter-of-factly maintained that the Dogon had received their information from aliens who had flown in from the Sirius system. That was the explanation, he claimed, for the cult of the star and the division of time into 50-year cycles, which coincides almost exactly with the period of Sirius B's revolution around Sirius A, and also the Dogon name for the star—Fonio, which designates a measure of weight for many African peoples. The latter may be viewed as a hint concerning the great density of the white dwarf star. Even the fact that Nomo, a creature living in the water, was the mythological father of the Dogon, was linked with ecological conditions in the far-off home of the aliens.

I asked Svetlana Berzina, Candidate of Science (History) and a specialist on ancient African history, to comment on Temple's sensational book.

"Several magazines have published scathing reviews of the book, branding it as speculation," said Berzina. "I think they are right. On the one hand, the Dogon myths and legends are complicated, confused and full of allegories that can be interpreted at will. On the other hand, their extraordinary knowledge of astronomy is no exception. The Egyptians, for instance, conducted very accurate observations of the Sun's annual movements and the position of Sirius in relation to it.

"It is possible that the Dogon really knew of Sirius B as well. But then the Egyptians knew of the existence of Uranus, which is not as bright as Sirius B. The former is impossible to see with the naked eye, but regrettably, the Egyptians' astronomy instruments have not been preserved.

"As for the coincidence of Sirius B's revolution with the calendar of the Dogon, investigations conducted by Germaine Diterlain after Gruillol's death showed that he had made a mistake and that the time cycle of the Dogon was not 50 but 60 years and hence had nothing to do with Sirius. The correction was published in 1971, but Temple and others did not notice it. Not only did the Dogon have a 60-year cycle, but so did many other peoples in the Western Sudan who did not practice the cult of Sirius. It is true that the word 'fonio,' which some were prone to regard as a hint at the great density of the star, stands for a measure of weight. However, the original meaning of the word was 'a grain of millet.' These grains were first used for weighing gold and later as a general measure of weight. I think the word 'fonio' actually hints at the size of Sirius A as it is seen from Earth and not at the density of Sirius B. As for Nomo, here again it is not only the Dogon, but other people living in Western Sudan, Senegal, Mali, Liberia and the Ivory Coast as well who have myths about a forebear who lives in the sea. On the other hand, these people do not have the cult of Sirius.

"The Dogon are a most interesting subject for study, and I believe that Africanists will be able to decipher many of these mysteries without the help of people from outer space," concluded Svetlana Berzina.

I would like to add that it would really be surprising, incomprehensible and illogical if the Dogon or any other people had created a cult of some small, inconspicuous star. So why should we wonder at the cult of Sirius since Sirius is the brightest star in the heavens?

Alien Traces

I have said nothing yet about the "traces" left by the aliens to which their supporters persistently refer. The column in India is made of pure iron, which ancient smiths did not know how to smelt. But it has long been proved that it was struck from an iron meteorite and is a kind of memorial to a heavenly phenomenon that sparked the imagination of the Indians. The so-called Baalbek terrace actually does compare in size to a launching site. But only in size. We are still unable to fly from star to star, but our launching complexes are highly sophisticated engineering structures and not simply stone terraces. Even if we assume that Baalbek was built by aliens, then why can't we find even a bit of wire or any bolts or traces of rocket flame at the launching site?

"Extraterrestrial beings have nothing to do with it!" exclaimed Isidor Katsnelson, an expert on ancient civilizations. "Baalbek was a Roman colony. It was the Roman Emperor Antonius Pius who started to build the colossal temple in the second century A.D., and Emperor Caracalla [Marcus Aurelius Antonius—Ed.] completed its construction in the third century."

"Is it true that the structure had blocks weighing up to 600 tons?"

"Yes, it is."

"But it's impossible to lift such weights without modern machinery."

"Says who? The pyramid of Khafre has stones weighing as much as 500 tons and it was built 2500 years before Baalbek, when iron implements did not even exist. But no one has the audacity to say that the great pyramids were also built by people from outer space."

One of Däniken's trumps was the gigantic birds, animals and insects depicted on the barren Nazca Plateau on the southern coast of Peru, which are claimed to be the landmarks of an alien airstrip. The cultural relics of the Nazca were discovered by the late German archeologist Paul Kosok and his assistant Maria Reiche in 1939. They determined the date of their construction as the third century B.C. to the seventh century A.D. They also discovered the method that was used to trace the pictures on such large areas and even the measure of length that was used for the purpose. Kosok called the Nazca pictures "the world's largest book on astronomy." They served as a kind of solar and lunar calendar with the help of which the inhabitants of the valley determined the day of solar opposition, the beginning of spring and fall and time for plowing and harvesting. The images had both applied and religious significance, therefore it is not surprising that they are seen best from above, because, after all, they were intended for the gods in heaven.

Even if the archeologists had not explained the origin of the drawings, on what grounds should they be attributed to aliens? The contradictions arising from doing so are quite obvious. What was it that the aliens wanted: a space center (Baalbek) or an airstrip (Nazca)? Why did they have to dig trenches on an airfield? (The only way to make the pictures was to remove the upper layer of the soil and reveal the lighter rock below.) And why did the aliens choose to depict creatures they had no way of knowing as markings for their airfield? What is more, if they wanted to leave traces on Earth, why did they choose to do things so easily confused with the activity of human beings? Modern astronauts and cosmonauts, for instance, sent pennants to Venus and Mars and planted flags on the Moon, which not only contrasted sharply with everything that was to be found on those celestial bodies but could also explain the origin of those traces of another planet and indicate the return address, so to speak. For some reason, the aliens did nothing of the kind on Earth. On the contrary, they left traces that could easily be confused with the traces of human activities.

The Origin of Life

Däniken made haste to enlist the famous English biochemist and Nobel Prize winner Francis Crick and the American biochemist Leslie Orgel as his allies. The two scientists have assumed that life on Earth did not start by itself, but that it was brought to Earth by aliens in the form of microorganisms in a spacecraft. However, contrary to Däniken's pseudoevidence, Crick and Orgel's hypothesis, despite its fantastic nature, has scientific substantiation, which may be convincing to some and unconvincing to others. If life started spontaneously, these scientists say, then it would be natural to presume that it originated in different spots on the planet, in different conditions, that there were several independent breeding grounds where the inanimate turned into the animate. Then how do we explain the fact that all living creatures on Earth have the same genetic code? Doesn't that point to a single forebear, to a colony of microorganisms, for instance, delivered to Earth in a spaceship by extraterrestrial beings? Another argument advanced by the biochemists is this: Why is it that such a rare and widely dispersed chemical element like molybdenum plays so important a role in biochemical processes? Could it be that earthly life was born in a place where there was an abundance of it?

Crick and Orgel advance a scientific hypothesis since it can be confirmed or overthrown with the help of experiment. If, for instance, it could be established that the processes transforming the inanimate into the animate are continuing today in different parts of the globe and living organisms with an identical genetic code are being formed as a result, then the hypothesis would be disproved. If we establish contact with a highly developed civilization that actually was our forebear, then the hypothesis would be confirmed. So far, Crick and Orgel do not make any categorical statements and, unlike Däniken, do not indulge in wishful thinking. They simply offer food for thought. I believe we should approach the question of visits by extraterrestrial beings in the same spirit.

I think the fact of the visits by aliens could be admitted in two cases: if we discover irrefutable traces of their arrival on Earth (a spaceship or research equipment of unfamiliar construction) or a civilization of rational beings is found that will provide proof of their visits to our planet.

Blind faith based on superficial knowledge of the subject is actually harmful because the myth about aliens gives a simple and easy answer to very difficult and complicated problems that the history of the ancient world poses before us. While draping itself in the garb of science, the myth harms science, including the truly scientific problem of establishing contact with extraterrestrial civilizations. There is no end of unanswered questions for genuine researchers in this field, starting with the language of signals from space and ending with the notorious flying saucers.

Courtesy of *Komsomolskaya Pravda*

HE NEVER SEEMS TO RUN OUT OF IDEAS

The fact is that the name Alexander Kazantsev, a famous Soviet science-fiction writer, will probably mean nothing to our readers since none of his novels have been translated in the U.S. However, if we mention that the idea for Erich von Däniken's sensational book and film **Chariots of the Gods?** was suggested by Kazantsev, then perhaps his stature will be better defined. Alexander Tropkin introduces him here.

DO YOU REMEMBER in the film how the plane lands on the ideally level, mysterious plateaulike landing strip in the Nazca desert area of Peru?" asks writer Alexander Kazantsev. "Well, I really am sorry that I wasn't a participant in the filming of that and wasn't able to feel the thrill of that unusual landing, although I was the one who asked Däniken to film it."

"All the same, you still assume that the builders of the Nazca airstrip were visitors from space?"

"I'd like to! At least, nobody has been able to disprove my assumption."

In all frankness, I must admit that when I was preparing for my interview with Alexander Kazantsev, I thought that this supporter of Paleolithic contact with extraterrestrial visitors might have changed his views somewhat after all the scalding criticism the film *Chariots of the Gods?* received from scientists and reporters from around the world. But that was not to be the case at all. I can say that he stated his views about Yaroslav Golovanov's article beginning on page 47 of this issue concisely: "Totally unconvincing, and greatly stretching the point."

Kazantsev could hardly be categorized as one of those thickheaded conservatives who hold onto their views no matter what. He is constantly searching earnestly for counterarguments, analyzing new facts and publishing sensational articles that stir up a storm of discussion. Kazantsev's enviable stubbornness is viewed by skeptics with scorn. I, too, was inclined to a good-natured joke or two, to a certain point. However, I must admit that it certainly was worth it to hear the conclusions in defense of Paleolithic extraterrestrial contact right from the source.

Kazantsev took a small clay figurine of a *dogu** from his bookshelf. By the way, he has perhaps the world's largest collection of such figures.

"Just look," said the writer. "This figurine is 5,000 years old. It was created by people of the Stone Age. Could they have made such a likeness of a modern space suit without having seen the real thing? Here you've got the airtight helmet, slitted glasses on it, straps—not stone ones—holding the suit together, hatches for examining the helmet from the rear and what's especially remarkable, a breathing filter. It's hard to believe that the people of the Stone Age could have thought up such detail."

"Couldn't it be a stylization of some ancient Japanese ceremonial costume?" I countered timidly as I carefully examined and probed every one of the *dogu*'s mentioned details.

"That's impossible. These figurines were made long before the Japanese appeared, and the style of these 'little gods' was borrowed by them later. This has been proved by specialists. It's curious, though, that they continued to make these *dogu* for hundreds of years after the 'sons of heaven,' mentioned in Japanese legends, appeared on the islands."

I decided not to argue with him and ruin the interview. But my opinion is that many of the archeological mysteries that Alexander Kazantsev poses are just like the "wonders" in Erich von Däniken's film *Chariots of the Gods?*. These are the very things that brought it success and unheard-of profits. However, the film actually provoked serious scholars (historians, archeologists, ethnographers and area studies specialists) to prepare solid rebuttals to his theories. Thanks to such research (mentioned in Golovanov's article on the preceding pages) and later scientific reports and authoritative publications, the theory of prehistoric extraterrestrial contact has lost one trump card after another. In just such a manner the handmade Baalbek terraces lost their aura of mystery; the colossal stone monuments on Easter Island in the eastern Pacific acquired a truly terrestrial origin; and a convincing explanation for the huge iron column in India was found. Perhaps in time scientists and scholars will be able to positively refute the remaining mysteries that Alexander Kazantsev argues for. Perhaps scientists have just not gotten their hands on them yet.

But that still does not rule out the possibility that this relentless science-fiction writer will turn out to be right. And what then?

"Take the Black Prince for example!" exclaimed Kazantsev passionately. "It's a mysterious satellite of our planet that moves in a direction opposite all orbiting space devices, toward them—contradicting certain theories. . . . I've repeatedly suggested sending a probe near it to study it, particularly since it's technically feasible. What if it isn't a captured meteorite, but an artificial object left in Earth orbit with the calculation that in order to reach it, humanity must have reached a high enough level of technological development? And what if we were to find valuable information inside it?"

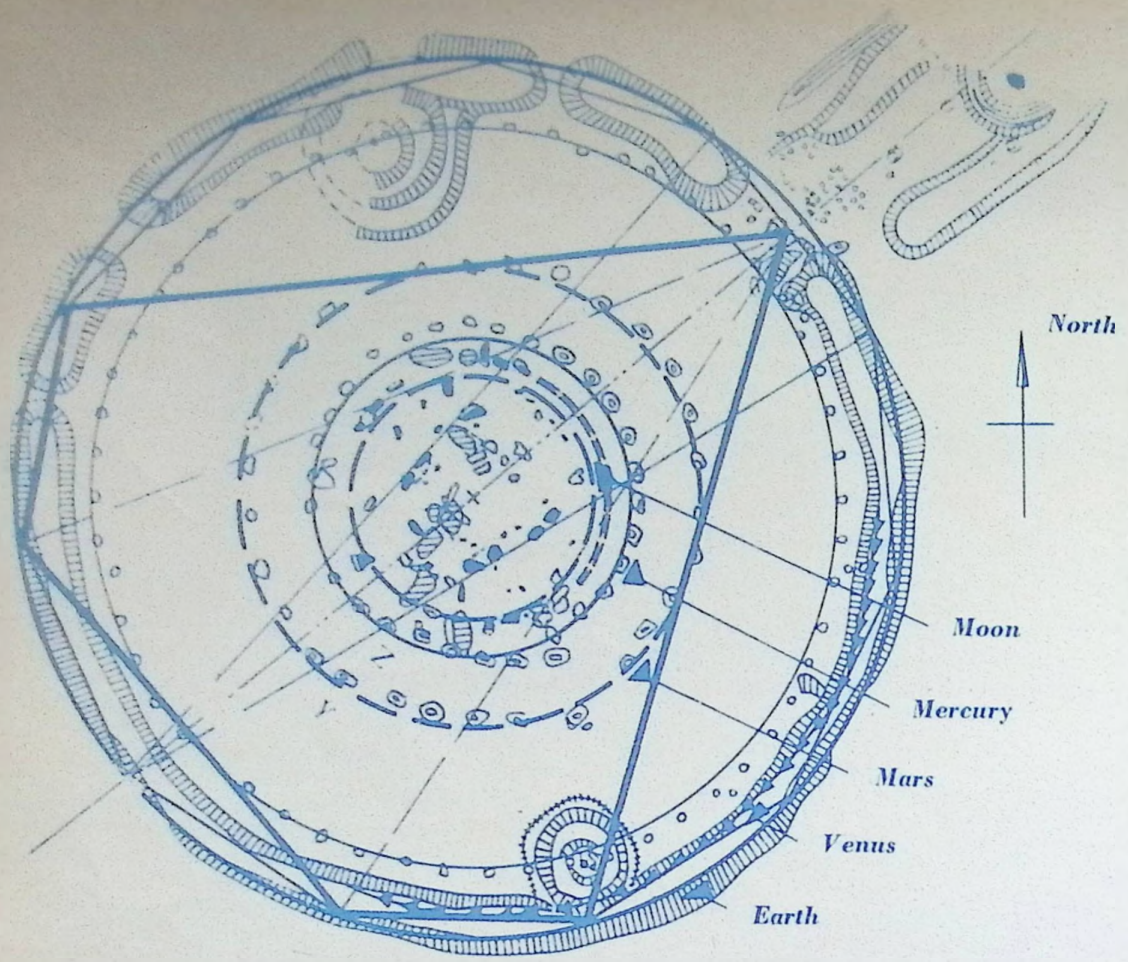
Questions, questions and more questions. There was a profusion of them in my talk with Alexander Kazantsev. He could not, and by the way did not, attempt to answer all of them. As he sees it, his mission as a science-fiction writer is to develop bold propositions and hypotheses that will either be proved or refuted by life itself. It must be mentioned that after the publication of his novel *Stronger Than Time*, specialists found about 120 technological discoveries and inventions on its pages. The ideas contained in another one of his novels, *The Blazing Island*, were realized in the facilities of a Moscow research center.

The Tunguska Miracle

The fate of Alexander Kazantsev's hypothesis about the famous Tunguska meteorite is an interesting one. Curiously enough, scientists' interest in this mysterious phenomenon that occurred more than 70 years ago in the Eastern Siberia taiga has not disappeared, but has, in fact, grown. This is in great part due to Alexander Kazantsev. Moreover, he is considered the leader of a movement that is gaining more and more supporters in the scientific world. From this has sprung the unflagging interest of the European and American press and television in his theory.

In 1946 Kazantsev published a short story called "The Blast," and five years later the story "The Guests from Space." According to their fantastic plots, the Tunguska catastrophe was caused by the explosion of a spaceship that had flown in from another planet. Kazantsev offered possible causes for the unheard-of size of the explosion. The stories created a sensation overnight. The new theory immediately made friends and enemies. Initially, at least, it was accepted; a little while later, however, it was declared downright unscientific, and people consciously ignored it. Time, however, has dealt with it in its own way. Dozens of scientific expeditions to the site of the blast, each armed with more and more modern equipment, have more or less confirmed Kazantsev's hypothesis. Most researchers were inclined to believe the nuclear blast theory, which resulted in the unusual lighting of the night sky in Europe and Africa, the presence of radioactive elements in ▶

*Dogu are abstract clay figurines, generally of pregnant females, made in Japan between the fifth or fourth millennium and 250 B.C.



the trees that remained intact and the surprising phenomena of their mutation—growth speeded up 10 times. If it was an explosion, then it was a nuclear one, and then you had to concede the possibility of the artificial nature of an exploding substance which could very well have served as fuel for a spaceship (since science knows of no radioactive meteorites, and the content, for instance, of uranium in common meteorites is miniscule). A barogram recorded in London on the day of the blast eloquently confirms this theory. In no way does it resemble the barogram of a normal explosion, but it duplicates that of a nuclear blast.

I could recount quite a few scientific confirmations of Kazantsev's daring guess. But at the time I was more interested in his feelings about another hypothesis concerning the Tunguska explosion that was recently proposed by two American scientists. What does Kazantsev think about it?

"Yes, I'm familiar with Jackson and Rhein's point of view," he responded. "It really is quite extreme, but unfortunately, it's too isolated from the results of actual research conducted in the region of the explosion. The 'black hole' the size of a speck of dust that supposedly collided with the Earth would, according to calculations, have had a mass equal to that of the Sun, no less. It's difficult, however, to conceive of the consequences of the touch of such a massive 'speck of dust' with our planet. We would be talking about an irreversible and fatal catastrophe for the Earth, and not the one which occurred in the Siberian taiga at the beginning of the century."

Extraterrestrial Visitor in an Apartment?

Kazantsev's latest science-fiction, or to put it more accurately futurist, novel disappointed his followers a little. There was not one word about extraterrestrial contact in it. Judging from everything he's said, his new novel, too, will be about problems here on Earth. In it Kazantsev attempts to portray the people of the twenty-second century, their psychology and moral values (all of which would deserve a special and no less interesting talk than this one). However, it was hard for me to believe that Kazantsev would let me go without giving me some entirely new, sensational hypothesis supporting extraterrestrial contact as a small parting gift. And I was right. At first, however, it seemed as if Kazantsev was simply relating the fantastic plot of a future story:

"One day I opened my mailbox, just as I normally do, and there among the newspapers and letters I discovered a thin notebook—like the ones schoolchildren use for drawing—filled with mathematical equations and sketches. A week later I found a second one, and then a third one. I was greatly interested in the contents of these notebooks. My friends—scientists—to whom I showed them, were excited about them and wanted to meet the author as soon as possible. But I had no idea who this mysterious person was because the name in the notebooks was absolutely illegible, and there wasn't a return address. And so time went along. It seemed as though there was absolutely no hope of discovering anything for certain about the author. And then suddenly. . ."

At this point in his narration Kazantsev paused, flipped through a thick book and opened it to a page with a picture of two "extraterrestrial beings" (a giant and a dwarf), who supposedly have been repeatedly sighted by "eyewitnesses" near mysterious UFOs.

". . . And then suddenly the doorbell rang. I opened the door and there, standing on the threshold, was this one. . ." (He pointed to the drawing of the dwarf.)

"Really?"

"Yes, really! I'm not kidding! You can ask my wife. She saw the whole thing. He was a little over a meter tall and had a big head with a flat forehead. There was no space suit, just regular European clothes, and he spoke perfect Russian: 'I sent you my calculations. Were they any good?' We introduced ourselves. It turned out that my 'extraterrestrial visitor' had a perfectly terrestrial name—Valentin Tereshin. He introduced himself as an amateur astronomer from Ivanovo Region in Central Russia. I introduced Tereshin to my scientist friends that very day."

"And what was in your 'Martian's' notebooks?"

"Oh, that's the most peculiar part of all. But first I have to digress for a moment. You're certainly familiar with *Stonehenge Decoded*, the delightful book by Gerald Hawkins and John White? It's about the megalithic monument built in southern England somewhere around the Stone Age and the Early Bronze Age [c. 1900-1600 B.C.]. The gigantic boulders of Stonehenge have been called the eighth wonder of the world.

"Well, Hawkins and White managed to prove that this cyclopic structure of huge stones, pits and banks served the ancients not only as a temple but as a unique observatory. With it the priest could almost flawlessly predict solar and lunar eclipses, determine the relationship between the dates of the rising and setting of the Sun and Moon, and so forth. The book's authors even call Stonehenge, as paradoxical as it may seem, a Stone Age computer. What about that! In short, the Englishmen's discovery was a true scientific sensation.

"Well, what about Tereshin? What did he have to offer? This young man with a clear gift for mathematics had discovered a blank spot in Stonehenge, which had already been studied inside and out. Nobody before him had ever attempted to study the rings of the temple from a geometric point of view. Without going into detail, I'll just say that with the help of geometric constructions, Tereshin managed to find the key to the layout of the stone slabs: a lunar angle and an integral expression of pi. These facts testify to remarkable and mysterious mathematical and astronomic knowledge on the part of the people of the Stone Age. In addition, Valentin Tereshin uncovered one more, and perhaps the most important, link in the secret of this stone wonder—a pentagram. Having made his calculations and then applying them to the map of the temple, he discovered a striking regularity in the size of the rings of stone and pits: Their diameters are a model of none other than the diameters of the inner planets—Mercury, Mars, Venus, the Earth—and the Moon. In addition, deviations in the layout were minimal—all in all, one per cent. The pentagram, enlarged 60 times, literally embraces the entire complex of all ancient monuments on the enormous territory of the Salisbury Plain and unites them into a sort of well-thought-out, compact system that excludes any possibility of random chance in its composition. The question must be asked: Who could possibly have worked out such a creditable and visionary plan for Stonehenge and the surrounding megaliths? For, after all, archeologists and historians have proved that several generations of ancient engineers and builders stuck to this one plan for 300 years.

"Now," says Kazantsev, "let's make some hypothetical conclusions based on the discoveries of these two Englishmen and Valentin Tereshin.

"Who could have been the general designer of the cyclopic structures on the Salisbury Plain and how could he have attracted thousands of ancient Englishmen, tearing them away from getting their daily bread, with his mad idea to drag stones weighing tons for many miles? We are not talking about the technological capabilities of the island's inhabitants at that time; we are talking about the incredible mathematical and astronomic knowledge that the people of the Stone Age must have had. What construction genius and engineering skill! However, aside from Stonehenge, there is no evidence of highly developed civilization on the British Isles at that time.

"Therefore, we can assume that Stonehenge is the material expression of extraterrestrial information, which we have yet to decipher and comprehend fully. It's possible that the extraterrestrials encoded some sort of higher laws of nature, unknown to Earth dwellers, in this matter. . . ."

I was so carried away with Alexander Kazantsev's new theory that I forgot to ask him about Valentin Tereshin and what he's doing now. What I found out was, to put it mildly, astounding. Judge for yourself. After publishing a series of serious articles in major scientific journals, Tereshin refused all sorts of tempting offers and promises of a dazzling career in the academic world and disappeared just as suddenly as he had appeared.

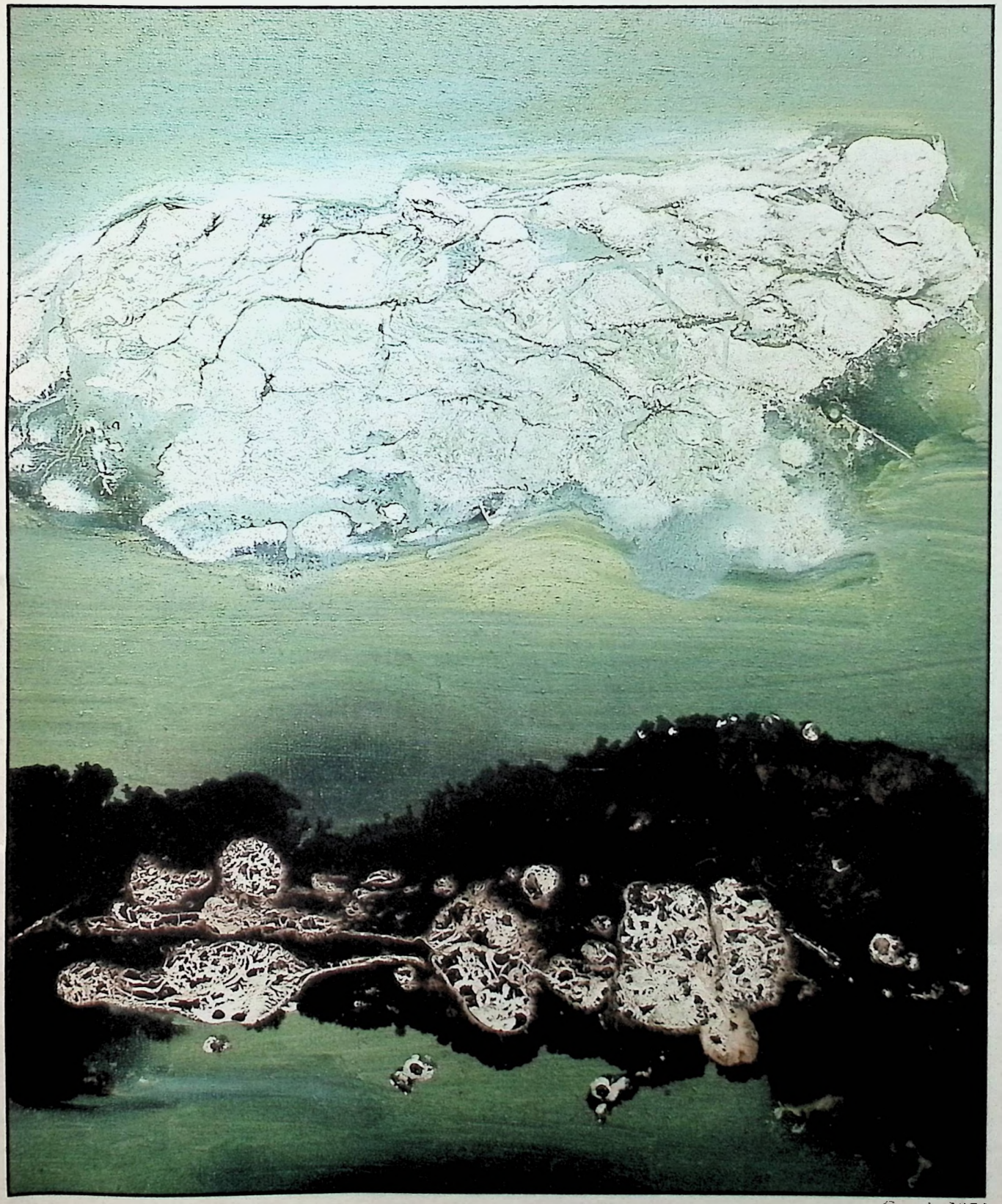
What's more, undoubtedly possessing outstanding, if not unique, mathematical abilities, he, to the surprise of scientists who had talked with him, did not know the basics of many areas of mathematics like trigonometry and higher mathematics.

Could it actually be that Kazantsev's Moscow apartment was visited by a visitor from outer space?

"I can't say anything for sure . . . but it's possible. Anything's possible!" he said in parting, smiling craftily. ■

AN ARTIST AND HIS SPACE FANTASIES

Science-fiction artists is a professional term that refers as much to painters and graphic artists as it does to writers. With the help of their imagination, oils, pastels and etching needles, they leave the confines of Earth quite easily (in contrast to cosmonauts) and set out on distant travel, creating a world of planets and creatures unknown to us. Art critic Irina Kalashnikova interviews the well-known Moldavian painter Mikhail Greku here.



Genesis, 1978.

MIKHAIL GREKU's studio appeared somewhat austere to me at first glance. Neither the customary pictures hanging on the walls nor the traditional plaster copies of ancient works of art or the icons so popular among artists were there. The walls were completely bare. Only pieces of a faded handmade rug and an old crucifix carved out of soft Moldavian limestone served as decoration for the studio. The place was littered, however, with cans of paint, sprayers and numerous stretchers. Canvases were lined up along the walls and piled on shelves. Because the paintings faced the walls, the only thing I saw was monotonous wooden frames. The minute Greku turned them around, however, the studio came alive with beautiful gardens, fermenting wine, a frail-looking, big-eyed boy driving huge black oxen, an old windmill swinging its arms and a ruined fortress rising out of pearl gray water. All these paintings represent the poetic images of Moldavia, where the painter was born and grew up. His canvases are full of complicated associations and philosophical meditations on life.

In form, Greku's paintings came across to me as temperamental as Moldavian music and as simple and wise as folk art. I said as much to the artist. He gestured to the stone cross that hung above me and said: "You see crosses like this in village graveyards. They don't represent the canons of the church for me. I see them as the embodiment of the centuries-old pain, grief and hard times of the peasants. The crosses are simple in form and emotional at the same time. It is these qualities that I value as a painter. I find that craftspeople have a remarkable sense of material. They can turn anything—wood, stone, wool or clay—into a work of art.

"I read in Igor Stravinsky's *Dialogues* that Beethoven did not ▶

Geyser, **1973.**

write music for the piano but proceeded from the piano. The medium gave birth to the image. In this sense, my ideas come from the kinds of paint I use, from aerosol sprays and enamels. I often get an unexpected creative spark or inspiration from them."

To illustrate, Greku began showing me a large series of his paintings of outer space. There was something fascinating about the swirl of lines and splotches, about the molten substances slowly flowing down. It reminded me of the color of melted amber. There was something mysterious about the blue-black film of resin and the red sparks that shone here and there.

Greku's space fantasies, which he painted after he participated in the international symposium "Space in Pictorial Art," held in Moscow in 1973, could be likened to meditations on the beginning and the end of the black infinity of the universe. His paintings ask whether people can possibly conquer the unknown. What awaits us if we do encounter other worlds in space? What do those distant worlds look like?

The works in this series are distinguished by a limited range of colors and at the same time by diversified combinations of texture. Not satisfied with the traditionally smooth surfaces of paintings, Greku applies paint in a way that makes a canvas appear convex.

"It seems to me that art is much more complicated than it used to be," the painter said."An artist not only needs to study nature and reality but also new materials. Perhaps that is a purely subjective opinion, but these colors, the products of twentieth century science and industry, seem to me anyhow to contain our contemporary ideas of the world. I tried to demonstrate this in my space series. Look at the canvas that I call *The Crater.* It was done in fluorescent light blue lacquer. See how it spreads and floats. Doesn't it remind you of the mysterious space beyond us?"

The paint looks as though it flowed, coagulated and then slid heavily downward, creating not only the appearance of space objects but also reflecting processes that go on inside them.

The viewer seems to dissolve in the bottomless depth of the paint, to float in this extraordinary world of color and light. The artist stirs the imagination and sweeps the viewer off his feet with his fantasy and unusual ideas. The viewer is forced to give his own interpretation to these philosophical generalizations and these mysterious and often disturbing visions.

Mikhail Greku's color reminds me of the bold hues in the canvases by the late Mexican painter and muralist David Siqueiros, who gave up the traditional brush and took up the spray gun instead. Like Siqueiros, Greku makes wide use of all kinds of technical innovations. A creative search that takes a painter from the traditional realist manner of the nineteenth century to space fantasies with a spray gun—isn't that a bit too contradictory? I don't think so. Only the form has changed, but the artist's attitude toward the world remains basically the same.

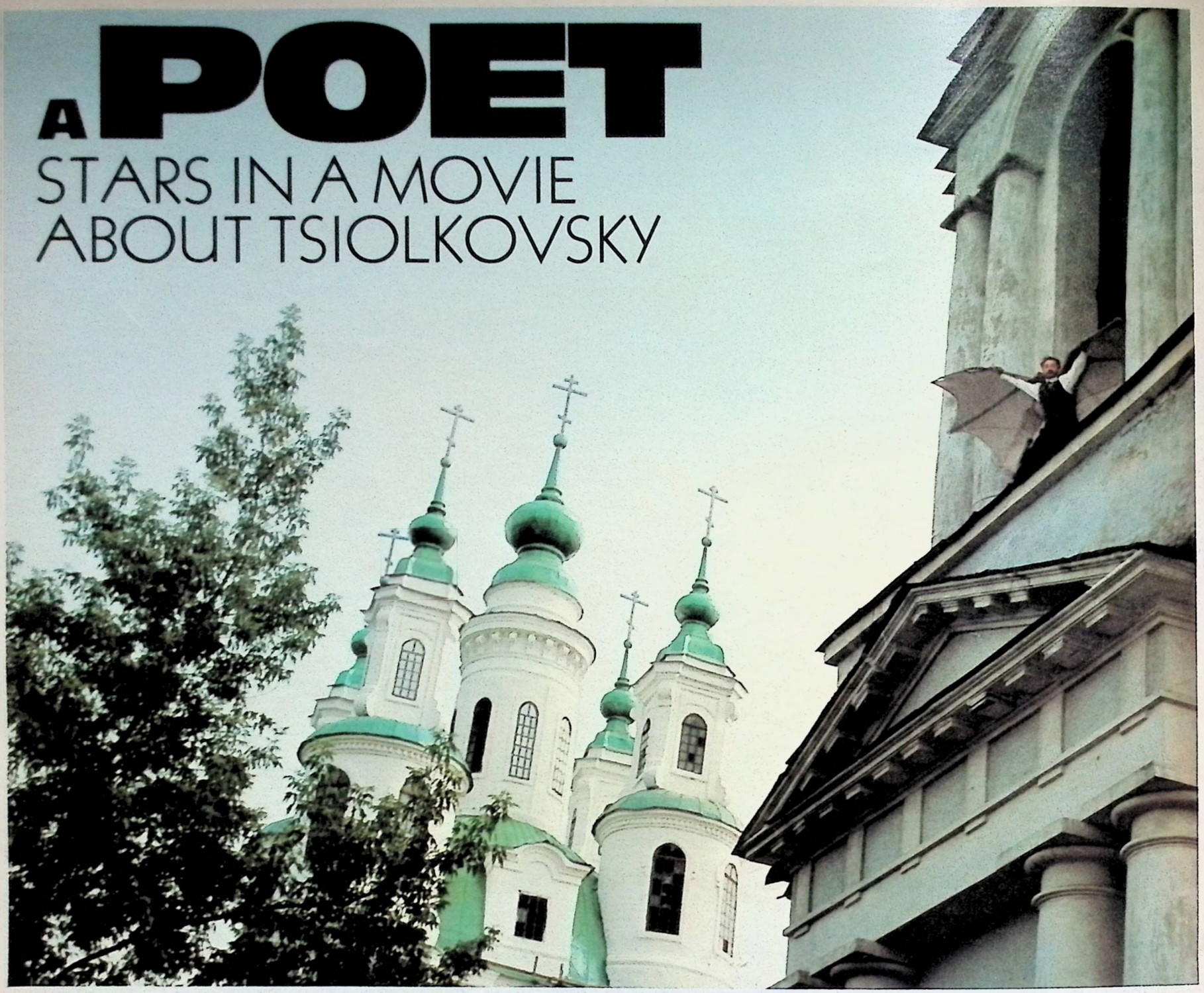
As though reading my thoughts, Greku said: "I like anything in art that is straightforward and direct, anything that comes from an artist's inspiration and not from cold, rational intellect. Leonardo da Vinci advised his students to look more often at the clouds, at old spots on walls and to try to imagine all the pictures they could represent. It's thought by association—something that no artist can do without.

"I appreciate the art of Vasili Kandinsky, Kazimir Malevich and Jackson Pollock because they freed the artist from literary stamps and photographic portrayal. But at the same time, strange as it may seem, abstraction is limited because its range of association is too great." ■

The Rocks of Goris, **1977.**

Outer Space—Near and Far (a fragment), **1973.**

A POET STARS IN A MOVIE ABOUT TSIOLKOVSKY



Yevgeni Yevtushenko as Konstantin Tsiolkovsky. During one experiment the scientist plunged from a church tower into the air using wings he had designed.

There wasn't a cloud on the horizon when the young schoolmaster Tsiolkovsky wed Varya, played by actress Larisa Kadochnikova.

Takeoff, a feature film about the life of Konstantin Tsiolkovsky, the father of modern rocket and space research, was directed by Savva Kulish and stars the famous poet Yevgeni Yevtushenko. The film has received rave reviews and awards at a number of international film festivals. Yevtushenko talks about taking his first screen test years ago, about his first film appearance and about the great man he portrayed.

From the roof of an old wooden tower the scientist watched the stars.

I THINK it was in 1947 that I read in the paper that young men were being screen-tested for the main role in the film *Un Capitan de Quince Anos (Fifteen-Year-Old Captain)* after the novel by Jules Verne. The next morning I went to the film studio instead of going to school. A long line of young candidates for captain stared with awe and dread at a door which had "Assistant Director" on it and from which came shouts like: "Show some righteous indignation! What's the matter, don't you understand Russian? What are you hesitating for? Is this what we have in our schools today?"

The unsuccessful captains rushed out of the door as if they had been scalded, with red spots of shame on their cheeks. I imagined the creature called assistant director to be hairy, disheveled and huge, with black smoke spewing from his mouth. I gripped the doorknob, wet with the sweat of the other candidates' palms, and entered a room that appeared quite empty at first glance. Only a second later did I notice a small man with his tie hanging loose perched on the edge of a chair. There was a wild, hopeless look in his eyes. It seemed to me that he was about to fall off the chair and never get up again—he looked so exhausted. "Well," he said with quiet despair, not even looking at me.

With my eyes glaring (trying to look as fearsome as possible), I started reciting a mournful poem by Alexei Surkov at the top of my voice. He raised his eyes in surprise and backed away from me, in fear, I think. Then he groaned, "Listen, can you think of anything simpler to recite? A fairy tale, for instance. . ."

"I don't like fairy tales," I said firmly, all set to enact "righteous indignation."

"Go away, boy, go away," he whispered almost imploringly. "Your indignation is too righteous. You frighten me, kid." That was the end of my first try to get into films.

Exactly 30 years later I received a call from Mosfilm Studio. "This is assistant director Chikireva speaking."

The words "assistant director" immediately brought back memories of my failure. "Kulish is planning to make a film about Tsiolkovsky. Would you like to try out for the part?" the voice continued. I mumbled something in reply. Besides my unpleasant reaction to the words assistant director, I still had a bad taste in my mouth from two other unsuccessful attempts to get into films. One was with Italian director Pazolini when he was making *The Gospel According to St. Matthew*, and the other with Soviet director Eldar Ryazanov making *Cyrano de Bergerac*.

"But I don't look like Tsiolkovsky," I said.

"That's not true," answered Chikireva. "My husband is a makeup man. We saw you recently on television during a poetry reading. You recited 'The Fair in Simbirsk,' and both of us said you looked very much like Tsiolkovsky. We'll be expecting you tomorrow." I didn't take the invitation too seriously, but I went anyway.

I acquired a new face under the hands of Mikhail Chikirev. A stranger looked back at me from the mirror. He wasn't Tsiolkovsky yet, but he was no longer me. Savva Kulish dropped in, acting very casual. We had been friends for about 20 years, so it was psychologically difficult for him to test me. Which explains why his assistant had phoned me on her own initiative, as it were. The film world has its own brand of etiquette. In this world there are not only hurt feelings but deep and lasting wounds after unsuccessful tests. However, Kulish couldn't keep up the role of casual visitor. He looked with amazement at my new face and a gleam appeared in his eyes. His feigned indifference disappeared. "Give him a screen test," he said hurriedly and dryly, "and we'll rehearse tomorrow."

The next day there was no rehearsal. But there was a lecture—a very spirited and informative lecture in which Kulish recounted not the script of the film, but the story of the man whom I was to play. To think that I had thought I knew all about Tsiolkovsky. That's the delusion of many whose information is gleaned from the popular biographies of the great. In a general educational sense, Tsiolkovsky was just a great self-taught inventor. But after I went to his home town of Kaluga and delved into the archives, carefully turning over the yellowed pages of monographs stamped "Published by the Author," the figure of a great thinker, the founder of a fundamentally new science rose before me. The young Tsiolkovsky was acquainted with the idealist philosopher Nikolai Fyodorov, the curator of the Rumiantsev Library in Moscow [today the Lenin State Library of the USSR—Ed.]. Tolstoy and Dostoyevsky were among Fyodorov's admirers. Fyodorov believed that humanity, torn asunder by bloody wars, would realize its internal unity only if it united in the name of a common cause. Nothing brings different people closer than the realization that they have a common foe. And people do have a common foe regardless of their nationality and religion. That foe is death.

Fyodorov went further. He dreamed of the time when not only we, the living, would become immortal, but when science would be capable of resurrecting our distant ancestors.

I don't think anyone would be averse to breakfasting with Plato, lunching with Leonardo da Vinci and dining with Pushkin. Impossible? But then science is only in its infant stage and does not even know its own possibilities. Tsiolkovsky, however, believed that Fyodorov's ideas would materialize in the future.

Tsiolkovsky was a realist. He was concerned about where the human race would live. After all, the Earth was becoming more and more crowded. So Tsiolkovsky raised his eyes to the stars, to the infinity of the universe. The rocket had been invented many centuries before him. But he was the first to join the ideas of rocket and space. Without ever having flown in an airplane, he foretold the psychological changes in the outlook of people on Earth when they would see their globe from outer space.

The people who master space will see the beauty and defenselessness of the Earth, the unnaturalness of war, the repulsiveness of all types of exploitation and inhuman treatment of people by people and the ravaging of the natural beauty of our small but remarkable planet. Ultimately, that will bring people from senseless feuds to unity. A hundred people have been in space so far. Tomorrow there will be a thousand, and then there will be millions who will inhabit unknown galaxies. But the greatness of the Earth, which was the launching pad for such an unprecedented takeoff, will not diminish, but will increase in the eyes of its grateful descendants. The Earth will always be a monument to that takeoff. Space philosophy, of which Tsiolkovsky was a chief creator, will become the possession of all people. The inventor's greatest day is yet to come.

That was what I discovered about the man I was to play. But how was I to play the role of such a great man? Jump out of myself? Pretend I was Tsiolkovsky? "Don't act. Be yourself," Kulish told me. That's easier said than done. Moreover, being myself did not mean being Tsiolkovsky. Perhaps the director was wrong.

As it turned out, he was right. Being yourself means getting rid of everything that is superficial and shallow and bringing out the best in yourself. We approach greatness only when we purge ourselves of everything that is not "us." "I don't want you to repeat Tsiolkovsky's words, I want you to think them," Kulish hammered into me. Perhaps he was urging me to lose my own individuality. No, that was not so. I realized that communion with another individual whom you have grown to love, and even getting lost in that individual, is not a loss but a gain.

The farther you move away from your everyday routine self, the closer you approach your true self. The closer you are to your own self, the closer you are to the one you love and admire. And I must say, I grew to love Tsiolkovsky.

The film is completed. I cannot be its judge. I am quite sure that many more books and films, better than ours, I hope, will be written and made about Tsiolkovsky. But the words "our film" are special to me.

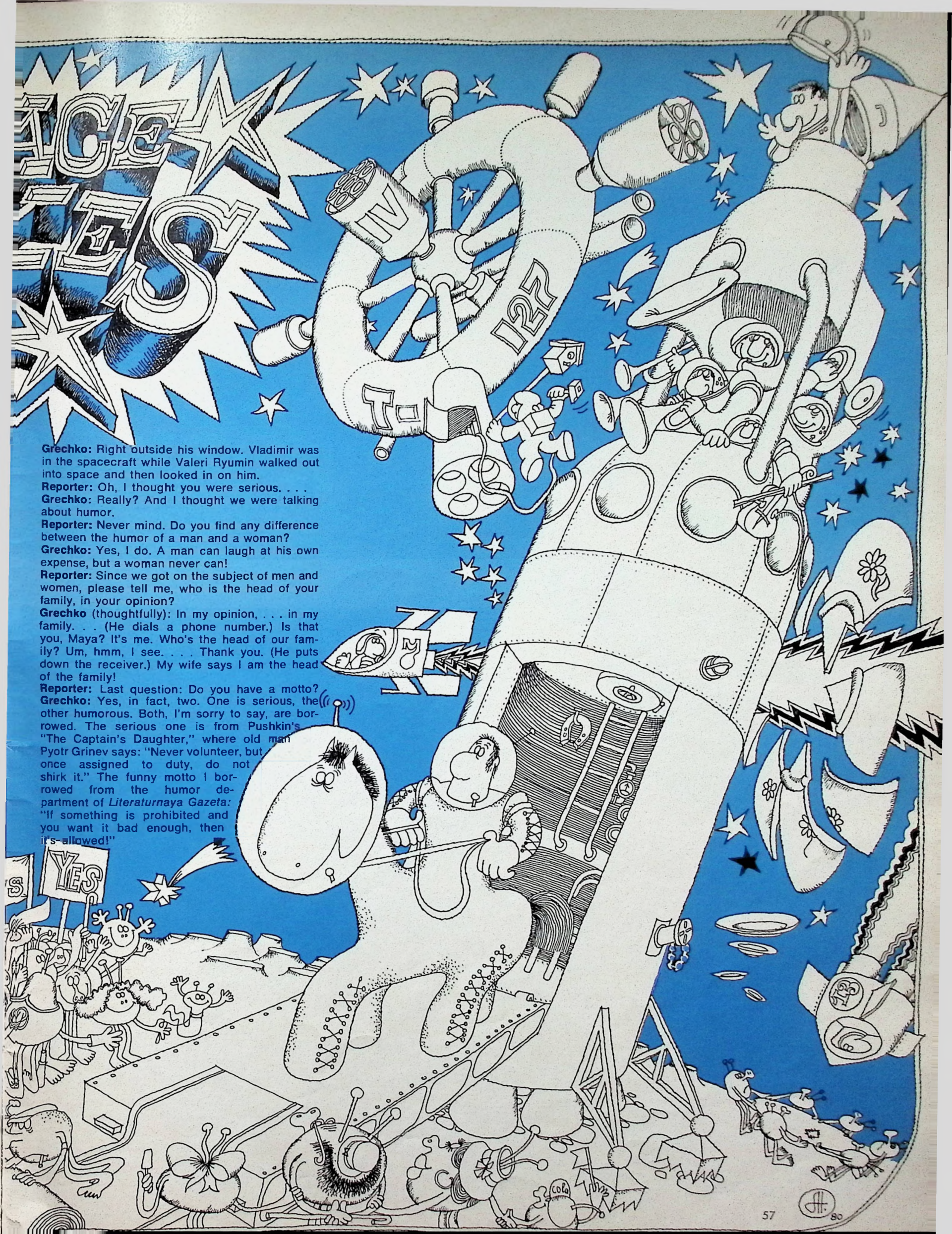
It is not impossible to go from being a spectator to an actor. But after you accomplish that, how do you touch the minds and hearts of filmgoers and become part of their struggles, sufferings and hopes? It's impossible to predict. I guess only time will tell. ■

Courtesy of *Sovetskaya Kultura*

Drawing by Andrei Nekrasov

The delightful and quick-witted cosmonaut Georgi Grechko.

Reporter: Would you venture into space if you didn't have a sense of humor?
Grechko: You promised not to talk about work.
Reporter: I'm talking about humor and not work.
Grechko: Then the answer is No, especially when it's a long flight. There are times when you get depressed. . . . That's when we listen to Alla Pugacheva's song "If you are miserable long enough, you'll be rewarded!" And it helps, you know. Another thing that worked was our little tricks. While Yuri Romanenko and I were in space for three months, we made up a day-to-day program on a piece of blueprint paper that was a meter long! We folded it like an accordion and opened a "page" a day. That way, the flight seemed a little shorter.
Reporter: Does anything funny ever happen during a flight?
Grechko: Yes, it does. For example, Pyotr Klimuk dozed off after work in one of the compartments one day. When Vitali Sevastyanov knocked at the compartment door, Klimuk woke up and asked, "Who is it?"
Reporter: I'd like to ask you something that everybody is curious about. Have you ever seen any visitors from space?
Grechko: No, I haven't, but Vladimir Lyakhov has seen one.
Reporter: Where?



Grechko: Right outside his window. Vladimir was in the spacecraft while Valeri Ryumin walked out into space and then looked in on him.

Reporter: Oh, I thought you were serious. . . .

Grechko: Really? And I thought we were talking about humor.

Reporter: Never mind. Do you find any difference between the humor of a man and a woman?

Grechko: Yes, I do. A man can laugh at his own expense, but a woman never can!

Reporter: Since we got on the subject of men and women, please tell me, who is the head of your family, in your opinion?

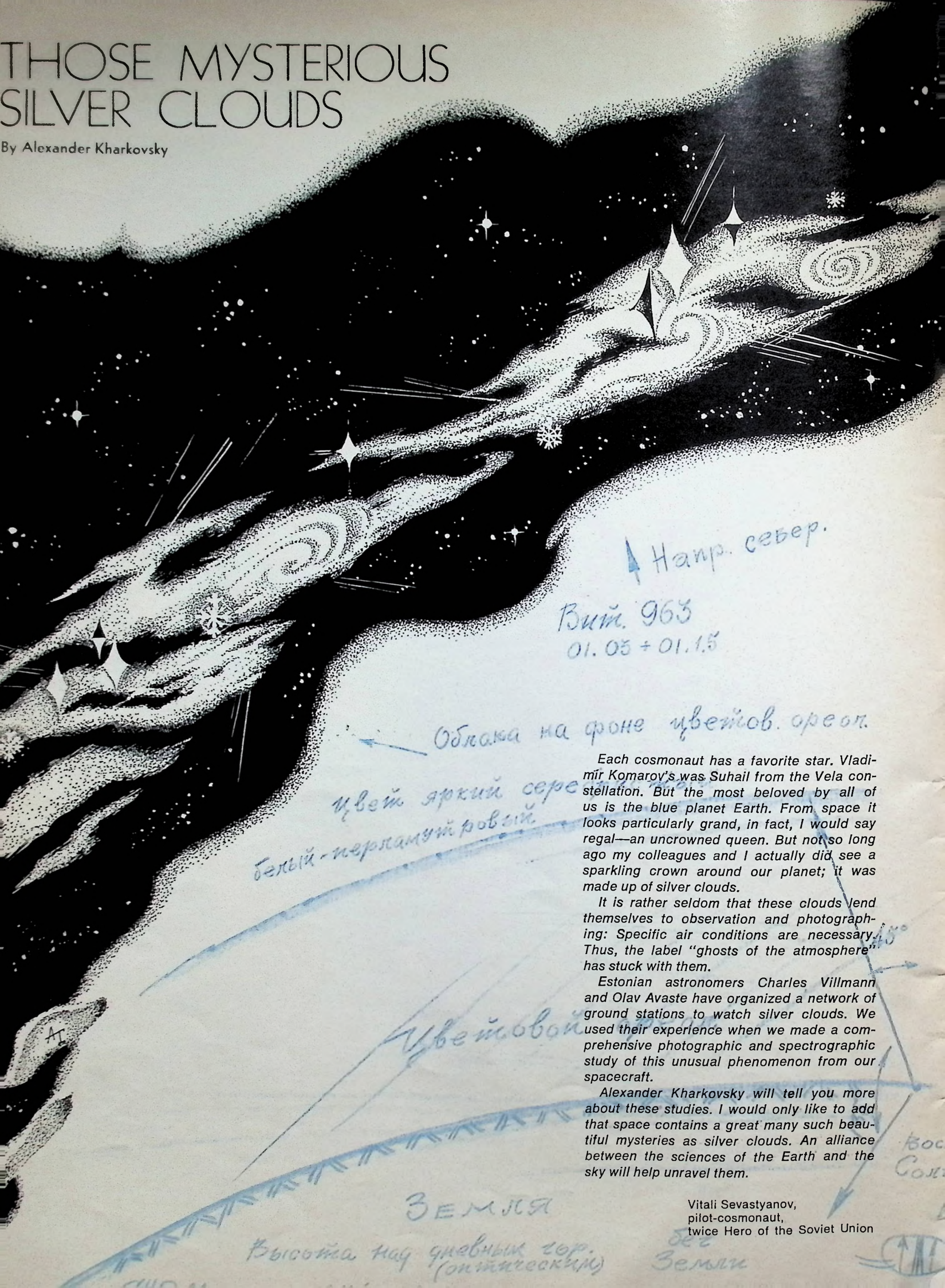
Grechko (thoughtfully): In my opinion, . . . in my family. . . (He dials a phone number.) Is that you, Maya? It's me. Who's the head of our family? Um, hmm, I see. . . . Thank you. (He puts down the receiver.) My wife says I am the head of the family!

Reporter: Last question: Do you have a motto?

Grechko: Yes, in fact, two. One is serious, the other humorous. Both, I'm sorry to say, are borrowed. The serious one is from Pushkin's "The Captain's Daughter," where old man Pyotr Grinev says: "Never volunteer, but once assigned to duty, do not shirk it." The funny motto I borrowed from the humor department of *Literaturnaya Gazeta:* "If something is prohibited and you want it bad enough, then it's allowed!"

THOSE MYSTERIOUS SILVER CLOUDS

By Alexander Kharkovsky



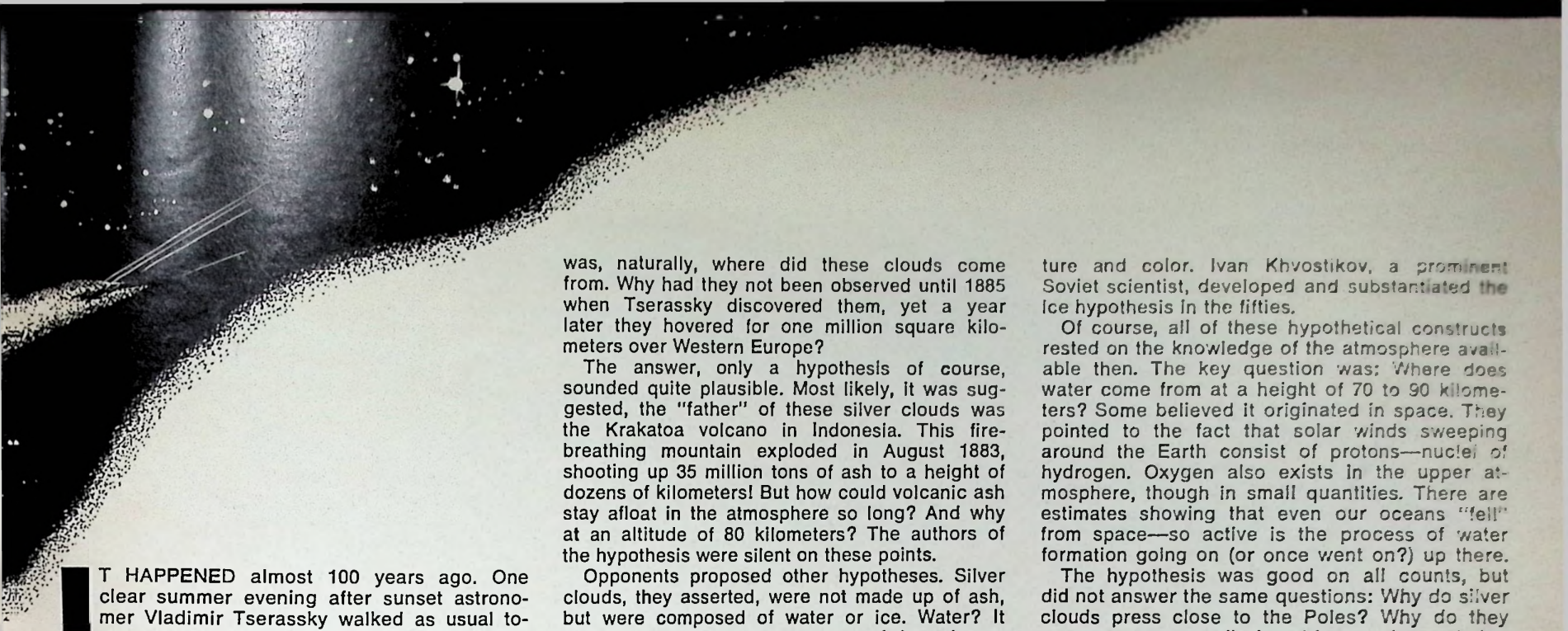
Each cosmonaut has a favorite star. Vladimir Komarov's was Suhail from the Vela constellation. But the most beloved by all of us is the blue planet Earth. From space it looks particularly grand, in fact, I would say regal—an uncrowned queen. But not so long ago my colleagues and I actually did see a sparkling crown around our planet; it was made up of silver clouds.

It is rather seldom that these clouds lend themselves to observation and photographing: Specific air conditions are necessary. Thus, the label "ghosts of the atmosphere" has stuck with them.

Estonian astronomers Charles Villmann and Olav Avaste have organized a network of ground stations to watch silver clouds. We used their experience when we made a comprehensive photographic and spectrographic study of this unusual phenomenon from our spacecraft.

Alexander Kharkovsky will tell you more about these studies. I would only like to add that space contains a great many such beautiful mysteries as silver clouds. An alliance between the sciences of the Earth and the sky will help unravel them.

Vitali Sevastyanov,
pilot-cosmonaut,
twice Hero of the Soviet Union



IT HAPPENED almost 100 years ago. One clear summer evening after sunset astronomer Vladimir Tserassky walked as usual toward his observatory, located on a quiet street in Moscow's Presnya District. A chance look up at the sky made him stop abruptly. The sky was filled with clouds that he had never seen before. The astronomer wrote in his diary somewhat later:

These clouds, outwardly so different from all the rest, are most notable for their brilliance; they shone luminously in the night sky, giving off a white and silver light that sometimes turned azure, with a golden hue near the horizon. At moments the buildings became noticeably lit up with it, and one could even make out distant objects. Formations reminiscent of lunar craters were visible here and there deep among the clouds. But the most characteristic shape was narrow strips stretching along a straight line and bending—they looked like a jagged shore with bays and inlets.

Tserassky pointed out that for all their apparent "massiveness," the clouds were so ephemeral that they did not screen out the less bright evening stars. And so began the observation of these strange formations in the atmosphere. The longer astronomers watched them, the more amazed they were. First of all, it was surprising that the clouds constantly managed to stay at about 80 kilometers above the Earth. They also appeared only in the summer for some reason and only in areas lying not farther south than 50 degrees north latitude. There was no end to the questions.

Volcanoes? Meteorites? Ice?

The first question scientists tried to answer was, naturally, where did these clouds come from. Why had they not been observed until 1885 when Tserassky discovered them, yet a year later they hovered for one million square kilometers over Western Europe?

The answer, only a hypothesis of course, sounded quite plausible. Most likely, it was suggested, the "father" of these silver clouds was the Krakatoa volcano in Indonesia. This fire-breathing mountain exploded in August 1883, shooting up 35 million tons of ash to a height of dozens of kilometers! But how could volcanic ash stay afloat in the atmosphere so long? And why at an altitude of 80 kilometers? The authors of the hypothesis were silent on these points.

Opponents proposed other hypotheses. Silver clouds, they asserted, were not made up of ash, but were composed of water or ice. Water? It could have come from the crater of the volcano, they said. Didn't Vesuvius once spew forth 10 billion tons of water during one 18-hour eruption?

Still others objected. Volcanoes, they pointed out, do not only erupt in summer. And then, too, many volcanoes are located farther south than 50 degrees north latitude—that is, in areas where silver clouds do not occur.

Forty years later when scientists compared the frequency of the appearance of noctilucent (night luminous) clouds (commonly referred to as silver clouds) with that of volcanic eruptions, they found no correlation. So the volcano hypothesis was abandoned.

But a new hypothesis was quick in coming. In 1926 Soviet scientist Leonid Kulik categorically stated that silver clouds owe their origin to meteorites. He based his assertion on his own studies of the famous Tunguska meteorite, which fell in 1908.

The meteorite hypothesis answered many questions. Silver clouds appear rarely. And meteorites, too, are not frequent guests. Both can more often be observed in the summer.

The supporters of this hypothesis argued that silver clouds are simply meteorite dust drifting in the upper layers of the atmosphere.

But why does it accumulate only at a height of 80 kilometers and never lower? It is kept there by upcoming streams of air. On an area millions of kilometers wide? Strange streams!

And the origin? It would be logical for meteorite dust to amass in the tropical zone for it is there that we see the greatest amount of dust. Yet silver clouds, for some reason, inhabit the middle latitudes, not the lower latitudes.

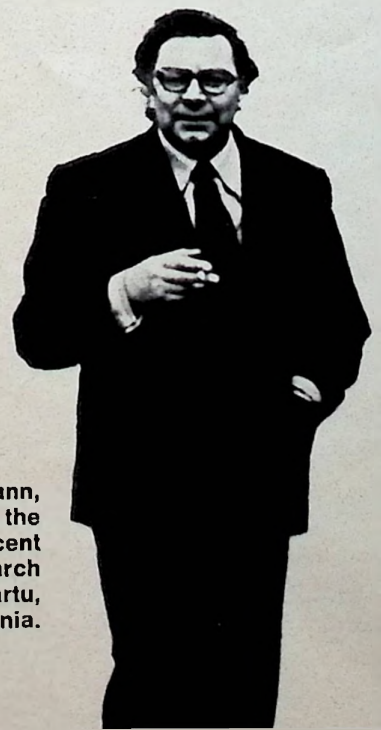
Perhaps the dust is metallic, so it tends to gather near the magnetic poles of the Earth? Recent studies have shown, however, that iron meteorites make up no more than 7 per cent of all meteorites. Armed with this discovery, the opponents of the meteorite hypothesis clinched their argument against it by asking: Why don't silver clouds appear more often after meteorite showers?

Though all these arguments have not destroyed the meteorite hypothesis, its supporters have taken an all-out defensive. The hypothesis itself has survived, but alongside it a new—condensation or ice—hypothesis has also appeared. I say "alongside" because the new hypothesis does not totally reject the previous hypotheses, meteorite or even volcano, and is even ready to look for compromise between them. For the advocates of the ice hypothesis, it is of utmost importance that they determine what silver clouds consist of, and only then how, from what sources—celestial or terrestrial—these components have gotten into the clouds.

The author of this hypothesis, Alfred Vegener (the same one who proposed the theory of the continental drift), suggested back in the early twenties that silver clouds consist of tiny ice crystals. It's the ice crystals, according to this scientist, that give the clouds their outline, structure and color. Ivan Khvostikov, a prominent Soviet scientist, developed and substantiated the ice hypothesis in the fifties.

Of course, all of these hypothetical constructs rested on the knowledge of the atmosphere available then. The key question was: Where does water come from at a height of 70 to 90 kilometers? Some believed it originated in space. They pointed to the fact that solar winds sweeping around the Earth consist of protons—nuclei of hydrogen. Oxygen also exists in the upper atmosphere, though in small quantities. There are estimates showing that even our oceans "fell" from space—so active is the process of water formation going on (or once went on?) up there.

The hypothesis was good on all counts, but did not answer the same questions: Why do silver clouds press close to the Poles? Why do they appear in summer (is it colder up there at that time than in winter?) and why always at the same, strictly limited height?



Charles Villmann, founder of the Noctilucent Clouds Research Center in Tartu, Estonia.

Firing Rockets at Clouds

In the last 20 to 25 years, the study of the atmosphere has made considerable headway. One can, in fact, speak of a rediscovery of the air ocean. Rockets are penetrating it, and artificial Earth satellites are permanently watching over it. Yet the mysteries in the atmosphere have not become fewer in number.

Armed with aerospace technology, reliable instruments and spectroanalyses, scientists hoped that they could confirm some hypotheses about the nature of silver clouds.

Technology has cleared up some of the picture. For example, in the fifties first a spectral analysis of the upper atmosphere and then data obtained by the American Explorer 12 bore out the existence of water at an altitude of 80 kilometers, that is, in the zone of the formation of the silver ghosts. To check the possibility of a birth of such clouds in southern latitudes, American researchers twice used stages of the Saturn rocket to deliver tons of water to a height of 100 kilometers. The water was dumped out, but no clouds materialized.

Early in the sixties scientists undertook a new attack on the clouds with direct weather-rocket hits. The rockets had special traps for collecting particles.

The first results proved encouraging. The number of particles in the silver cloud zone was twice as high as that in a cloudless sky. Moreover, many particles had little halos which some researchers interpreted to be traces of evaporated pieces of ice. It looked as though the ice hypothesis could be raised to the rank of theory.

There was one catch, however. Sulfuric acid could be equally responsible for the effect. Traces of sulfur were indeed discovered in the rocket traps. This perplexed scientists. Where did sulfur come from at such a height? From space? Not likely. The sulfur content of meteorite matter is negligible. From the Earth? But how could industrial gases get way up there? It was a mystery.

In 1964 and 1965 new rocket-based experiments were performed. The results were negative. Not one particle was detected. Then scientists began to wonder if ion clusters might play the role of nuclei of condensation in the formation of silver clouds.

Large Objects Are Better Seen At a Distance

The Institute of Astrophysics and Atmospheric Physics of the Estonian Academy of Sciences in Tartu has a special Soviet research team engaged in the study of silver clouds. An international geophysical center to explore these clouds is also based in Tartu. Estonian scientists are ▶

working in very close contact with cosmonauts. The names of cosmonauts Vitali Sevastyanov and Pyotr Klimuk rank alongside those of leading scientists at the institute—Charles Villmann and Olav Avaste, recent winners of a State Prize of the Estonian Republic for a series of original studies of silver clouds.

Charles Villmann, head of the space research division at the institute, was the theoretician and coordinator of the research. He restored an old observatory in a suburb of Tartu, fully equipping it for observations of the clouds. Those observations formed the basis for his dissertation and work. Villmann was among the enthusiasts who advocated the establishment of a broad national network of stations to monitor this atmospheric phenomenon. Such a network now exists: The institute receives information about silver clouds from space satellites and orbital craft, as well as from research ships and ground centers located in the zone where they appear. Villmann himself has flown to the arctic region numerous times for launchings of weather rockets and has participated in expeditions on land and at sea.

Villmann showed me the initial entry in a log of a maritime expedition. It was dated April 12, 1961. Coincidentally, Yuri Gagarin made his historic space flight on that same day. Villmann smiled. As the man coordinating the work of the ground network of observation stations, he had realized from the beginning that no true success in the study of silver clouds could be achieved unless a look at them from below was supplemented with a look from above—from space. But how were they to be observed from there? So Villmann asked Sergei Korolyov, then in charge of the Soviet space program, for help.

In the early sixties Korolyov's representative went to Tartu to discuss the idea of designing a special instrument to detect silver clouds from space. In 1965 future cosmonaut Vitali Sevastyanov also visited Tartu. Villmann initiated him into the science of clouds. This started a many-year friendship between the scientist and the cosmonaut. Later Villmann went to Stellar Town near Moscow, where Soviet cosmonauts live, and gave a series of lectures on silver clouds. With Sevastyanov and his colleagues he developed instruments for their study. He knew that sooner or later these clouds would be studied from space.

Above the Clouds

On May 24, 1975, Soyuz 18 lifted off. Cosmonauts Pyotr Klimuk and Vitali Sevastyanov placed it in orbit. For the first time in the history of space flights, a comprehensive photographic and spectrographic study of silver clouds was carried out.

Sevastyanov kept a detailed diary on the clouds. Here is an excerpt:

> ***July 2, 1975:*** *Last night and this morning we observed another miracle of nature—silver clouds. These clouds hang at a height of 60 to 70 or 80 kilometers. They are of totally unknown origin and largely a puzzle. So we are now watching them in space. These are the first such observations, and we are true pioneers—watching closely, making notes, dictating on tape recorders, sketching.*
>
> *Ground control made an exception and permitted us while we were in the Earth's shadow to orient our craft toward sunrise and, should we detect silver clouds, study them with spectral equipment and photograph them.*
>
> *We have successfully accomplished everything.*
>
> *Silver clouds are enchanting. They have a cold white color—slightly mat,. sometimes mother-of-pearl. On the edge of an absolutely black sky, the structure is either very fine and bright or cellular, resembling a swan's wing when the clouds are lower than the "crown." They do not rise higher than the "crown."*
>
> *The "crown" is a luminous layer of intense brightness encircling the Earth at a definite height over the nightly horizon. Sometimes it sparkles.*

After rereading these lines, Sevastyanov recalled the moment when he told ground control about his discovery. Pyotr Klimuk, the ship's commander, unable to restrain himself, had said into the microphone: "We see the clouds! It is very interesting up here! I have never witnessed such a sight before. You can't imagine how beautiful the twilight horizon is. It's a very interesting range of colors. And above the color halo, eclipsing everything else are the silver clouds! I've never seen anything like it in all my life. The Sun is below and lights them up. They're not high over the horizon so far. They're bright. . . ."

Sevastyanov added: "The clouds may be composed of solid sulfuric acid or some other matter. It's difficult to check. Silver clouds 'live' too high up.

"The cosmonauts who went before us had never seen such clouds, so ground control received our report as a real sensation. . . . What's more, we not only took pictures of the clouds, we also made some spectrographs. . . ."

Sevastyanov summed up his scientific observations in an article that he coauthored with Villmann. The year 1975 produced a bumper crop of silver clouds. In all, they were observed by cosmonauts 27 times, and in almost every case, they were also watched from the ground. "The idea that silver clouds girdle the Earth in a continuous ring has been stated before," Sevastyanov and Villmann wrote. "Now space observations by the crew of the Salyut 4 once again support this very important conclusion." Observations also confirmed that silver clouds have many tiers and that their fields can be global at latitudes higher than 45 degrees.

So, are these clouds as characteristic of the Earth as rings are of Saturn or polar caps are of Mars? Science has yet to answer this question.

Scientists believe that like silver fairy castles, these clouds hold the key to the processes occurring in the atmosphere.

Each Wednesday—International Geophysical Day—rockets crammed with meteorological instruments blast off into the sky. From data flowing into a central atmospherics observatory in Moscow, researchers construct a synoptic picture that is then complemented by American research in the Western Hemisphere.

All of this information has recently raised new riddles and problems. For example, a temporary winter warming up at an altitude of about 50 kilometers was discovered. The jump in temperature is impressive—as much as 40 degrees Celsius. Then the warmth descends to a height of 20 kilometers. In the Northern Hemisphere this process repeats itself with a regularity that is so far unexplained.

Or take another phenomenon: Winds blowing in the stratosphere over equatorial regions change their directions so regularly that it appears that somebody is controlling their movement. What is causing this? Science does not know the answer yet. But it is global phenomena like silver clouds that will probably make it possible at last to create a model of the atmosphere and answer these questions too. An all-round approach is necessary: The ocean of air should be explored both from space and from the Earth's surface.

The search for clouds from space is being carried on consistently. In January 1978 cosmonaut Georgi Grechko reported from Salyut 6: "Above the South Pole we saw very beautiful silver clouds. They had many layers. What if we cut through them with all our instruments?"

After permission was given, the Flight Control Center invited Charles Villmann for consultation. "Excuse me," Villmann heard the voice of cosmonaut Grechko say, "but I asked them to invite you so that you could specify the data for photographing. Did you have a good trip?"

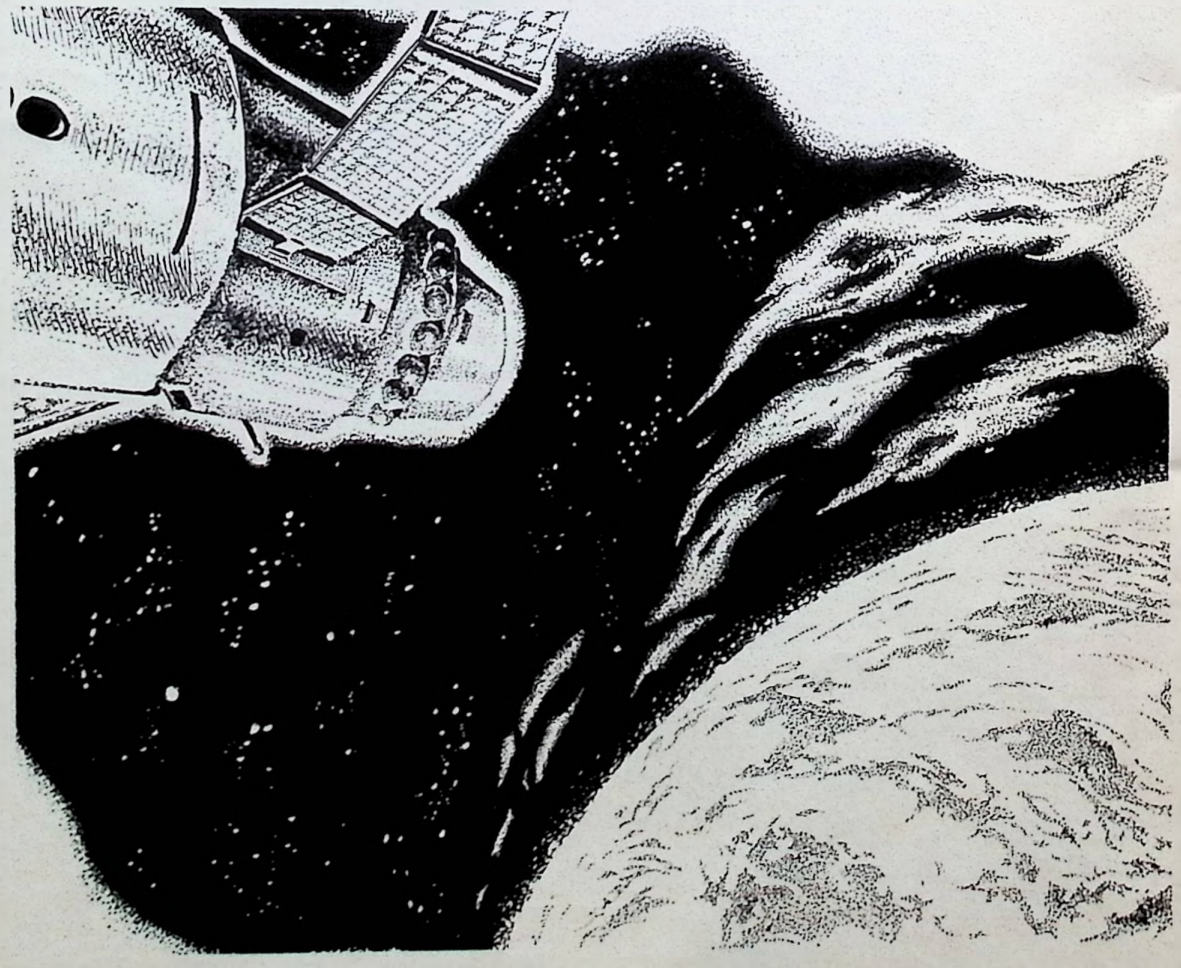
"Yes, thank you," replied the scientist. "After all, it's easier for us down here on Earth. My recommendation is that you photograph with two exposures."

The cosmonaut got excellent pictures of the clouds. Summing up the work of the Salyut 6 crew, Villmann said: "The results are interesting. We will report on them at international conferences. Because of the jumps in temperature, the clouds have many tiers. Most likely they disappear under the influence of ultraviolet rays of the Sun."

The Salyut 6 studies have proved that silver clouds appear over the North Pole in summer, and in winter over the South Pole—almost like the polar caps of Mars.

"Could these clouds be predicted?" Villmann was asked.

"We will try. In any case, the screen between space and the Earth, as silver clouds are sometimes called, is gradually losing some of its mysteriousness." ■



By Gennadi Gerasimov
SOVIET LIFE Commentator

SOVIET FOREIGN POLICY AFTER THE 26th CPSU CONGRESS

BECAUSE CONTINUITY is a salient feature of Soviet foreign policy, careful observers did not expect any sudden or sensational foreign policy zigzags or turns from the 26th Party Congress held at the end of February and the beginning of March.

This formal trait of being consistent and continuous "from congress to congress," formal in the sense that it does not speak of the gist of policy, is extremely convenient for members of the international community: It allows them to incorporate the already known Soviet foreign policy constants into their own calculations. This is simpler to do with what can be predicted than, for example, with catchwords that change every four or five years.

According to the theory of international relations, this should always be the case since the aims and tasks of foreign policy are determined above all by objective national interests, which are to a considerable extent permanent. However, in international practice, in contrast to theory, instances are not infrequent when, say, a rather broad interpretation of such interests introduces an element of subjectivity and becomes a source of tension.

The aim of Soviet foreign policy as it is defined is to ensure for the Soviet people the requisite external conditions for fulfilling their constructive tasks. In his report to the 26th CPSU Congress, Leonid Brezhnev identified this national interest with that of all humankind: "For at present nothing is more essential and more important for any nation than to preserve peace and ensure the paramount right of every human being—the right to life."

Peace as a Priority

The general predictability of Soviet foreign policy does not mean, however, that the 26th CPSU Congress would not add anything new in concrete terms to that policy. To some extent its very predictability, paradoxically enough, came as a surprise to those commentators who are apt to analyze international relations somewhat like cock fights, with "challenges" and "replies" to them.

From the Soviet point of view, the chief "challenge" (to use an expression that has not taken root in the Soviet press) is that nuclear weapons threaten to destroy human civilization. Mind you, this conclusion rules out the possible "victory" of one side or the other in the event of a nuclear war.

I would like to draw the attention of the American reader once again to the way the Soviet Union visualizes the outcome of a third world war. In his report Leonid Brezhnev gave an assessment of the results of a "limited" nuclear war in Europe. He said that such a "limited" war would "from the outset mean certain destruction of European civilization." Long before this statement, the Soviet leader agreed with the opinion of a group of U.S. scientists on the disastrous consequences for the whole world of a Soviet-American nuclear war. And he stressed again in his report: "The peoples must know the truth about the destructive consequences for humankind of a nuclear war." He suggested that a competent international committee be set up which would demonstrate the vital necessity of preventing a nuclear catastrophe. The committee could be composed of the most eminent scientists of different countries. The whole world should be informed of the conclusions they draw.

For a Dialogue to Continue

Because in its foreign policy the Soviet Union proceeds from the main task of ensuring peaceful conditions for the nation's development, it naturally attaches much importance to the state of relations between the two nuclear giants, the Big Two. Incidentally, the entire international situation depends in many respects on the policies of our two countries. In the opinion of Leonid Brezhnev, there are two reasons why it is necessary to conduct an active Soviet-American dialogue at all levels, including summit meetings as the decisive link. The first reason is the present state of relations between our countries. It leaves much to be desired. In view of what has been said above concerning nuclear war, it needs to be improved. The second reason is the pressing nature of international problems calling for solution. How can they be solved without talking to each other?

The Soviet invitation to start a dialogue contains no reservations, a priori estimates or preliminary conditions. But since the arms race is regarded by us as our common enemy and since we consider it necessary to act quickly before military weapons get out of hand, we look upon the problem of limiting and reducing strategic arms as very urgent—and that was the view expressed at the congress. That is why it was said with full authority at the congress that the Soviet side is prepared to continue without delay the relevant negotiations with the United States while retaining all the positive things which have been achieved so far in that field.

Concrete proposals were made, too: to agree on limiting the deployment of new types of submarines, on banning modernization of existing and development of new ballistic missiles for these submarines. And that is only the tentative beginning of the list. The Soviet Union is prepared to negotiate the limitation of any kind of weapons.

Balance of Forces

In its analysis of the prospects for world development, the 26th CPSU Congress proceeded from the existing military-strategic equilibrium between the Soviet Union and the United States, between the Warsaw Treaty members and NATO. Western experts are agreed that such a parity does exist. For example, Dr. Christoph Bertram, director of the International Institute for Strategic Studies in London, writes that an analysis conducted by his institute revealed a "rough balance between the United States and the Soviet Union" in the field of strategic nuclear weapons.

There is wide recognition of the fact that this balance objectively helps to safeguard world peace. For instance, a joint French-West German statement of February 6 mentions the "principle of global balance of forces."

The purpose of Soviet policy is only to maintain this balance while reducing the levels of armaments as much as possible. There is no such aim as gaining superiority over the other side. To expect to win a nuclear war was termed "dangerous madness" at the congress.

The congress also put forward other proposals to ensure peace. The Peace Program adopted at the 24th CPSU Congress and extended at the 25th Congress will continue. Moreover, the Soviet Union does not claim any monopoly on peace diplomacy. It has proposed, for example, that a special session of the UN Security Council be called at the highest level, with leaders of other countries invited to attend, in order to look for keys to improving the international situation and preventing war.

Japan's Prime Minister, Zenko Suzuki, like many observers, characterized the Soviet initiatives as a new "peace offensive."

This assessment perhaps contains some notes of skepticism. But if such "offensives" were to be undertaken by other countries, they would meet halfway, and everyone would be in the winners camp against the common enemy—the threat of nuclear war. ■

SOVIET COSMONAU

"Vast sums are spent on space research. But what are the practical benefits?" Lyudmila Yenyutina asks Alexei Yeliseyev, the former pilot-cosmonaut now in charge of Soviet space flights, in the interview below. "Space flights are coming close to being profitable. Many branches of the economy benefit from research," he says. "Scientists believe that future orbital stations and satellites will yield millions."

Q: Now that we have entered the eighties, I would like to ask you what you consider to be the most important breakthroughs in space research and development in the seventies.

A: The creation of the Salyut permanent orbital stations has been perhaps the most interesting and important event for us in the past decade. It was a qualitatively new step that enabled us, on the one hand, to dispatch a vast array of scientific instruments into space and, on the other, to provide those working in space with more comfort.

The possibilities for research have been greatly enhanced by the new supply system for orbital stations. The system has prolonged the station's active life by replenishing its storehouse of scientific instruments during the flight. Thus, the scale of scientific programs has grown.

Orbital stations have also taken on more space research tasks of vast importance to the national economy. Their work should have a significant economic effect.

Finally, it was at the stations that serious technological research was launched. Scientists now possess hundreds of samples of substances impossible to obtain on the surface of our planet. As you know, gravity interferes with making alloys of substances with differing densities. This obstacle is minimized to the utmost by weightlessness. In addition, better crystals can be obtained in space. And the electronics industry is in need of just such crystals. The experimental coating of various surfaces is another highly interesting area. Today scientists are faced with the problem of restoring the optical properties of space telescope mirrors. When future orbital helio-electric power stations are built, we will have to make large-diameter mirrors in space instead of restoring them. We must be ready for such jobs.

I might mention that the duration of piloted space flights has greatly increased. The longest flight before 1970 lasted 18 days; the record now is 185 days. The quantitative increase is not the most important point here, though. The thing is that now cosmonauts returning to Earth after six months in space are in much better physical shape than they were after the first flights, which were no longer than a few days at most.

Most interesting data on distant space has been obtained in recent years by American space probes. I am referring to the studies of Saturn and Jupiter. The new information about the rings of the two planets, their satellites and near-planet space is undoubtedly of great scientific value.

Q: Do you think the Soyuz-Apollo project could be called one of the most significant events of the past decade?

A: Yes, by all means. It seems to have demonstrated most convincingly that the Soviet Union and the United States can successfully and fruitfully cooperate in such a complex area as space research. But there is more than just the technical achievements that are important here, although the production of quite a large set of compatible means was a serious obstacle to be overcome by specialists from both countries. However, I would put the political and possibly even the psychological aspects of the cooperative effort at the forefront since in the course of work together the distrust and suspiciousness that had accumulated over the years were eliminated and a good friendly relationship developed. Regretfully, it began to deteriorate again later on.

Q. What direction is space research likely to take in the next few years?

A: The main direction will undoubtedly be the development of orbital stations. We will continue to perfect them along with the piloted transport ships and unmanned cargo craft that dock with them regularly. We have already tested the new piloted Soyuz T spacecraft, which is designed for three cosmonauts. The piloting system of this craft is based on a high-capacity electronic computer. The computer checks the serviceability of the instruments onboard, gauges fuel consumption and performs a great many other operations. In addition, the Soyuz T is equipped with new engines and a new descent control system guaranteeing greater landing accuracy.

The Soyuz Ts will soon replace the Soyuz transport ships, which have worked productively in space throughout the past 10 years.

We are concentrating attention on orbital stations and means of communication with them because research in near-Earth space will be our goal for the next few years. We are learning to decipher space photos of our planet taken in various light wavelengths. If we learn to do it correctly, we can accurately tell when a harvest is ripe, the amount of water to be carried by a flood, whether there is dead wood in a forest, and the like. In the future, satellites will produce photos for ground-processing centers to decipher and regularly provide agriculture and fishing specialists, astronomers or hydrologists with up-to-the-minute information. Today we have at our disposal both meteorological and communications satellites. The time will soon come for agricultural, astronomic, geographical, geological and many other kinds of satellites.

In addition, research into deep space will continue.

Q: What is your opinion of the space shuttle developed by the United States?

A: As far as the design concept goes, American specialists have come up with quite a few interesting engineering solutions. The shuttle's successful flight will undoubtedly be a breakthrough in applied astronautics.

Personally though, I don't quite see the sphere of application for the ship. Our cosmonauts say that during their first month in orbit, they are only learning to "see" and to work productively because many things escape their notice at first. It is reported that the shuttle's flight will last anywhere from 7 to 30 days. I think it can be used to bring back to Earth some unique instruments. But then, such instruments must be very valuable.

Q: Would it be possible, in your view, to coordinate the research programs implemented in the Soviet Union with those of the United States after the launching of the space shuttle?

A: Of course it would. Moreover, I think the Soviet Union's well-designed and tested Salyut research station, which can stay in space for several years running, and the unmanned spaceship which would supply the orbital station with new crews, instruments, fuel and foodstuffs, could be beneficial to both sides. I think American specialists see that too. They started talks with us on the subject. Unfortunately, the talks were discontinued.

Q: Is the USSR working on a shuttle?

A: As in any sphere of engineering, the quest for new solutions is conducted in diverse directions, multiple-use technology being one of them. But at present we are quite satisfied with the new Soyuz T series.

JTICS

IN THE EIGHTIES

Q: What would you say about the possibility of manned flight to far-off planets?

A: I suppose that for the next few years manned spacecraft will be used only in near-Earth orbits. The thing is that the present level of technology excludes such a possibility—with reasonable financial outlays of course. Automatic probes will continue to study the planets. But space science and engineering are developing so fast that perhaps within the lifetime of our generation people will see far-off space as well.

Q: Vast sums are spent on space research. But what are the practical benefits?

A: The briefest answer, I believe, would be to say that space flights today are coming close to being profitable. Many branches of Soviet economy benefit from space research. Scientists believe that future orbital stations and various kinds of satellites will yield millions of rubles in profits.

Let's look at a few examples. Cosmonauts have discovered a number of geological formations that usually indicate mineral deposits. Drillings corroborated the forecasts, no geological expedition had to be sent to the area, and money was saved. Information on glaciers obtained from outer space helped to make *The World Atlas of Glaciers* more accurate. Semiconductors and crystals obtained in space are being successfully used in experimental instruments on the ground, particularly in laser technology.

Q: Do you think that the first orbital industrial enterprises can be built by the late eighties? Are such plans realistic?

A: Orbital industrial labs, I suppose, could be set up in the eighties. However, I would refrain from using the sophisticated word enterprises here. Such labs would automatically produce materials for instrument engineering.

Q: What is your idea of future space stations?

A: There will be two kinds, I believe. First, manned stations with cosmonauts permanently at work there; and second, those visited by cosmonauts periodically for adjusting instruments, loading film, picking up materials and maybe changing the mode of operation. A lengthier stay for cosmonauts at such stations might even be undesirable. Orbital stations for astronomic research, for instance, have to be oriented in space with accuracies of up to the tiniest fraction of a second of arc. A cosmonaut moving in the station changes its position or, as we put it, disturbs it. Then again, absolute weightlessness is required for technological research. A cosmonaut's movements would be sure to cause certain accelerations and that could disrupt the technological process. Quite a few other tasks can be carried out by automatic space stations alone. Possibly a base block will be set up for communication with automatic stations; the latter will be able to dock regularly with it for examination or routine repair.

Our Salyut orbital station could serve as the prototype of such a block since two spaceships are able to dock with it at the same time now.

I don't think stations with artificial gravitation will be built within the next few years. First of all, it is much more difficult to conduct many kinds of research in them, say astronomic or technological research. Besides, artificial gravitation is not so good for people either since continuous rotation causes a number of very unpleasant side effects. Meanwhile, we have seen that even a six-month flight in weightlessness is not only safe, but is also easily endured. According to our medical experts, space flights can become even longer.

Personally, I don't think there is any point in making space flights much longer. The danger to a person's health is not the only consideration. There are other purely human and psychological factors. If you take a look at expeditions to the North or the South Pole, you will see that with the rather comfortable conditions created there for people, there is no serious reason to be uneasy about their health. Despite this fact, the length of all such expeditions is strictly limited.

Q: Do you think there will be more women cosmonauts?

A: Of course there will. There were women on the team when the first space flights were readied. Valentina Tereshkova's flight in 1963 proved that a woman can withstand all the physical and psychological loads cosmonauts have to endure in space.

But space flights still involve loads that are very taxing for the body during launching and landing, as well as in outer space. Weightlessness is a load for the body, too.

Experts believe that men are able to better withstand the various stresses, overloads and psychological influences. Therefore, preference has been given to all-male space crews.

However, in recent years flight conditions have been improved, and medical demands on future cosmonauts will be relaxed even more. So women will soon take their place among space researchers again.

Q: Will preference be given to manned or to unmanned flights in the next few years?

A: Both will be made. But as I said earlier, orbital stations will dominate.

Once cosmonauts fully master research methods at orbital stations, automatic equipment will step in. But by that time cosmonauts will have other tasks to perform. Paradoxical as it might seem, the more we learn, the more questions crop up. It's an endless process. So I don't think the day will come when the number of manned space flights will be reduced. And one more thing. An automatic probe can only bring information to which it has been adjusted, while people can engage in creative activities and research. And that is exactly why cosmonauts have discovered phenomena that automatic probes were unable to record. I'm referring to, among other things, the vertical sky luminescence, the silver clouds and the polar aurora. After watching hundreds of sunrises and sunsets, cosmonauts have noticed the peculiarities of the atmosphere, also "overlooked" by automatic probes.

True, there is one more problem. Orbital stations have many functions today. They are being used simultaneously for medical, biological, astronomic and technological research. But what with the high level of development of science and engineering, one cannot be an expert in several spheres. The only way I see it is to dispatch into space someone who knows both the spaceship and the planned experiments, instead of an expert in one particular area. Once specialized piloted ships are put into orbit, it will be more expedient to have an expert on the crew.

At present we must strive for a situation where any healthy person would be able to make a space flight. I believe this can be achieved in the next decade. Thus, the door to outer space will be open wider. ■

From top to bottom: Academician Yevgeni Chazov of the USSR, Dr. Bernard Lown and Dr. Jack Geiger of the USA and Dr. Frank Sommers of Canada.

PHYSICIANS *Continued from page 9*

destined, or mandated, by society to shepherd life from birth to death, to heal the ailments of people, psychological and physical. We are not in a position to assess the political scene. But we are in a position to spell out the implications if a nuclear war does occur—even a limited one. The amount of human injury is unimaginable. What has happened in the world today is an atrophy of the imagination. This atrophy of imagination doesn't operate for us as physicians because we always confront the one victim, and the one victim to us is an impossible challenge.

(Dr. Lown then showed three slides of a young patient who had 60 per cent of his body burned. The first slide showed the patient as a burned infant, the second after numerous operations and the third as a young boy with few scars to show.)

These three slides represent the miracle of modern medicine and technology. To achieve this end, 35 operations and 300,000 dollars were required. Three such patients with acute burns would overwhelm the Shriner Burn Center. Three such patients! We made a projection of how many patients there would be in Boston (if a nuclear attack occurred). They would number in the hundreds of thousands. What could we physicians do for them? It's lunacy that we talk of one explosion and a limited war. These are questions that have, to my mind, an essence of immorality, a negation of human life.

Professor Takeshi Ohkita, director of the Research Institute of Nuclear Medicine and Biology in Hiroshima: Our ordeal in Japan has been under investigation for the past 35 years. This somehow has set the standards for evaluating what will happen in the case of a nuclear war. It is hard to explain the details of our research into the medical consequences of the Hiroshima and Nagasaki experience, but I would like to stress the fact that since those bombings, we as a nation have decided to have no nuclear weapons.

Dr. Jack Geiger, professor of community medicine and director of Program in Health, Medicine and Society at City College in New York: I am encouraged. I think it is the beginning. I think it is terribly important that we got physicians from 11 countries. Next year we need physicians from 30 countries. I don't know of any country in the world that doesn't have a stake in this. . . . I think we have a tremendously difficult task in many countries of the world to make people understand what the danger really is and to make them understand that it is not inevitable, that it is not something that can't be controlled. It's interesting, people don't feel that way about cancer, that it is hopeless, that there is no point in trying to do anything about it. We have to give people the same kind of feelings about nuclear war.

I'd like to talk about the mind set that goes with all the habits of feeling that our security is increased by the accumulation of dangerous weapons and that the other person's security is increased by the ever more dangerous weapons. This makes it extraordinarily difficult to recognize that we may in fact all be decreasing our security, which is what we think is happening in terms of escalating the probability of accidental use, and the like. We don't think that is immutable any more than we think that war is inevitable and the "danger" is immutable. The first step is to make clear some of the anxieties that go with this mind set and some of the fears and some of the unrealities. Part of what we hope to do in terms of public education and curriculum is to work very hard to change that.

Dr. Patricia Lindop, professor of radiobiology at the Medical College of St. Bartholomew's Hospital in England: I think that the magnitude of the problem, if you look at it for all of nuclear war, is that even if people survive, there would not be the resources for them to be maintained in a sensible situation of living. Therefore, any planned civil defense that increases the number of human beings who survive without increasing the resources is a cruel deception. Secondly, characteristics of nuclear war are unique in that the radioactive contamination affects not just man but everything that man depends upon—his soil, his water, his foodstuffs. It is quite wrong to try to think that civil defense against nuclear war will be anything except a travesty of morality.

Dr. Frank Sommers, a psychiatrist at the University of Toronto and president of PSR in Canada: I think the overwhelming impact on us as caretakers of health is that there is a dangerous kind of thinking that perhaps leads to other modes of thinking that really are archaic in the nuclear age —which is that with nuclear weapons, classical concepts of winning and losing exist. They do not. This changes the whole nature of how conflicts have been resolved in the past. And we fear that regression to these kinds of thinking, coupled with the danger that so many people have the inability to visualize what will happen due to these experiences never having been experienced by most people of the world. The experiences of Hiroshima and Nagasaki have been forgotten all too soon.

We feel there are no winners or losers in a nuclear exchange. We must find new ways of thinking, new ways of resolving conflict. This is a real challenge. ■

THE CHIEF THEORETICIAN OF COSMONAUTICS

No issue on Soviet cosmonautics would be complete without mention of the late Mstislav Keldysh. As president of the USSR Academy of Sciences between 1961 and 1975, he made a great contribution to the development of the Soviet space program and national scientific projects.

THE NAME of Academician Mstislav Keldysh (1911-1978), an outstanding scientist and mathematician, belongs in the galaxy of the brightest names in the field of science of the twentieth century, and this scientific age has been unprecedentedly lavish in producing stars of the first magnitude.

Even if Keldysh's greatest achievement had only been the solution of the famous problem of flutter (in the thirties, when the speed of aircraft was increased, planes suddenly started breaking up into pieces in midair because of the greatly increased vibration), this alone would have been enough for his name to go down in the annals of history. This, however, was only one of his first steps on the way to the summits of science, many of which he conquered later. One of his feats is especially dear to the Soviet people, and, in fact, to all humankind —he helped to put the first man in outer space.

"We owe the Soviet Union's leading position in this field," Academician Nikolai Semyonov wrote, "to two remarkable scientists, Academicians Sergei Korolyov and Mstislav Keldysh, who, with the enormous support of our party and government, have developed this great cause and who have gone down in history as the chief designer and the chief theoretician of cosmonautics, respectively. This was a triumph of science and technology, particularly mathematics, which has developed, under Keldysh's guidance, a new kind of navigation—interplanetary flight."

One must not think, however, that the summit of space exploration towers like a peak isolated from earthly affairs. It is closely tied with the rapid development of our country, its economy and science, with the penetration of scientific, particularly mathematical, methods into every sphere of life. Incidentally, Mstislav Keldysh aptly described the latter fact himself: "As in physics, the spirit of mathematical thinking is making increasingly important strides in chemistry, biology and geology and is invading the social sciences, particularly economics. A study of the fundamentals of logical processes and the theory of operations, the methods of abstract mathematics and the development of electronic computers have laid the groundwork for a new and great scientific and technological revolution for all humanity. . . ."

Keldysh was an outstanding organizer of scientific programs. While he was president of the USSR Academy of Sciences, a start was made on the development of new lines of research that moved Soviet science to a leading position in the world. In addition, new research centers were set up, the union republics made further advances in science, and the organizational structure of the Academy was coordinated with the requirements of scientific and technological progress. The many beginnings he initiated are now producing concrete scientific results.

Gherman Titov, center, the second man to make a space flight, is flanked by Academician Mstislav Keldysh, right, the chief theoretician of Soviet space programs between 1961 and 1975, and Academician Sergei Korolyov, chief designer. This photo was taken after the completion of the Vostok 2 mission.

NEXT ISSUE

SIXTIETH ANNIVERSARY OF SOVIET GEORGIA

Old Land Mentioned by Herodotus

This constituent republic occupies a rather small area—about 70,000 square kilometers—but its nature and climatic conditions vary greatly: The inaccessible snow-covered ridges of Svanetia adjoin the crowded beaches of the Black Sea coast, and alpine meadows are not far from fertile valleys. Its physical appearance, too, is a study in contrasts. Ancient temples harmonize well with modern structures in newly built industrial towns. The population of the republic, which slightly exceeds five million, includes Russians, Armenians, Lezghins, Greeks and Ossetians in addition to Georgians—nearly 100 nationalities in all. The Georgians themselves are divided into several ethnic groups, but they share many common features. They are courageous, industrious, openhearted, cheerful, artistically gifted and always hospitable.

The past 60 years have been especially remarkable. Georgia has become an advanced industrialized republic, life in the countryside has been largely transformed, and major successes in education, science and culture have been achieved.

The May issue will tell the readers about the changes that are taking place today and describe the old traditions unique to Georgia. There will be articles about people doing various kinds of work —engineers, lawyers, winemakers, writers and film directors—and about several different towns and cities— Tbilisi, Kutaisi, Signakhi and others.

COMING SOON

Documentary material on the "unknown war": nazi Germany's attack on the USSR 40 years ago.

Water is used to help simulate weightlessness for cosmonauts in training. This laboratory in Stellar Town is wide enough and deep enough to submerge the Salyut station with the Soyuz craft docked to it even with the solar cells open.