



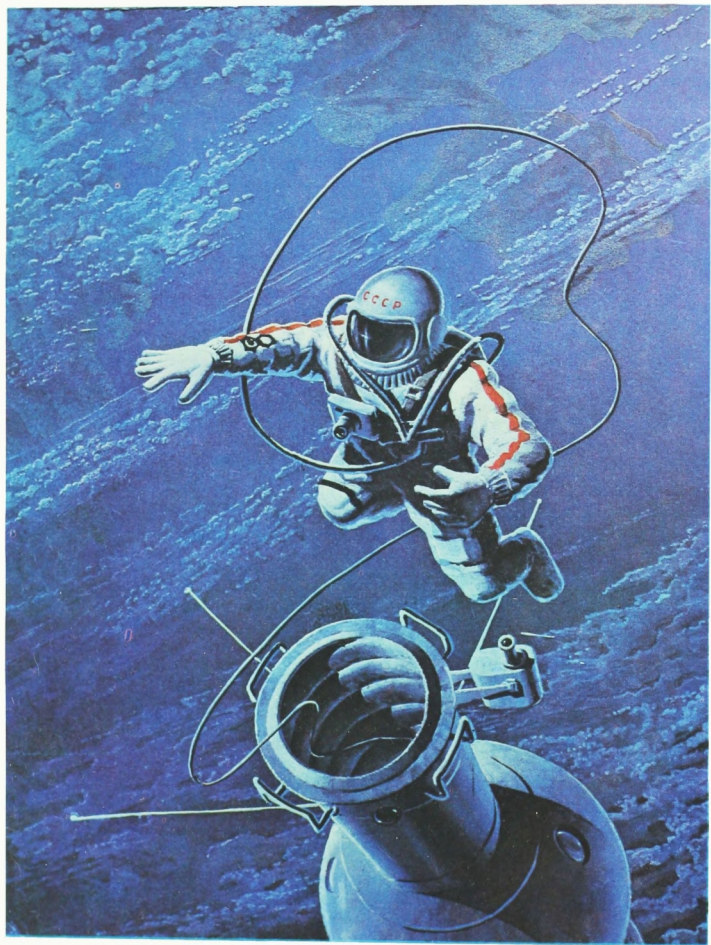
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THE SUN'S WIND





Alexei Leonov THE SUN'S WIND



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А. Леонов
СОЛНЕЧНЫЙ ВЕТЕР
На английском языке

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breathing, winking, smiling, and then dissolving in darkness.

Those of my friends who have been in outer space never tire of saying:

“How beautiful is our planet, the Earth!”

Do you know why we say so? Because kids like you live on this planet. And we see you from our spaceships. Your smile helps us in those unfathomable voids of no beginning, no end, no top, and no bottom. We know that you follow our flights. In fact, we have the feeling you are beside us in the spaceship. That is why we try so hard for our flights to come off successfully.

My young friend,

This story and the drawings are specially for you. I don't know your name or age. But I do know that you are a friend. And what can be better than friendship?

I trust I'll hear a lot of good things about you. You represent the future, and the future is always magnificent. That's why I'd like to know more about you now, and to tell you about my friends—the Soviet cosmonauts and US astronauts. You are probably dreaming of space flights. In that case, you'll want to know how the Soyuz-Apollo flight was prepared, and how it came off. But let's get acquainted before I begin my story. I am a Soviet cosmonaut and my name is Alexei Leonov.

Now that we know each other, I want to tell you that I saw you from outer space. No, I'm not joking. From space we can see all the oceans and continents, rivers, seas, deserts, mountains, forests, and fields. We can even distinguish the big cities, cities like Moscow, the Soviet capital. You should see how beautiful it is after dark. Especially from up high. The pearly strings of light, the many-coloured neon advertisements which look like the embers of a large fire, glowing red in an astonishing variety of shades. And all of this alive,

ASTP

You have probably heard this word before, though you may not know what exactly it stands for.

Let me explain. ASTP consists of the first letters of the following words: Apollo Soyuz Test Project.

At 3.20 p.m. Moscow time on July 15, 1975, spaceship Soyuz-19, manned by my good friend flight engineer Valery Kubasov and myself, lifted off from Baikonur, the Soviet launching site (we call it the cosmodrome). Seven and a half hours later, when it was night in Moscow and broad daylight in the United States, the US spaceship Apollo lifted off from Cape Canaveral manned by our American friends Thomas Stafford, Vance Brand and Donald Slayton. On July 17, Apollo approached the Soviet ship, and at 7.12 p.m. Moscow time the two spacecraft linked up. I'll tell you about our rendezvous in due course. Just now I want to introduce you to a little Moscow boy, Petya Grishin, who rang up the Moscow press center issuing reports about our flight, and said:

"Tell them they're marvellous!"

There were many other calls, telegrams, and letters in Moscow and Houston. Very many. But Petya Grishin's call was the first after the docking. And like us cosmonauts, the American astronauts were happy to learn that the little boy in Moscow was pleased with our performance.

On July 18 and 19, the mixed US-Soviet crew carried out joint assignments. In the afternoon of July 19, Apollo and Soyuz undocked and then linked up once more before parting. On July 21, the descent vehicle of the Soviet spaceship landed 54 kilometers northeast of the town of Arkalyk in the Central Asian part of the Soviet Union, and on July 25, the US spaceship splashed down in the Pacific Ocean about 600 kilometers off Hawaii.

That, my young friend, is what the word ASTP stands for.





The Earth from the porthole of our spaceship

THE PURPOSE OF ASTP

Let me first tell you why the Soviet-American space project was undertaken. That will help you understand the background to the flight and what we did in space.

Suppose a friend of yours is in trouble. What are you going to do? Will you look on how he suffers? Surely, you will rush to his aid.

So far, only Soviet and American pilots venture into outer space. But soon spaceships of other countries will blast off for the stars. What are we going to do if one of the spaceships gets into trouble? I know your answer: send up a rescue ship to pick up the shipwrecked spacefarers and bring them back to Earth.

You are absolutely right, my friend. That is what other people think as well, because all ordinary people want to help each other, and to live in peace.

The Soviet Union and the United States are very big countries. And world peace depends mainly on their living in peace and accord.

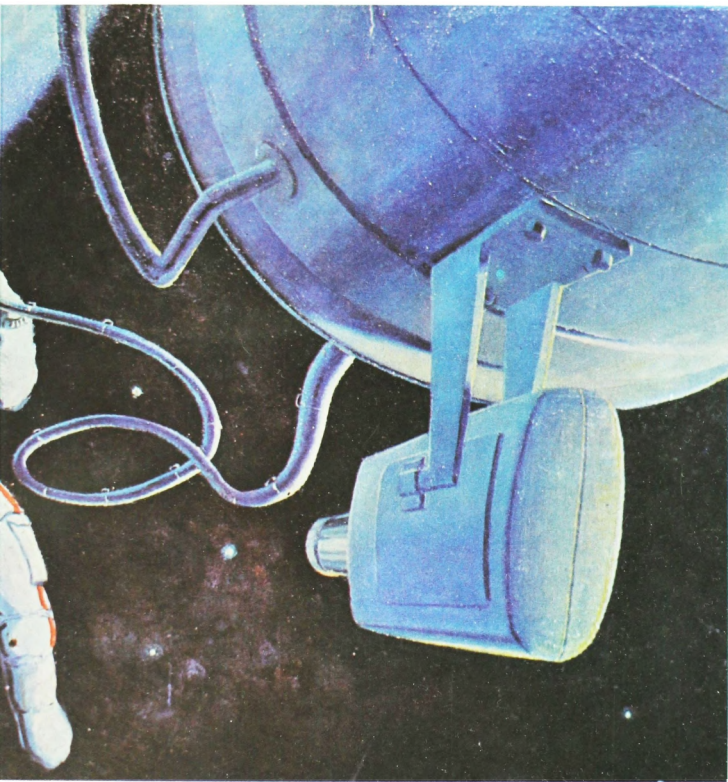
All nations need peace. We Soviet people have experienced the grief and suffering that war leaves in its wake. Our country lost 20 million of its men and women, boys and girls, in the past war. Altogether, the Second World War started by the nazis claimed 50 million human lives.

We can never forget this, and do not want innocent people dying from bombs and bullets in any more wars. This does not mean that we are afraid of anyone. Our country is very strong and rich. But to be really strong means helping the weak, and to be really rich means sharing generously with the poor.

We want all people—grown-ups and children—to live in a world at peace. We want all children to grow up healthy and beautiful. We want need and poverty to be banished from the Earth, and all nations to live happily.

The average Americans, and all other peoples, want the same thing. On our visits to the United States my cosmonaut friends and I





Space filming

found Americans to be friendly and hospitable. This makes them so much like us Russians. Americans try to make life comfortable. They are very hard-working, and they work with zest. True, from childhood they learn to count and earn money, which our children do not do.

We met American scientists, engineers, and technicians. And when there was time we visited fishermen, farmers, and cowboys. We sat at one table with them and spoke about the friendship of our two countries. Everyone we met spoke with warmth about the Soviet Union and the Soviet people.

The Soviet Union and the United States have made great progress in exploring outer space. The Soviet Union was the first to launch an artificial earth satellite. And Yuri Gagarin, a Soviet citizen, was the first human being to spin round the world in a spaceship. The Americans were the first to touch down on the Moon. Both our countries have sent rockets to Venus and Mars, and have built large space stations in which people can live and function for long stretches of time.

But space flights are still a difficult, costly and dangerous enterprise. This is why the leaders of our two countries have agreed that we should work together. And not just Russians and Americans will benefit from this mutual assistance. All the other nations stand to gain from it as well.

Besides, there are the secrets that space still holds for us. They will be easier to crack if we work together. The denizens of other worlds, which you, my friend, will possibly visit in years to come, could not care less who their visitors are, Russians or Americans, for to these still unknown creatures we earthmen will look alike—with our pair of legs and arms, our pair of eyes and ears, and one nose and one mouth. Don't you think so?

It would be great for all people if there were station-factories in orbit making things people need and cannot make on Earth due to the force of gravity. Building these space factories requires joint effort by several countries. There is also weather forecasting,

prospecting for oil, coal and iron ore, environmental protection and much, much else that cannot be accomplished without international cooperation.

In short, people have many more reasons to live in peace than they have reasons to quarrel.

Space is one of those areas where people must work together. This is why the Soviet and American people undertook the Apollo-Soyuz Test Project to show the rest of the world what nations can achieve if there is friendship.

HOW THE SPACESHIPS WERE PREPARED

The Soviet and American space scientists chose the Soyuz and Apollo spaceships for the joint project. Apollo had been designed for flying to the Moon. It carries a large stock of fuel and can perform intricate maneuvers in space. Soyuz, too, can change orbits in flight, but is designed for orbiting the Earth and therefore carries less fuel. Since this was the case Apollo was assigned to find and approach Soyuz in outer space. For this reason it was called the active partner, while Soyuz, which waited for Apollo in orbit, was the passive partner. If the Americans had picked the Gemini spacecraft, the situation would have been reversed, for Soyuz carries more fuel than Gemini. Gemini would have been launched as the passive partner to wait for Soyuz, the active partner, which would track it and accomplish the rendezvous.

But how to call the two ships was not the main difficulty: in either case the crews required a tremendous amount of knowledge and experience to dock successfully. It was agreed that if any malfunction occurred during our transfers from ship to ship, the Soyuz and Apollo crews would remain where the trouble caught them, and the ships would undock and return to Earth independently. This meant that I might have splashed down in Apollo, and Thomas Stafford might have landed in Soyuz near the town of Arkalyk.

As you know, there was no mechanical trouble and we fulfilled all the items on the ASTP program.

But let me tell you about the main difficulty. Cosmonauts in their spaceships breathe ordinary air under normal sea-level pressure. The American astronauts breathe rarefied oxygen. Why? Because the Soviet and US space programs had developed separately and went different ways. The Americans had at first tried to make their spaceships as light as possible. By using oxygen instead of ordinary air they reduced the weight of their

craft. The disadvantage of oxygen is that it explodes from the tiniest spark.

But you will probably ask why this created difficulties. Because we had to decide how the Soviet cosmonauts and US astronauts would transfer from one vehicle to the other without harm to themselves from the sharp change in atmosphere. (You have probably heard that sharp changes in the density of air cause people to become drowsy and sick.) At first it seemed simpler to have the same atmosphere in both ships, that is, ordinary air as in Soyuz. For this, the pressure inside Apollo would have had to be raised. That would have weakened its hull. And it is foolhardy to fly in space with a weak hull. Some technicians toyed with the idea of having a kind of airlock between the two ships. But that suggestion was rejected, because the cosmonauts would then have to stay in the airlock for eight hours before the nitrogen in their blood disappeared completely and it would be safe for them to breathe the rarefied oxygen in Apollo. First of all, it would be very tiring to stay that long in the airlock and, second, it would defeat one of the purposes of our experiment, for if this were a rescue operation, with one ship rushing to the aid of the other, every minute would count.

We had still another choice—to have the cosmonauts and astronauts put on the kind of spacesuit that I wore for my “walk in space” (I climbed out of the craft and floated in space) during the flight of our Voskhod-2 in March 1965. A spacesuit has everything to support life and enable the spaceman to work in space. But what is good in open space is not always good in a spaceship. The spacesuit would restrict our movements and, besides, we would have to communicate with each other by radio.

The technicians found a good solution. They lowered the pressure of the air in Soyuz and, to prevent the cosmonauts from becoming drowsy, raised the oxygen content. As a result the pressure in the spaceship was no longer the same as on the seashore, but as it is up on a mountain some three thousand meters above sea level. Yet, there was twice as

much oxygen as on the seashore. Now, we could move safely from ship to ship and not worry about the nitrogen in our blood.

But our difficulties did not end there. I have told you which of the two ships would maneuver in space and which would stand by until the maneuver ended. I have also told you that in case of danger each of us would remain where he was and descend to Earth. You already know what was to be done to the atmosphere in the spaceships to enable us to visit each other. But I must still tell you about the device that helped us transfer from ship to ship.

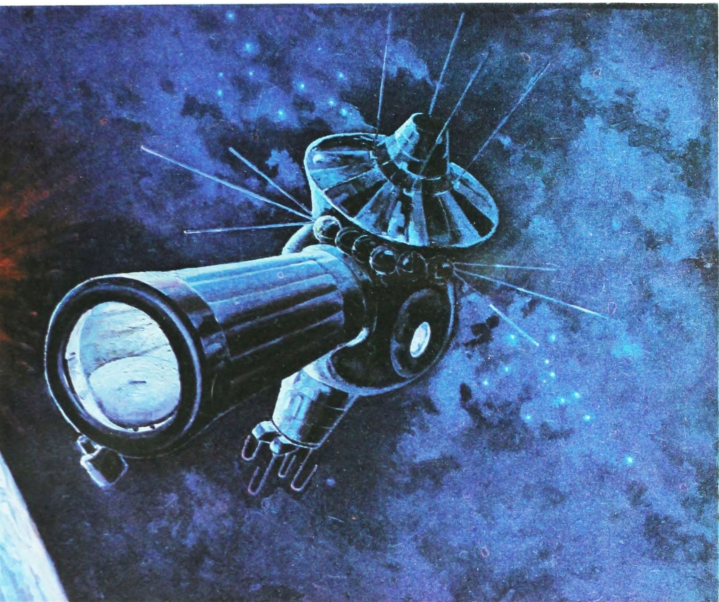
The Americans already had a device of their own for this purpose, and we had one, too. Our device, a docking unit, enables cosmonauts to transfer from Soyuz spaceships to the Salyut orbital research stations. The Americans have a different kind of docking unit, through which they transfer from transport craft to their Skylab space stations. Each has its good sides, but neither was suitable for the ASTP.

While the Soviet scientists were adapting the atmosphere in Soyuz to the atmosphere in Apollo, US scientists worked on the problem of the docking unit. They liked the shock-absorbing mechanism used in Soyuz to soften the docking, and suggested using it in Apollo. Then they found that it would take too much time to make the mechanism and decided that the two ships would keep the shock-absorbers they already had.

Finally, a new docking unit was designed. But the technicians weren't sure it would function faultlessly if the two ships approached each other at even a slight angle instead of a straight line. There was also this other snag: the Soyuz and Apollo were of different weights, and we were not certain how they would behave in space even if they approached each other in a perfectly straight line.

Yes, my friend, there were many difficulties, and the Soviet and American space scientists had to put their heads together to eliminate them. They helped each other to smooth out all the crinkles, and built a docking unit that would perform without a hitch

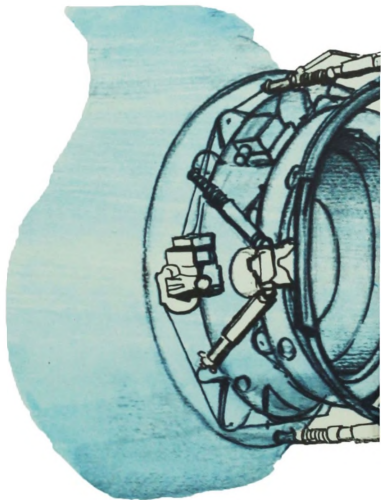


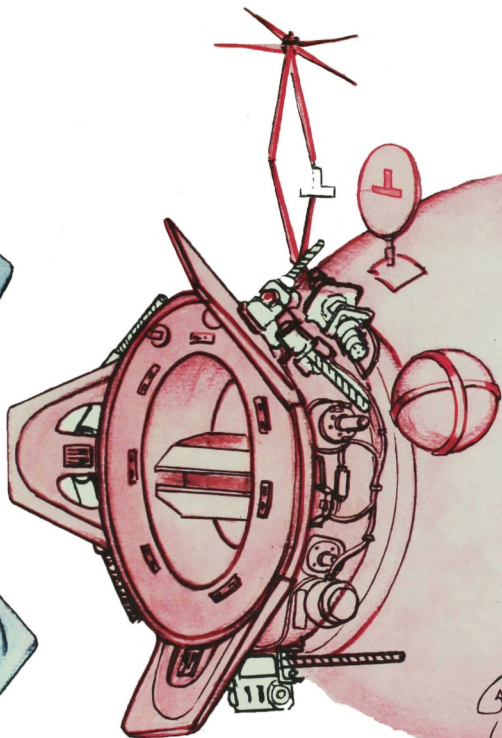
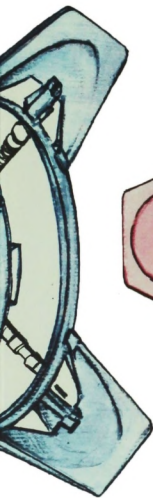


Spaceship Voskhod-2

in all possible circumstances. Then they selected the most convenient orbit for linking up Soyuz and Apollo and making one house out of them in which people could visit each other like neighbors living on one landing. They designed a cylindrical passage-way 3.2 meters long and slightly less than 2 meters in diameter. By passing through this device, called the docking module, we could visit each other in our spacecraft.

I have drawn two docking modules. The blue one is Apollo's and the red is ours. The latches and the docking ring resemble the petals and crown of a flower. The ring is hermetically lined. As the ships close in, the latches brush against each other until the surfaces of the rings on either side come together.





Spanner

THE FLIGHT TRAINING

A space flight is the culmination of a vast amount of work done by hundreds, even thousands, of large research and production groups. In fact, the whole country takes part in the preparations. (And the joint Soyuz and Apollo flight was prepared by two countries.) A tremendous responsibility devolves on the spacemen. This trust has to be vindicated. Each spaceman has to know his job and the flight program perfectly. Also, he has to learn to feel every moment what his buddy is doing and back him up when necessary. In fact, during the flight he and his buddy have to be like two halves of one being.

The spaceman must always have his wits about him and must be quick to find his bearings in any situation that may arise. You are not born with these qualities. It takes years of training to develop them.

Let me tell you what happened to me once. I was a novice cosmonaut, had never been in space, and was training for my first flight. That meant practising with various devices and simulators that make you feel exactly as you feel in outer space. Besides, you fly different types of planes and jump with parachutes.

I like parachute-jumping. I did it before in the Air Force, and also had many jumps to my name as a trainee cosmonaut. So, I was sure there was nothing I did not know about parachutes. One day, however, I catapulted out of the plane with a new type of parachute and suddenly felt that something was wrong. The next instant I discovered that one of the lines had twisted round my leg and I was floating head down to Earth. It took me some time to free my leg. This was when I saw that the line had also twisted round the aluminium panel on my back. Now I was descending belly down in a horizontal position. Things looked bad. Every second counted. There was just one thing I could do—to try and bend the lower end of the panel. This would release the line. With the ground only 30 meters away, I summoned all the strength I had, and felt the





A Houston winter

panel bend under my bare hands. The line came free in the nick of time and I landed feet first.

My buddies, who had observed my antics in mid-air, were running to my aid across the field. When I told them what had happened, they wanted to see if they could bend the panel back to its original shape. Hard as they tried, each for himself and then jointly, the metal resisted their efforts. Then I said I'd do it, for hadn't I done it a few minutes before? I took hold of the panel in both my hands, used all my strength, but did not get anywhere. I could not believe it at first. I had bent the metal in mid-air, when fighting for my life. Yet here, surrounded and helped by my buddies, I could not do it. I tried and tried. All in vain. In the end we had to use a hammer.

The Soviet cosmonauts knew about the plans for international cooperation in the exploration and use of outer space for peaceful purposes. Each of us hoped in his heart of hearts that he'd be the one selected for the Soyuz-Apollo project. But when I was told I'd be commander of the Soyuz main crew, the proposal came as a total surprise.

The first thing I said was:

"Magnificent. Lovely. But I don't know a word of English!"

"You have two years and two months to learn," came the reply.

The proposal to be on the main crew had also staggered Valery Kubasov. What could be more enticing? Valery is crazy about rockets, had read up on US space technology, and knew all about the Apollo-Soyuz program. But he, too, didn't know a word of English. In school and college, and later as a post-graduate student, he had learned German. He confessed to me one day that he was also awed by the responsibility that went with the Apollo-Soyuz assignment.

Learning English did prove the most difficult part of our training. The first time I entered the classroom I saw that our teacher was some 12 years younger than I. He stood up and introduced himself in English, though he was a Russian like me. From then on I

could not draw a word of Russian out of him. He just could not be persuaded to speak Russian. At best, he'd point at an object and name it in English. But the words would not stay in my head. There was no choice for me, however, and frequently I sat up until after midnight memorizing words. As time went on there came the satisfaction of feeling the words come to mind by themselves and line up into coherent sentences. All the same, my English is nothing to brag about. All I can say is that the US astronauts had as much trouble with the Russian language.

Stafford, Slayton and Brand had to work very hard before they learned to pronounce Russian words. Nor were they all that successful. Especially my friend Tom Stafford, who has not shaken off his Oklahoma accent to this day. And I don't think that our American friends are delighted by our English pronunciation either. All the same, the five of us learned to communicate splendidly in Russton, a word we coined in jest for our mixture of English and Russian. It is compounded of the first syllable of the word "Russian" and the last syllable of the word "Houston". Our Russton created many problems for the Soviet and American ASTP technicians. No translator, however good he was, and much less the technicians, could understand what we said to each other during our joint training.

I have gone into these details about the language problem, because Russton was the only "docking module" that kept together the many months of hard work by the thousands of Soviet and American specialists preparing the Soyuz-Apollo venture. In the end, the flight directors decided that during the flight the three American astronauts would speak Russian to us, and the Russian cosmonauts would speak English. This prevented us from using long sentences and from complicating our speech with difficult or slang words.

The first time the five of us met was on November 19, 1973, in Zvezdny (Star town), the Soviet cosmonauts' community. Our American friends had a taste of Russian winter in all its splendor. We showed them around Moscow and took them to the ancient

Russian cities of Suzdal and Vladimir. En route to Kaluga, the hometown of Konstantin Tsiolkovsky, the founder of astronautics, Stafford, Brand and Slayton asked the driver to stop the car a minute, got out and began romping about in the snow and throwing snowballs like a bunch of kids.

Snow is really a lot of fun. But in the past 10-12 years it had snowed in Houston just once, and the snow wasn't more than five centimeters deep. Yet it snarled up the traffic and children did not go to school. Because snow is something you have to get used to. Here, in Russia, we have plenty of snow. That was why the US astronauts behaved like kids. And, of course, Kubasov and I joined in. To make and throw a good snowball is an art, something you have to learn. And while you learn, I advise you to keep your face covered and to watch your playmates.

The Soviet cosmonauts and American astronauts are very fond of children. In many ways they are like kids themselves. They'll never admit it, though frankly I see nothing wrong in it. We trained and trained, getting to know every little detail about Apollo and Soyuz. So why not go to the projection room when you have some minutes to spare and see a few animated cartoons, which children are so fond of all over the world? Our US friends particularly liked "You Just Wait!" and "The Bremen Musicians", which are two popular Soviet cartoons. They spent hours in the projection room, watching the rapacious and inventive wolf chase the happy-go-lucky hare. And when the hare outwitted the wolf—as it always did—they laughed merrily.

We may have had difficulties mastering each other's language, but with the technical side things were much simpler. We liked Apollo, and the Americans liked our Soyuz. We trained together on the devices and simulators, as though we had already been launched. The only thing missing were the g-loads and the weightlessness. The Soviet cosmonauts learned everything about Apollo, and the Americans about Soyuz. In fact, we knew each other's craft so well we could easily swap places or form mixed crews.

It was a pleasure working with the Americans. They are warmhearted, and very brave. And, like us, they love a good laugh.

During our joint training, Thomas Stafford complained only once. This was when we ended one stage of the training and our American friends were going home. After the farewell party and a taste of our space cuisine, Stafford said:

"There's still a lot to be done, but I see no problems except one: with all this Russian hospitality we've gained so much weight the booster rocket will have to be enlarged to launch us into orbit."

Kubasov parried:

"It is an old Russian custom to feast visiting friends, and doubly so in outer space. That's why we had this dinner to find out what you like best."

It wasn't easy, however, to determine what the Americans liked best of all. They liked the tubes with borsch, the Georgian kharcho mutton soup, the cabbage shchi, the veal, the tongue in aspic, the roasted pork, and the Russian honey cakes. And at the end of the meal there was general merriment when we toasted each other with our tubes of black currant juice.

All in all, Kubasov and I spent 18 weeks training jointly with our American friends. During these weeks we solved many a technical problem, mastered all the details of the ASTP program and—most important of all—acquired mutual understanding and learned to trust each other.

THOMAS STAFFORD



General Thomas Stafford was the Apollo commander, and I'd like to say a few words about this remarkable and fearless man.

Lanky Tom was getting ready for his fourth space flight. Nobody had yet been in space as many times as he. He had a reputation of being reckless, and our people did not regard his predilection for "speeding" as the most laudable of traits in this truly brave man's character, especially out in space.

The American astronauts call Stafford "Granddad" though he is not really old. He has children like his buddies and like us, but no grandchildren.

I think they call Stafford "Granddad" because he is kind and level-minded, always polite, always well-disposed, and also always in good spirits. I watched him function in the spaceship. Despite his kindness, he kept a tight grip on the crew, everyone knew his duties, and the men worked together smoothly. Yes, Stafford knows his job very well.

Tom Stafford has acquired loud fame (and I might add that he is "loud" in other ways—he speaks loudly and laughs loudly and contagiously). But fame has not robbed Tom of his modesty. In fact, modesty is an essential trait of all the US astronauts, and this makes us even more fond of them, because like most other people we have no liking for conceit. Outwardly unhurried and prudent (he always calculates everything in terms of money and always wants to know what things cost, though he isn't tightfisted at all), Stafford is like a wound-up or compressed spring when it comes to flying, speed, and altitude. If you offer Tom to get into a new rocket this minute and fly at the velocity of light to, say, Jupiter, he'll probably first calculate how much it'll cost, estimate his resources, and then consent.

Tom was launched into orbit twice, in Gemini-6 and Gemini-9, and splashed down with astonishing accuracy, a mere 640 meters off the mark. This is very close. And in 1969 he flew in Apollo-10 on the first Moon flight in history.

It was a reconnaissance venture, and the program did not provide for a Moon landing. That was left for others. Stafford's job was to blaze the path to the Moon and back, and to find and photograph a convenient lunar spot for Apollo-11 to land.

Stafford coped brilliantly with his assignment. He and Surnan transferred to the Moon capsule, parted from the command ship with Young in it, entered a Moon orbit and made observations of the Moon mountains and craters for eight hours from an altitude of just 12.8 kilometers, that is, from the usual altitude of a modern jet airliner.

Stafford also rehearsed descent to and lift-off from the Moon. In the beginning of the rehearsal he ran into difficulties not anticipated in the program: the moment the Moon capsule separated from Apollo-10 it began to spin. It took nerves of steel and a

thorough knowledge of the vehicle to stop this uncontrolled rotation and enter the Moon orbit. Stafford had both.

I drew Tom Stafford during our joint flight, and Tom autographed his portrait.

DONALD SLAYTON



I had first met Donald Slayton, commander of the US astronauts, at a congress of the International Astronautical Federation back in 1965. He was imperturbable, balanced in his manner, and amicable.

For 10 years he waited to fly into space, and was at last appointed pilot of the Apollo-Soyuz docking module.

“Waited” is not the right word. He had worked. He had worked hard, punishing himself mercilessly, running two miles a day and exercising in the gym. And when the ASTP was still only a vague project and Donald could have had no inkling of being assigned to it, he began learning Russian.

Donald Slayton was one of the first seven American astronauts. This was in 1959, and at that time the USA was still building little one-man Mercuries, of one of which Donald hoped to become the pilot. But two months before the launching of the second US spaceship, on March 15, 1962, the doctors pronounced him unfit. They said he had some sort of heart ailment.

He was put in charge of all the astronauts. He selected and supervised the training of

space crews. He had been the one who enlisted Stafford and Brand as astronauts. And the men whom he enlisted and trained kept going up into space one after another, while he stayed behind on Earth.

None would wager a penny that the doctors were ever to let him fly a spaceship. None, that is, but Slayton. He set himself a gruelling routine. To begin with, he noticed that his heart functioned flawlessly after a good run round the park. He told the doctors, but they had no explanation for it. Donald, who, of course, wasn't getting any younger, simply wouldn't admit defeat. He had always considered himself perfectly healthy. And finally in March 1972, exactly ten years after the doctors had pronounced him unfit, they permitted him to take an astronaut's training. He began preparing at once for the joint Soyuz-Apollo flight, for he had no time to lose. For him time was precious. He was getting on to fifty.

At a press-conference in Moscow shortly after the Soyuz-Apollo mission, correspondents asked him how he had conquered his ailment. He replied:

"I was never ill. But it took me ten years to prove it to the medicos."

This is a sketch of Don Slayton.

VANCE BRAND



Smiling Vance Brand was pilot of the Apollo command module. The other astronauts are very fond of Vance, and treat him like a brother. He is polite, sincere, industrious. Also, he has an inquiring mind. And he is fond of children. He has four of his own. A busy man, training endlessly, he does not get to see them as much as he would wish. We cosmonauts called him Vanya instead of Vance. He learned to speak Russian better than either Tom or Donald.

As in Donald's case, this was to be his first venture into outer space. He had dreamed of flying as a kid. Then he flew jet fighters, and later tested new planes and helicopters.

On April 12, 1961, when Yuri Gagarin became the first man to fly into space, Vance Brand had not yet joined the astronauts. Recalling Gagarin's feat, Vance said:

"I had known someone would one day go into outer space, but was staggered all the same."

In 1966, Vance joined the astronauts. Five times he was ready for lift-off—three times in Apollo and twice in Skylab. And all five

times he had bad luck. Others were launched, while he stayed behind. He became a veteran among the back-up men, but lost none of his good spirits and none of his faith.

Visiting Baikonur during one of our joint training sessions, Vance said:

"Baikonur resembles the place in California where we have our Edwards Base. Good thing that cosmonauts and astronauts lift off from similar terrain."

This here is Vance Brand. I drew him in space.

HOW TO BECOME A SPACEMAN?

Frankly, I haven't the slightest idea. Before becoming a spaceman myself I was a flier. And before becoming a flier I went to school. And before going to school I was an ordinary kid. Like you or your younger brother. I liked to yank at girls' pigtails. That wasn't a nice thing to do, you'll say. I know it myself now, with two daughters of my own. But I never pulled very hard and never made girls cry, and, besides, aren't you and I friends? And friends must tell each other the truth. When I grew a bit older, I understood that to be a man I must stand up for the weak. For this I had to learn to run, jump, and swim.

Here is how I learned to swim. Kemerovo, the Siberian town where I grew up, had a large pond. The neighborhood kids always went there, and those of us who couldn't swim came along. The older boys frolicked in the water, chasing each other and splashing about, and the spray sparkled all colors of the rainbow in the sun, the swimmers squealed with delight, and we who couldn't swim were green with envy. Not much fun sitting on the bank and watching others swim.

That made us think of a way of joining in the fun. We tied knots at the bottom of our pants, filled the pants with air by lashing them against the surface of the water, and then floated in the pond cradled between the pants' legs.

One day the kids played a trick on me. They pulled my "life-belt" out from under me in deep water. You can probably guess what happened. I went under, swallowed a whole lot of water, struggled back to the surface, and yelled: "Help!" The shore was far away, and it occurred to me that I'd probably drown before anyone came to my rescue. If anyone was going to save me, I'd have to be the one. And so I swung my arms, and swam ashore.

That was how I learned to swim. And swimming is still one of my favorite sports.



Running is another. I run and swim every day. In all weather, summer or winter, in the autumn mud and the thaw of springtime. Five kilometers every day so you can wring out my sweatshirt, followed by 500 meters in the swimming-pool. Someone has estimated that in a year I run the distance of two hundred cross-country marathons, pedal nearly a thousand kilometers on a bike, and cover 300 kilometers on skis. If I haven't time in the morning, I run and swim after work. Sport has become a vital necessity for me. Like the air I breathe. In Zvezdny people laugh about it. My tirelessness, they say, has tired the trainers. But that's in jest. And in my daily physical exercises, without which you can't be a cosmonaut, I can always rely on the support of my good friends—the boys and girls from our house. No matter how much home-

work they get in school, they always come with me to the swimming-pool. So there isn't a chance of my giving up sport so long as my little friends set the pace.

HOW I GREW UP

I grew up the day Mother first took me to school. This was a long time ago. Before you were born. Our country was only just getting on its feet. There were all kinds of shortages, including shortages of textbooks and schoolbags, let alone the kind with shoulder-straps that kids go to school with today.

My hometown Kemerovo was the capital of Kuzbas, a vast coalmining region. But that wasn't its only claim to distinction. It was also known thereabouts for its sidewalks—beautiful, wide, smooth sidewalks made of carefully planed timber planks. Walking along our sidewalks was like walking on a dance-floor. Especially of an autumn morning, when they were covered with crystals of frozen dew. It was as though the sidewalk was radiating from inside like a mother-of-pearl shell. This was the white, pink and blue effect of the sun's rays on the myriad little particles of white frost.

The night before, I had been given a canvas satchel that had once seen service as the bag of a gasmask, and had put all my treasures in it, all my picture books and magazines, to take along to school. In the morning I was in the best of spirits, very proud of myself, my left hand hanging on to Mum's hand and my right clutching the strap of my satchel. I don't think the renowned Kemerovo sidewalks had ever been more beautiful than on that September morning. Crystals of frozen dew sparkled and twinkled in the sun, as though they, too, were celebrating my having grown up. My only regret was that there weren't many people in the streets at that early hour, and that those who passed us were in an awful hurry and paid no attention to me.

I hardly noticed that my feet were freezing. The tops of my shoes looked decent enough, especially after the polish I had given them the night before. But their soles were worn through, and my toes touched the wood of the sidewalk. I looked over my shoulder and was delighted to see that my warm tracks

were steaming in a halo of sparkling hoarfrost. A human's tracks on Earth—that little and short-lived warm trace he leaves behind. The sun was magnificent that morning. Casting its gilded rays onto the Earth, it was rising slowly over the rooftops. I felt its warm caress. Years later, flying in space, I saw the same sun and recalled that September morning.

On the way to school, Mother wanted to take me to a barbershop, for my hair had grown in the summer. I did not want to go in, and was obstinate. Secretly, my bare toes scratched the surface of the sidewalk, and I watched the tiny froth of vapor rising from the trace this left, and then the trace itself growing to the size of a giant's footprint. After the hoarfrost had melted in one spot, I'd shift my foot slightly and begin scratching again. It was fun seeing what design this new print would leave on the sidewalk. Meanwhile Mother fretted, urging me to enter the barbershop and fearing we'd be late to school if I resisted much longer.

When I tell my daughter Oksana how I became grown-up, she laughs at me. You don't have to be grown-up to leave warm tracks on Earth, she says. Children's feet, too, can warm the soil.

I suppose she's right. Children do give off warmth. And it rises very high, reaching outer space. We cosmonauts feel it, and it makes things cosier for us out there so close to the stars.

MY FIRST DISCOVERY

I don't know why I remember the day I first went to school so distinctly. Perhaps, because it was the day I suddenly discovered that there was beauty in ordinary things, that you could spot it in things you had already seen hundreds of times.

For the first time in my life I had wanted to preserve my warm footprints on the sidewalk, and to tell everybody about my discovery. Look at the beauty around you, I wanted to shout, and look at this miraculous early morning; take it with you, preserve it!

I didn't know yet how beauty is preserved and passed on to other people. This was why I was obstinate before the door of the barber-shop.

I had learned to draw when I was very little, long before I began going to school. I did not know whether people derived any pleasure from my drawings. To be frank, I never thought about it. I just liked drawing. That was all.

Then came the war. Hardship and grief entered every Soviet home. It did not spare ours, too, though the battle-lines were far west of Siberia, across the Volga. We had a big family—as many as nine only of us children. But we didn't complain. We knew that since an enemy had invaded our land and wanted to kill our people, he had to be defeated and expelled.

We also knew that for all the grief, people needed joy, the warmth of strong and generous hearts. Despite the wartime hardships and the shortage of money, I asked Mother to buy me brushes and paints. Exciting, vivid, clear and yet mysterious, sometimes saying more to people than words, colors had entered my life and opened a world of new beauty for me. I would probably have become an artist if I had not been captivated by other colors—the colors of the eternally magnificent sky. I became a flier to be closer to it.

Why am I telling you this, my young friend? Because it doesn't really matter whether you become spaceman, doctor, architect or scientist. What matters is that you

should grow up to be fond of people and nature, and art as well. A liking for art is the beginning of creativity, and creativity is something you need in any job. I'll be happy if you get to like art, to appreciate its beauty and riches. He who appreciates art is himself a creator.

MY FRIEND VALERY KUBASOV



The war has left a mark on the hearts of most of my cosmonaut friends. Tracing back Kubasov's life story you will see what our country has had to go through, and how swiftly it has progressed.

Valery was born in a little town called Vyazniki near the ancient Russian city of Vladimir. Vyazniki is on the Klyazma River, and during the spring floods the trees are in water up to the knees and you can no longer distinguish the river banks.

After the war, Valery joined a fishermen's brigade like most of the other local kids. Few men were left in the town. Many hadn't returned from the war and their place had to be taken by youngsters. And where one little boy couldn't do the job, two of them did it.

On finishing school, Kubasov joined the Moscow Aviation Institute and became a graduate engineer.

He was in his last year of college when the Soviet Union launched the world's first artificial earth satellite, the first sputnik. And Valery was one of those who were gripped by the space fever. He became a space technician. You have probably heard of the Soviet

"Venuses" that fly to the distant planet whose name they bear. You need more than a powerful booster to reach Venus. You also need a vast amount of knowledge. Valery was one of the men who calculated the trajectories.

In October 1969, Kubasov was lofted into space in Soyuz-6. He was the first spaceman to perform a welding operation in outer space. Tom Stafford describes him as the "expert in space welding of metals". "If anything cracks," our American friends jested, "Kubasov will weld it." Kubasov dreams of space factories, and of flights to Mars and Venus. But I wonder how he'll bear it without his son Dmitry, who was born in April 1971. Kubasov spends all his free time with the boy. We always know where to look for him. If anyone asks us, "Where is Kubasov?", we answer without hesitation: "He's bringing up Dmitry." And we have never been wrong.

When we were out in space, the Americans and us, newspapermen asked Kubasov what he wished the children of the Earth—which also means you, my friend—and he answered:

"I wish them a lot of happiness and that they should never be deprived of their fathers and brothers."

Vance Brand's wife Joan, whose profession of builder is as peaceful as Kubasov's, agrees with him. Asked what she thought of the joint work done by Americans and Russians in outer space, she said:

"I don't want my children ever to know what war is. And likewise the children of the Russian cosmonauts. Americans have to be friends with the Russians. Vance thinks so, and I do too."

THE BACK-UP CREW OF SOYUZ

Yes, we know all too well about war. What Anatoly Filipchenko, commander of the back-up crew of Soyuz, remembers most from his childhood are the nazi air-raids. Born in Ostrogzhsk, some 90 kilometers from Voronezh, Anatoly was a little boy when the war broke out. The nazis bombed Ostrogzhsk many times, and for some reason the hospital was their main target. Anatoly lived near the hospital. During the air-raids his family and he took cover in the cellar. And one day when they emerged from the cellar, their house was gone and all the houses nearby were in flames. Anatoly's house had been destroyed by a direct hit.

The back-up flight engineer, Nikolai Rukavishnikov, is from Siberia like myself. On June 22, 1941, he and other kids were playing outside when an elder boy came up and said our country had been attacked by the nazis. Hard times had come for Nikolai and all other Soviet children. There was a shortage of exercise books, and the kids in school did their written exercises on the margins of newspapers. In winter—and the Siberian winter is freezing cold—the classrooms were practically unheated and the kids' breath turned to vapor. There wasn't much food either, but in a special children's canteen the kids had a square meal once a day. Nikolai still remembers the Young Pioneer Camp where his mother sent him for the summer. There the kids worked in the fields and, as Nikolai describes it, "put on weight" on the sound peasant fare.

But back to Anatoly Filipchenko. At fifteen he went to a factory manned mainly by women and boys like himself. They did a ten-hour shift day or night, making mines for the army and spare parts for tractors and harvesters. Ever since, Filipchenko has the deepest respect for plain working people and puts fairness and team-work highest of all.

In 1944 he joined the Air Force School in

Voronezh, a special school for boys who wanted to be fliers. It had just been set up and the premises were crowded, with fifty young men to a room in the hostel. Firewood was scarce, and at times the ink froze in the inkwells. But they studied hard. Later, Filipchenko finished the Chuguyev Flying School and became a fighter pilot.

He laughs uproariously every time he recalls his first flight. Instead of handling the joystick, he had hung on to his seat, thinking he would drop out of the cockpit if he didn't. In the excitement, he had forgotten that he was tightly strapped to the seat.

On October 4, 1957, his mates told Filipchenko about the launching of the world's first artificial earth satellite, and he refused to believe them. At first he thought they were pulling his leg (fliers, like spacemen, are fond of a good joke). When Gagarin took off for outer space a bit later, Filipchenko decided to join the cosmonauts despite his age of 33.

Nikolai Rukavishnikov's space career, too, began with Gagarin's flight. He was an engineer in the design bureau headed by Sergei Pavlovich Korolev, creator of the Soviet space rockets. But though Rukavishnikov had taken part in the first earth satellite project, the news that it had gone into orbit staggered him.

"I felt as though I had had a glimpse of another world," he said later. "It was as though a void had opened before me. I began to see things—the sky and the Earth—in a new dimension. It occurred to me that where the sputnik was hurtling through space there was no such thing as weather, or night, or day."

Some time later Rukavishnikov came to Zvezdny. He came with Vitaly Sevastyanov, who had lectured there before and whom we already knew. Rukavishnikov was awed to see so many cosmonauts at once. He took Sevastyanov aside and said:

"Where'd you bring me to? All I see around me are Heroes of the Soviet Union."

Sevastyanov chuckled:

"You'll be a Hero yourself one day, perhaps."

And his prediction came true. In April 1971, Rukavishnikov was test engineer aboard spaceship Soyuz-10.

Filipchenko and Rukavishnikov have a lot in common. Both are reserved, calm and well-meaning. Both admire people who do their job well and are modest. This is probably because both of them know their own job, and both are modest themselves. Rukavishnikov once said:

"I'm the least famous of the cosmonauts."

In the Apollo-Soyuz project Filipchenko and Rukavishnikov were assigned to test the new Soyuz model—exactly like the one that would take part in ASTP.

This was a preliminary flight, and it was to show us how well we had readied Soyuz for its joint mission with Apollo. In this flight, the Apollo docking unit was simulated by a special docking ring that covered the contact sensors of the Soyuz docking unit.

Manned by Filipchenko and Rukavishnikov, Soyuz-16 did everything that Valery Kubasov and I were to do on the joint mission. This was in December 1974, or seven and a half months before the Apollo-Soyuz lift-off. Filipchenko and Rukavishnikov blazed the trail for us and, having done their job under the ASTP program, were also planning to accompany us to Baikonur. During the Soyuz-19 blast-off they were on the launching site and maintained contact with us in the sector where we entered orbit. For us, Kubasov and myself, their voices represented the voice of our country. And if for some reason our Soyuz-19 had not met with Apollo in orbit or had had to make an emergency descent, they would have followed us into orbit on a back-up Soyuz spacecraft for a second try.

Filipchenko and Rukavishnikov had learned the ASTP program as thoroughly as we, had taken part in the joint training with the US astronauts, and had made friends with them. Having accomplished the Soyuz-16

flight, they had in a way completed the preliminary work on the ASTP program and were ready any minute to replace us. Now we were on our own—Kubasov and myself, and our American friends Stafford, Brand and Slayton. Everything depended on how well we fulfilled the Earth's orders.

BEFORE LIFT-OFF

The many months of training were over. So were the English lessons. A very strict examining board had tested our knowledge. All of us got top marks, but Valery Kubasov passed the exams particularly well. One very eminent and very strict professor who had examined Kubasov, said:

"All the others deserve their top marks alright, but Kubasov—" Words failed him and he spread his arms, then added: "I wouldn't hesitate to let him take my chair as examiner."

We were preparing for our final joint training—a simultaneous session by the two crews at a distance of 16,000 kilometers from each other. On June 29, 1975, Valery and I took our stations in the Soyuz simulator in Zvezdny, and the Americans took theirs in the Apollo simulator in Houston. The personnel in the Soviet and American flight control centers, too, were on their job.

"Soyuz, this is Moscow. Good morning," I heard over the earphones. "How d'you feel?"

"Moscow, this is Soyuz," I replied. "Audibility perfect. Feel fine."

That final session was like a dress rehearsal. We were going to "play through" the whole flight program to a strict schedule, while the Soviet and American flight control centers would see how well they were prepared to control our flight.

The Soviet Center was taxed to the limit, for it had to manage two programs at once: the Apollo-Soyuz preparations, and the flight of the Salyut-4 orbital station that had been launched some time before, manned by our friends Pyotr Klimuk and Vitaly Sevastyanov.

Direct telephone and TV communications had been set up between Moscow and Houston since June 27. You picked up the red phone and Houston was on the line. The line would be open round the clock until the Soyuz-Apollo flight was over.

I heard Tom Stafford speaking Russian with his redoubtable Oklahoma accent:

"Astronauts and cosmonauts can talk to each other, and with Moscow and Houston."

There were special trainers in Moscow and Houston whose job was to create problems for us and for ground control. They would think up some trick, and the next moment one of the systems on the ship began to "malfunction". We were expected to spot the trouble at once and put things right.

The simulated docking was only some forty minutes away when the Houston trainer complained that the automats signalling readiness of the Soyuz docking unit weren't functioning. Ground control was perplexed: was this a malfunction of the docking unit or merely a blown-out fuse? A quick check could show, but how were they to check if Soyuz was out of radio range at that moment? Moscow Flight Control Center requested Houston to help establish contact with us. Houston replied that it had its hands full finalizing the Apollo orbit and the Soyuz wasn't their headache. Though our Flight Control knew that all these negotiations were just a game, they were annoyed with Houston and were about to postpone the docking to a later hour. That would give the Houston people something to think about.

The Soyuz crew saved the day: while Moscow and Houston negotiated, Kubasov and I established off our own bat that the docking system was in working order and that the signal had "vanished" because the automatic devices informing ground control about the state of the spaceship's various systems had gone on the blink.

The Soviet and American trainers were pleased. They knew perfectly well that the docking system was flawless.

The joint training with all sorts of trumped-up and tricky problems lasted three days—June 29 and 30, and July 1. This was just as long as our American friends and we were going to work together in space from the moment the ships approached each other to the moment of their undocking and their two subsequent joint scientific experiments.

In the meantime, the final preparations for the lift-offs were in full swing at the launching sites. As early as June 16, the people at Cape Canaveral had begun filling Apollo's fuel



The Apollo launcher

WE SET OUT FOR BAIKONUR

tanks. The spacecraft and the Saturn launch vehicle had taken on fuel, and now final tests were being made of all systems aboard the ship and launcher. In Baikonur, the Soviet launching site, they had charged the fuel tanks of the Soyuz by July 1.

On July 1 at dusk the joint training was completed. I got in the last word to Houston: "Have sighted Apollo. Approaching for link-up."

Ten minutes later I rushed to my office to discard the training suit, and rang up my daughters Vicky and Oksana to see if they wanted to accompany me to the swimming-pool.

"But take your time," I said. "I still want to run my five kilometers."

Fitness is something you've got to think of all the time. The doctors are unbendable. They won't accept excuses. It had been agreed between the Soviet and American medical personnel to examine us 120 days before the flight, and then again 45, 30, 15 and five days before it. All that time they kept a watchful eye on our physical condition. They subjected us to tests in a special device where the blood was artificially drained from one part of the body to another, and took all sorts of other tests (an unpleasant but necessary procedure which you are probably familiar with, my young friend). They also made us endlessly turn the pedals of energy gauges, etc., etc. And after all this a common cold could get you scratched from the mission. No, I figured it was better to puff a few extra kilometers and swim in the pool to keep fit.

On July 2, 1975, US astronauts Thomas Stafford, Donald Slayton and Vance Brand flew from Houston to the Kennedy Space Center on Cape Canaveral. The following day we left Zvezdny for Baikonur.

Partings are always a bit sad. The entire population of Zvezdny and numerous guests came to see us off. They wished us luck. I said:

"Everything'll be okeh."

At 3 p.m., our TU-134 jet took off and set its course for Baikonur.

The night before, the four of us—Anatoly Filipchenko, Nikolai Rukavishnikov, Valery Kubasov and I—had visited Lenin's office in the Kremlin. It has become a tradition for us cosmonauts to pay homage to Lenin before going to the launching site.

I know of no other man who has done as much for his people, for the people of the whole world. His short life—Lenin died at 53—is a striking exploit unexampled in world history. I cannot stop admiring his greatness, his brilliant mind and extraordinary modesty.

An 1848 issue of a Moscow newspaper contained this brief item: "Townsmen Nikifor Nikitin has been exiled to a Kirghiz village called Baikonur for seditious talk about flying to the Moon".

Then came 1917, and our impoverished country where most people could neither read nor write was awakened to a new life by the Great October Socialist Revolution. And Lenin was the man who stood at the head of that Revolution.

Could those who had put out that old paper ever have anticipated that a little over a hundred years hence—a very short time in terms of history—the remote and forsaken "Kirghiz village called Baikonur" would become the place from where people fired the first artificial Earth satellite into outer space, then launched Yuri Gagarin in his spaceship, and from where they send spacecraft not only to the Moon, but to Mars and Venus?

And the credit for Baikonur's becoming

the first launching site into space is essentially Lenin's, and also a credit to the people who overthrew their oppressors under Lenin's leadership and became masters in their own country.

Baikonur is dear to me. I had been among the first to join the cosmonauts and instantly took to my new friends, especially Gagarin. Cosmonauts always give each other "call signs" or nicknames, and mine was "Blond".

Gagarin was a man of simple habits, always in good spirits, and modest to the point of shyness. He never sidestepped any problems or pretended to be what he wasn't, or limited himself by any convention of being like others or not being like others. When in difficulty he never pretended that things were easy, and when things went well he didn't pretend that he had no use for a bit of fun. And when he felt he had done something wrong, he did not hesitate to admit it.

I'll never forget the day of April 12, 1961. Gagarin was in the twentieth minute of his historic flight. His call sign was Kedr (Cedar). Flight control asked Kedr about his first impressions of outer space—the very first impressions that any human being had—and what the Earth looked like from out there, and how the ship's systems were working. Gagarin replied quickly, curtly, calmly. There is a tape of that radio conversation. He asked: "I'm Cedar. How's my lane? Over." Lane is what he called his orbit. I replied: "Cedar, your lane is just right. Over." And he said: "Fine. My best to Blond." This was at 9.27 a.m.

I cherish the thought that the first name ever pronounced in outer space was mine.

Soon, I was launched into space myself. More, it was part of my mission to climb out of the ship and take a "walk" in space. During the "walk" I had a feeling of indescribable freedom—nothing impeded my movements in that bottomless cosmic ocean.

There is another name I always remember gratefully. That of Sergei Pavlovich Korolev. I could speak of him for hours. All our life on the cosmic fairway is associated with that fine man. Best of all I remember two of my

encounters with him. The first, when we were invited to step inside the model of the Voskhod-2 spaceship. Korolev asked me to perform the operation of entering and exiting from the ship's airlock. Whether he had picked me accidentally or intentionally I do not know. But I was in seventh heaven. This was when it became the dream of my life to be the first to "walk" in space.

The second encounter was also in Baikonur, on the pad from which Pavel Belyaev and I were later to be launched into space. At that time, however, I was still on the threshold of my first lift-off. There was a crowd of people seeing me off. Korolev was calm and very kind. During a launching every second counts. So he was very brief:

"All I ask is that you should go out of the ship and right back in again. And may the Sun's wind be a fair wind."

THE LIFT-OFF

By tradition the spaceship is brought to the launching pad early in the morning. Our 49-meter-long Soyuz-19 was positioned at 7 a.m. on July 12.

A rocket is a thing of extraordinary beauty on Earth. But I knew that a flying spaceship is of still greater beauty against the background of the twinkling constellations.

Fifteen years before, when Yuri Gagarin was about to lift off into space, the words of the great Tsiolkovsky were cited here in Baikonur:

"Humanity," he had said, "will not always stay on the Earth. In pursuit of light and space it will at first venture to the edges of the atmosphere, and will ultimately conquer all the space around the Sun." And Tsiolkovsky's vision is coming true.

All the final preparations for the Soyuz-19 lift-off were completed. Apollo, too, we were notified, was ready for launching.

Stafford radioed, "vsoy otchen o'kay," which in Russian means, "everything is very okeh."

True, the weather in America had deteriorated. There had been hurricanes and thunderstorms. To protect Apollo from the lightning it had been placed in cover.

Our coach drove to the launching pad. People were milling about at the foot of the rocket. Dressed in our spacesuits—indispensable in space but none too comfortable to wear on Earth—Kubasov and I climbed out of the coach. I made my report:

"The Soyuz-19 crew is ready for lift-off."

My first space call sign had been Almaz (Diamond). And usually cosmonauts keep their call sign in all subsequent flights. But this time Kubasov and I had a new, joint call sign: Soyuz. The Americans liked it. Just as they liked the name of our ship. The word soyuz, meaning union, they observed, stood for the substance of our joint mission in space.

We, too, liked our call sign.

The elevator took us to the top of the rocket. We looked around. The last waves of the arm, the last farewells.

We took our stations in the spaceship. Time began to run backwards.

The only way I can describe my feelings at that moment is that they were solemn and joyous. We began a conversation with Flight Control, awaiting the words now familiar to all our boys and girls:

"Key on lift-off."

"One—"

"Two—"

Everything on board was in perfect shape.

"Earth to ship...." This meant the last of the support gantries that had held the rocket upright had been removed. Then we heard the order:

"Ignition! "

"Lift off! "

I glanced at my watch. It was 3.20 p.m. Moscow time.

The Earth reported the situation second by second. We heard every word of it. The g-load rose perceptibly. The ship's velocity increased, tearing us free of the Earth's gravity.

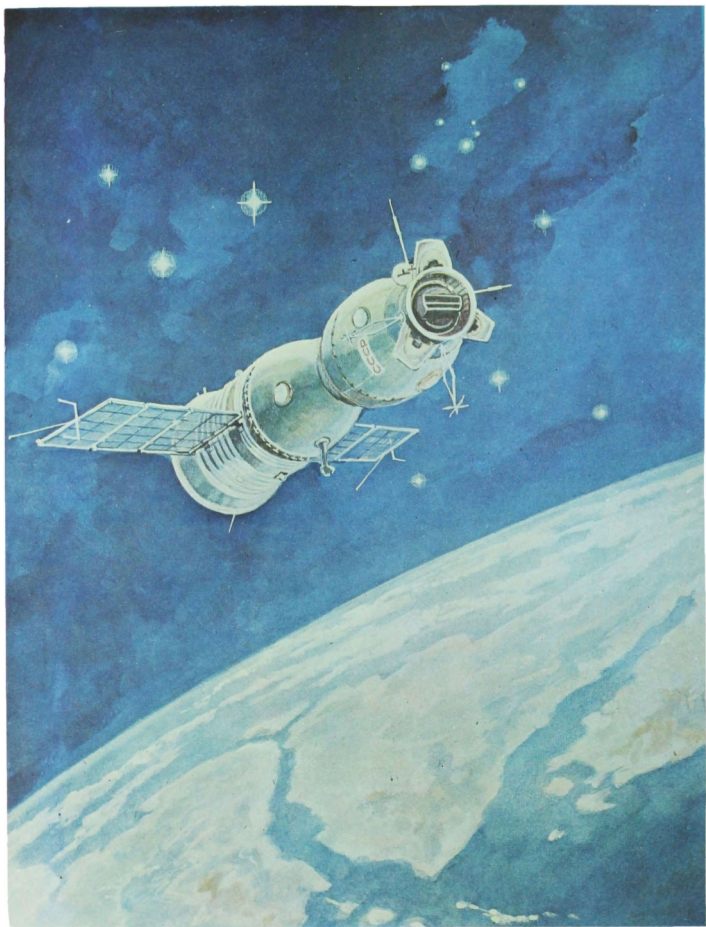
When we reached outer space and the g-load gave way to weightlessness, Thomas Stafford got through to us on the radio and said:

"See you soon."

The TV commentator intervened, addressing Stafford:

"Patience, man. Not for another two days."

Apollo raced into space from Cape Canaveral at 22.50 hours.



Soyuz in flight

THE ARITHMETIC OF OUR FLIGHT

The work we had been training for during the past more than two years and that the whole world was awaiting with bated breath had begun. Soyuz-19 entered orbit very close to plan. The first spins round the Earth weren't a perfect circle. They were ellipses 186 kilometers away from the Earth at perigee, that is, the point closest to the Earth, and 221 kilometers at apogee, the point farthest from the Earth. When Apollo entered outer space it was some 6,000 kilometers away from us. The Soyuz travelled on, while Apollo followed along a lower orbit at a higher velocity and gradually catching up.

On our fourth spin we performed the first maneuver to shape the orbit in which we were to rendezvous with Apollo. For this I oriented the ship for acceleration. Meanwhile, Kubasov was readying the automats. At the fixed hour we activated them, and the ship travelled on like an autopiloted plane. Strictly on schedule I fired the engine. The ship gained altitude perceptibly. We felt a slight g-load. I turned off the engine within about a second of the prescribed time. Shaping the orbit as agreed on Earth was a very responsible job. Here is why.

Suppose in going into orbit the spaceship exceeds the calculated velocity by one meter per second. On the face of it, a meter per second is a trifle. But at the other end of the orbit this "trifle" will amount to a deviation of three and a half kilometers. Furthermore, the ship will take a "mere" two seconds more than the calculated time to perform a circuit round the Earth. And its location will deviate by as much as 15 kilometers from the originally calculated. The longer the vehicle is in outer space the greater this deviation becomes, until the two ships that are to rendezvous in space lose each other entirely.

Mere humans would have their hands more than full coping with this problem on their own. This is why swift and clever computers are used. All the same, man must

pilot and handle the ship. All the computer can do is prompt him how to do the job better. A spaceman must, therefore, be able to solve difficult mathematical problems. If he doesn't know how, he is sure to lose his way in space.

After the first orbit correction, we repeated the maneuver on our seventeenth spin to finalize the docking orbit. Now the craft was no longer travelling in an ellipse, but in a perfect circle round the Earth at an altitude of 225 kilometers. The Apollo crew, too, performed its first maneuver in order to keep Soyuz within sighting distance.



Apollo in flight

WORKING IN SPACE

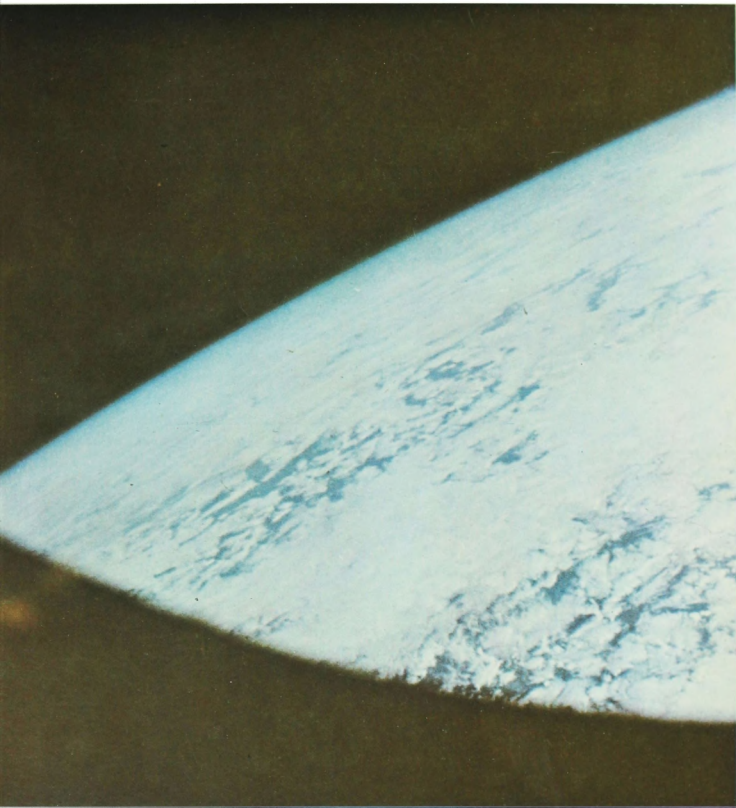
We combined our space maneuvers with other important work. Kubasov and I had begun a set of biological experiments on July 15, including experiments with plant seeds and the fry of an aquarium fish known as *Danio rerio*. Identical experiments had been made by Anatoly Filipchenko and Nikolai Rukavishnikov, and now we wanted to compare our results with theirs.

A few words about weightlessness. As you know, the force of gravity that operates on Earth is absent in outer space. This is why we float in our ship, instead of walking. You get accustomed to weightlessness quickly enough, and the state you are in when you feel no top or bottom is fairly pleasant, provided you have been properly trained. This weightlessness isn't simply a pleasant sensation, but also very useful. Kubasov, the first man ever to weld metal in outer space, suggested that metals with properties that you can't get on Earth could be smelted in space. The Soyuz-Apollo program therefore provided for an experiment under the name of "universal furnace". We had to find out what new materials—metals and semiconductors—could be obtained in a space furnace at 1,100°C.

At the time of the first space launchings Korolev had said: "Humanity reminds me of the man who tears down the walls of his house for firewood instead of going to the forest."

You might ask why people need new materials. Take steel. A piece of this very enduring metal sinks instantly if you put it in water. This happens, because the specific weight of steel is many times greater than that of water. It was discovered, however, that in space you can obtain an entirely different type of steel resembling foam in appearance. This is exactly what it has been named—foam steel. This new material consists 90 per cent of gas and only 10 per cent of ordinary steel. Foam steel will not sink in water, yet its endurance is that of ordinary steel. Foam steel will be very useful for building new types of planes and automobiles, and, of





The Earth through the porthole

course, spacecraft. Furthermore, in outer space you can manufacture glass of ideal purity for optical devices, and many other useful things.

In short, my young friend, there is a lot that can be made in space. In years to come, spacefarers will be engineers, technicians and workers. The Soviet Union and the United States are wasting no time to explore the possibilities of manufacturing new materials in orbit. As far back as 1928 Tsiolkovsky wrote that "in due course man will create dwellings in space. They will surround the Sun, and the riches at people's disposal will increase billions of times."

SURPRISES

Space flights rarely come off without unforeseen happenings. In the case of Soyuz, the television system went "blind" on the first day of the flight, and in Apollo's case one of the hatches of the air lock suddenly resisted manipulation. There were other surprises. As a result, our American friends, Kubasov and I had to work very hard instead of sleeping on the night of July 15.

Flight Control in Moscow and in the United States made rush studies of the malfunctions aboard Soyuz and Apollo. Our television was soon put right: the block that was supposed to connect our various TV cameras to the ship's transmitter had gone out of order. It was decided to cut out the "sore spot" and connect the cameras directly to the transmitter. Vladimir Dzhanibekov, commander of the back-up ground crew, performed the whole job on Earth and sent us his recommendations. We made the repairs in three goes. After nightfall on July 15 and in the course of the night we lifted the panel that covered the "ailing" block in the orbital module, and removed it. In the morning of July 16 we started the repairs and made the new circuit. In the evening of July 16 we appeared on TV screens in millions of homes and everyone who saw us that night said we looked pleased.

And pleased we were: instead of the insulation tape that Vladimir Dzhanibekov had used on Earth and that we did not have aboard our ship, we had used ordinary adhesive plaster. And it had worked.

Our American friends, too, had fussed about with the obstinate hatch, and had then also gone to bed, while the people in Houston cudgelled their brains, looking for the cause of the trouble. It didn't take them long to find it, and on waking up in the morning the refreshed astronauts went to work on it. In about half an hour after they had received

instructions from Flight Control as to what lid to remove and what nuts to unscrew and then to screw on again, the hatch opened.

"Okeh," the astronauts informed Flight Control. "The way to the docking module is clear! "

COSMONAUTES AND ASTRONAUTS HAVE A LAUGH

Tom Stafford's report to Flight Control that there was a stowaway aboard Apollo created a minor commotion. The stowaway, was a large Florida mosquito. It had flown into the cabin before lift-off and was now accompanying the astronauts on their mission.

This bit of news made us all laugh.

And the tension caused in the US Flight Control Center by the unfortunate business with the obstinate hatch, I was informed, was also lifted by my cartoon of our American friends and their mosquito which flashed across the screens of the control monitors in place of the columns and columns of dry figures.

On our 21st spin we were pleased to learn that there'd be a chance to talk to Pyotr Klimuk and Vitaly Sevastyanov, the crew of Salyut-4, who had been in orbit for nearly two months. We had missed their company all that time.

"Congrats on entering orbit," Salyut-4 said to us.

"Thanks. Hail to the space old-timers," we replied.

Shortly before leaving for Baikonur, I had seen Klimuk's son Misha in Zvezdny. He had asked me to give his father his love out in space and to say he missed him. I did as requested. Then it occurred to me that Klimuk and Sevastyanov had been in space for two months. It seemed such a long time, while in due course, when new large stations and space factories go into orbit, people will stay up for still longer. Would it be six months, a year, or two years?

In days to come people will work in space for longer than two years (flying to Mars or Venus, for example). And what are the children of the spacefarers going to say to it? Won't they miss their parents?

Then I thought it would be a good idea to instruct the designers of space stations and factories to provide room for a kindergarten



or classroom. Why not? Surely, you kids will back me up on this. No kid would ever think of refusing to live in space for a year or two beside mum and dad, to go for space walks, and admire the Earth and stars from outer space? And we adults will certainly be better off with our children by our side.

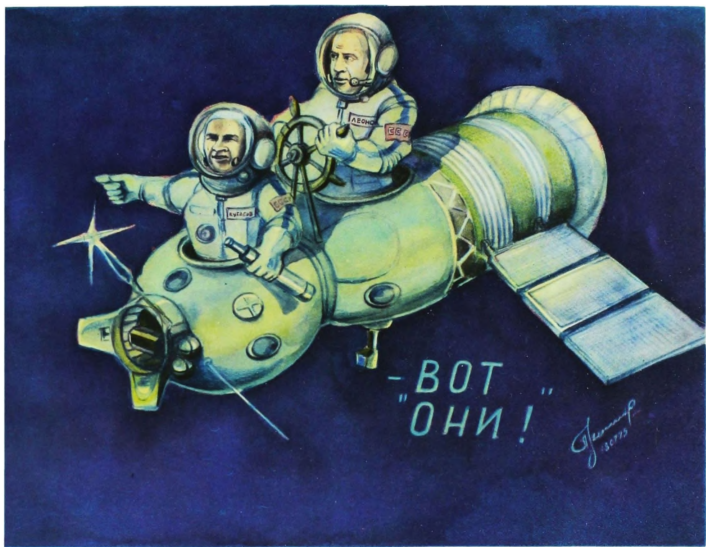
Klimuk thanked me for relaying his son's message. Then he said:

"We are following your flight all the time. Sometimes, we catch your radio conversations with Flight Control. We don't join in, because we don't want to interfere. You've got a big job on your hands."

We conversed for a long time, interrupting each other in our eagerness. There was so much we wanted to say after all this time. Salyut was slightly higher up and a bit ahead

of Soyuz. And the tracking station let us have a long talk. Klimuk and Sevastyanov were pleased to learn that our TV cameras were functioning again and Earth could see us.

"If anything wants repair," I said, "let's have it, we'll do it."



A few friendly cartoons

BEFORE THE DOCKING

By mid-day Moscow time on July 17, 1975, our Soyuz had made thirty circuits round the Earth, and thirteen of these in the docking orbit. The deviation from the pre-calculated orbit was a mere 250 meters with tolerance at 1,500 meters, and the deviation in time from the ship's precalculated arrival at rendezvous point was seven and a half seconds with tolerance at 90 seconds.

After firing their engines to correct the orbit, the US astronauts made astronomical observations and experimented with the universal electric furnace.

The time of the rendezvous was drawing near.

At my request, the US designers had

attached a docking target to Apollo. This made it easier to approach and dock. Our Soyuz, its unfolded solar power panels making it look like a plane, had its beacons on, and when Apollo came near we also turned on our orientation sidelights. The beacons helped our US friends to spot us at a distance of several hundred kilometers.

The crews of both spacecraft, two tiny particles in outer space, took an active part in the search and approach operation. Earth had worked out a detailed plan of action if the operation would for some reason go wrong. It had been planned, for example, that if Apollo should fail to lift off due to bad weather, Soyuz would wait for it in orbit for another one, two, three or four days. Procedures had been agreed upon and entered into the ship's

log in the event the docking device or the orientation lights on one of the vehicles should fail. There were even instructions on what to do if a ship sprang an air leak, if the radio equipment failed, or if a fire broke out. As you see, my friend, the flight program contained provisions for a whole lot of emergencies.

In the morning of July 17 our first radio contact with Earth began at 10.15 a.m. Moscow time.

We heard Vladimir Dzanibekov's voice say: "Good morning. How d'you feel? Had a good night's sleep?" "We feel fine," we replied. "How's Apollo?" "Good. They're still asleep."

The pressure in the Soyuz modules had already been lowered and the oxygen content in the air increased. We were ready for transfer from ship to ship.

On that memorable day of the world's first docking of two spaceships of different lands wanting to live in peace with each other, our crews had a hearty breakfast: the job before us was a big one. But due perhaps to the pressure having been lowered in our ship or for some other reason, the jam suddenly escaped my hands. While cleaning up the mess, I learned that our American friends were also busy "cleaning up": as he was opening a package of strawberries, Vance Brand had let it slip out of his hands and the Apollo crew were now in hot pursuit of the berries.

"The whole ship is a strawberry color," Apollo reported.

"And how does it smell?" Houston asked.

Many of the strawberries the astronauts simply ate up as they retrieved them, but a part was stored away.

On our 34th spin we established direct radio contact with Apollo. At that moment, our ships were over the Atlantic Ocean and were just 430 kilometers apart.

"Soyuz," we heard Stafford's voice say over the earphones in Russian. "A good day to you. How well can you hear me?"

"Audibility good," I replied in English.

"Greetings."

The approach went well. We were nicely positioned on the rendezvous orbit. Apollo was still a little below us. I turned the Soyuz 60 degrees on its fore-and-aft axis, because at docking the Apollo's antenna had to be directed at a US communications satellite "suspended" over Kenya, which was to relay our radio and TV transmissions to Earth.

There was excitement in the Flight Control centers. Kubasov had reliable contact with Moscow, while I kept in close touch with Apollo and Houston in English.

"To you, Kubasov, in the Russian custom, we wish neither down nor feathers," said Moscow Flight Control. "And tell the Americans we're keeping our fingers crossed."

The Russian expression, "neither down nor feathers", means about the same thing as "keeping one's fingers crossed".

The distance between Soyuz and Apollo diminished. Stafford and I had good two-way radio contact. He spoke Russian, and I spoke English.

"I hear you very well, Alexei," he said.

"Beautiful picture," I replied. "The ship is exactly in the center."

The three directing latches of the Apollo docking unit entered between the latches of the Soyuz docking unit. It was like two daisies getting their petals mixed.

The Soyuz had begun the turn on its fore-and-aft axis at 19 hours 4 minutes 47 seconds. Kubasov recorded the precise time. There was a light bump, and on our control panel the "coupling" signal flashed on.

"Rigid link-up, coupling accomplished!" I heard in my earphones.

Vance Brand reported that he had turned on the pull-in mechanism.

The twenty-ton pull-in turned Soyuz and Apollo into a new and dependable space home.

The time was 19 hours 9 minutes. The docking had been accomplished three minutes before schedule. Was this another case of Tom Stafford's "speeding"? Moscow flight controller V. Blagov chuckled:

"We've managed to convert Stafford to our faith: the mooring had been gentle."

HANDSHAKES IN SPACE

The docking was the star hour of the Apollo Soyuz Test Project, a star hour for all humanity. The road to it had been an arduous one, with many twists and turns. These were due to past strains, and all too often to plainly not knowing each other.

The finest minds dreamed of the day when all the nations on Earth would live as one family, as brothers. There is still too much malice, evil and injustice on Earth. But there is more of the good and exultant. There is more of that for which it is worth living and striving in a world at peace.

The United Nations Organization has done a great deal for peace on Earth. This was why we had taken the UN flag along on our flight, and handed it to our American friends as a symbol of peace. Later, when Kubasov and I visited the United States, the five of us astronauts and cosmonauts turned the little flag over to the United Nations Organization for safekeeping.

What the Soviet Union and the United States have achieved in the exploration of outer space does not belong to just our two countries. It belongs to the whole world, to all the big and small nations.

We had also taken along the flags of our own countries, halves of the commemorative ASTP medals, and other souvenirs. Besides, we had a box with the seeds of tree species that grow in Russia, and our American friends had one with the seeds of American trees. This had been Tom Stafford's excellent idea. We exchanged the boxes in space, and when we got home we planted the seeds of friendship in our native soil.

But all this came later. Let's get back to the story of our docking. We opened our hatch and waited for Apollo to open the hatch leading to the docking shaft, the air lock. We saw the hatch tremble and slowly move aside. Tom Stafford's grinning face appeared in the opening, and his loud and happy voice said:

"How are things, Alexei? Come here, please. To me." He picked the Russian words carefully, and was visibly excited. Uncertain

of having been understood, he added in English: "Please."

I, too, seem to have been properly excited. This is probably why my invitation in English, like Stafford's in Russian, was anything but formal:

"Come on, Tom, enter!"

We floated towards each other into the cylindrical shaft, shook hands, and embraced. Nor did we trouble to conceal our emotions, the excitement and joy that gripped us.

We listened with deep attention to the greeting sent us, participants in the historic experiment, by Leonid Brezhnev, General Secretary of the Central Committee of the Communist Party of the Soviet Union, and to the message from US President Gerald Ford.

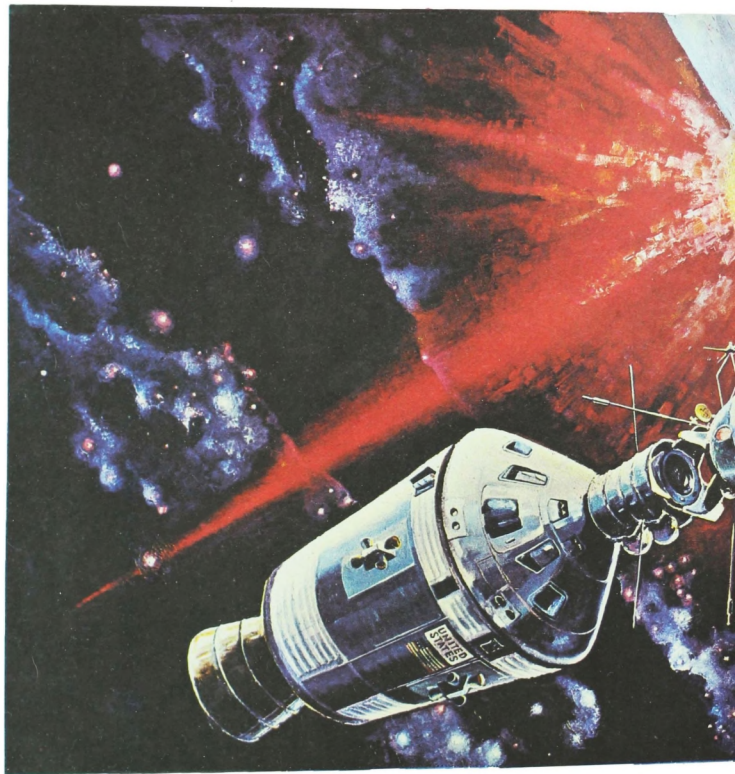
"The whole world is following your difficult joint program of scientific experiments," said Leonid Brezhnev in his greeting. "The successful docking has confirmed the choice of technical solutions effected in creative co-operation by Soviet and American scientists, designers and cosmonauts. It is safe to say that Soyuz-Apollo is the prototype of future international orbital stations."

And President Ford told the spacemen:

"Your flight is a momentous event and a very great achievement not only for the five of you, but also for the thousands of American and Soviet scientists and technicians who have worked together for three years to insure the success of this very historic and very successful experiment in international cooperation.

"It's taken us many years to open this door to useful cooperation in space between our two countries, and I'm confident that the day is not far off when space for millions made possible by this first joint effort will be more or less commonplace."

Then, as good friends always do, we visited each other. At first, Thomas Stafford and Donald Slayton came to us. We gave each other the flags of our countries, and had dinner. Like that first time on Earth, we "clinked glasses" with our tubes of black currant juice. In the meantime, Kubasov went off to visit Vance Brand in Apollo.





Docking of Soyuz and Apollo

Out in space every minute counts. So, after the meal we got down to our work. Donald Slayton and Kubasov, the space welder, began the joint "universal furnace" experiment. Tom Stafford and I signed a document recording the world's first international space docking and assembled the commemorative medals out of the halves that each of the crews had brought along. When I visited Apollo the following day, July 18, 1975, Stafford and I put together two commemorative panels bearing the national emblems of the Soviet Union and the United States out of little metal plates which we had brought with us. Each of the panels also bore the date of the docking.

During the crew "swaps" we did our best to work efficiently and harmoniously, just as though the five of us were one crew. Nothing less than that would have done. You may recall, my young friend, that in case of a serious malfunction in the Soyuz-Apollo space home each of us was to remain where he was, where the alarm caught him, and return to Earth. For this we had to know each other's spaceship as thoroughly as our own.

Our joint flight came off magnificently, and, as you know, there had been no malfunctions.

We held a press-conference from outer space. The questions were of all kinds. There was this one, for example: what did you have for dinner when the astronauts visited you, and what did they give you for dinner on your visit?

Space food isn't the same as food on Earth, and is prepared quite differently. Not by us. By space food experts. But as an ancient philosopher once said, "a feast is graced not by what you eat, but with whom you eat". We had dined with our very good friends, and that was the main thing.

Answering the newsmen's questions, Stafford and I peered into the none too distant future.

Replying to the question, "In what other space flights would you still like to participate?" Stafford said:

"ships, to participate in new flights. Before long there will be the space shuttle program and I would sure like to be on it. I hope Alexei will have a spaceship by then designed for a new joint flight. Mankind is on the road of progress. There will be new space hardware. I hope there will be new and better spacecraft for joint missions, and that they will be more useful for all of us on Earth."

I agree completely. I should certainly like to be on a ship that will stay a long time in space and from which I could look down with the eyes of an artist on the so diverse face of the Earth, on its many colors, impress this upon my memory and paint it for all people. I should like to rise to altitudes higher than those we fly at today. The Earth must look quite different from there.

THE PARTING AND RETURN

On July 19, Kubasov and I took up our stations in Soyuz, and our American friends in Apollo. We raised the pressure of the air in our ship and reduced the oxygen content to normal. Before the flight we had obtained the American side's consent to one more joint experiment: an artificial solar eclipse.

The eclipse caused by the shadow of the Moon and observed from Earth does not always give the observers all the facts they want. They are prevented from getting precise information about the Sun's corona by the continuous atmospheric changes on Earth. It is different in space, where nothing interferes with observations of the corona. The information we were going to get would therefore interest very many scientists.

That day we also had the good fortune of conversing with Anatoly Filipchenko and Nikolai Rukavishnikov, who had returned to Moscow from Baikonur.

"Soyuz, how's audibility? I'm Filipchenko. How are things?"

I was glad to hear my friend's voice.

"So far so good," I replied.

"And that's how it is going to stay," he said. "Your families have asked us to give you their best wishes. They are fretting and can't wait to see you back."

Kubasov, who cannot live a day without missing his son Dmitry, muttered: "What's there to fret about? Everything's fine."

"What's there to fret about? Everything's fine."

"How are your American colleagues?"

"Still sleeping," Kubasov replied. "They had a hard day."

"Give them our best," Filipchenko said, and Rukavishnikov added:

"Good-bye. Looking forward to your landing!"

The undocking of Soyuz and Apollo began at 3 p.m. on July 19. Our American friends performed an orientation maneuver and asked if we were ready for undocking. We confirmed. The Apollo crew uncoupled the

latches of the docking unit and informed us everything was ready for the parting.

A spring pusher softly disengaged our two ships. Moving away from us, the astronauts photographed our Soyuz. Later, researchers used the snaps to investigate our ship's degree of exposure to the Sun. Firing its rocket engines, Apollo started on the artificial solar eclipse experiment.

An unforgettable spectacle! Kubasov and I had feared that the flames bursting from Apollo's exhaust would botch our view of the eclipse. I didn't know yet if we'd get good films of the Sun's corona. But the colors that presented themselves to our sight were so magnificent and fantastic that I couldn't tear myself away from the porthole. Yes, the colors of the Sun's corona had so stunned my imagination that the first thing I did on returning home from the mission was to put it all on canvas.

When the distance between our craft was about 220 meters, Apollo switched on its braking engines. Again, our ships maneuvered for a link-up. This time Soyuz was the active partner, and Apollo was passive.

At 3.40 p.m. the second docking was completed. But the program provided for no crew "swaps", and we undocked for the last time at 6.26 p.m.

So long, Apollo, so long, our American friends Tom Stafford, Dick Slayton and Vanya Brand. until our reunion on Earth, that beautiful blue Earth of ours—our common land and home.

At about 11 p.m. Moscow time, Apollo performed a parting maneuver to avoid collision with Soyuz, and was soon out of sight.

In the 24 hours after the parting with Apollo we made several biological experiments for scientists were expecting the maximum information from us in order to draw certain conclusions. Also we photographed the sunrise: the weathermen and opticians had asked us to do it.

The mission was nearing its end. Kubasov and I transferred the materials and appliances with the results of our work to the descent capsule, and retested the descent systems.

Then came the last TV broadcast, after which communication was solely by radio.

The experiments on the program had all been performed. We were preparing to return to Earth. The following day we would switch on the braking engines, and in another 45 minutes would come down in our motherland.

The anticipation of stepping on firm soil! In the morning of July 21, on our 95th orbital spin, Kubasov and I put on our spacesuits and transferred to the descent capsule. Orientation was precise. All the ship's systems functioned normally.

On our 96th spin, over the Atlantic in the region of Ascension Island, the craft left the orbit and began its sweep to Earth. Our altitude at that moment was 217 kilometers, and the distance from Apollo something like 800 kilometers.

Our ignition cartridges went off when we were over Central Africa and separated the equipment and orbital modules from the descent capsule. It was a pity that the orbital module, where we had held our "space reception", had to go. But it couldn't be helped. Only that which is vitally necessary for further operations is kept, everything else is jettisoned.

"All normal aboard. Separation accomplished on the dot, motion stable." I reported to Earth. Flight Control replied:

"We can hear the two of you conversing."

Kubasov growled back:

"Why do you do that? It's eavesdropping."

We put the ship on course. The sound of the descent engines was now clearly audible. We felt fine.

Everything was screwed down tightly. The descent was coming off well. We had already passed the Caspian Sea. The atmosphere resisted our swift flight and flames enveloped the protective heat-insulating shell of the descent module.

"Situation normal. Portholes covered with soot," I reported to Earth.

"How do you feel? "

"Splendid. Thanks."

"You're going to land 25 kilometers from planned point."

The parachute that would slow up our descent was to open any moment, followed by the big main one.

The first parachute opened, and then the giant one unfurled as well. In a few minutes we would land on Earth.

The landing was at 1.50 p.m. Helicopters whirred in our direction, and people came running. The search party opened the hatch, helped us unbuckle the straps and detach the spacesuits from the ship's life-support systems. In a few seconds we were surrounded by fliers, doctors and journalists. Questions were fired at us. We tried to answer them all at once, to thank everybody. I said:

"My dear friends, the flight is over. It had been tough. Very tough. But now it's easy, because we're home. We're giddy, giddy from joy and fatigue, and the sleepless nights. All in all, we slept not more than 20 hours. Thanks for your support."

Kubasov was saying:

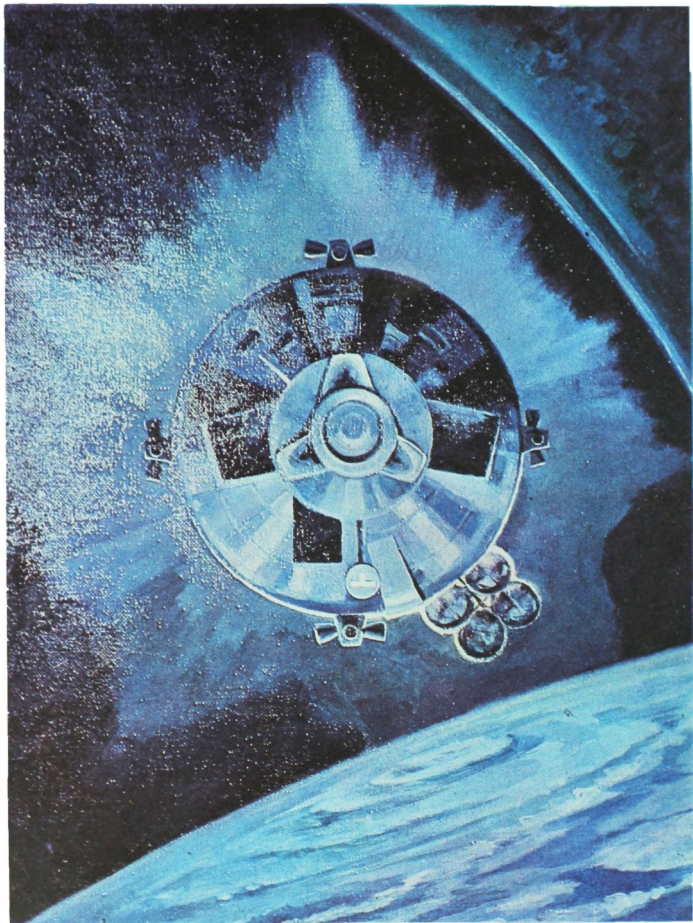
"We had our rendezvous with the American spaceship, met the American astronauts, and shook hands. Now we are glad to be back on Earth."

A friend gave us a piece of chalk. Kubasov and I wrote in big letters on the sooty hull of our good ship Soyuz-19:

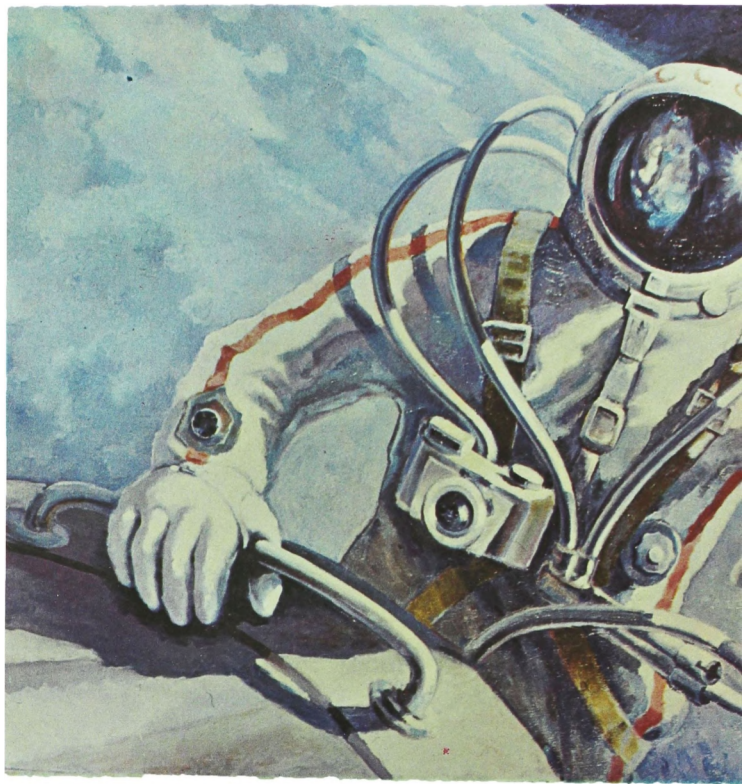
"S p a s i b o".

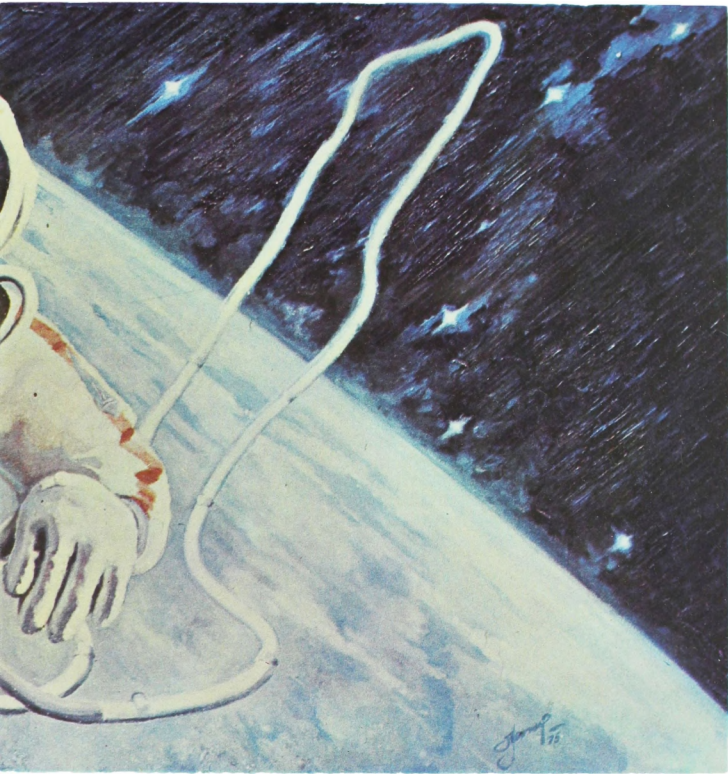
This is the Russian for "thank you".

On July 25, 1975, the US spaceship Apollo with the three astronauts on board splashed down safely in the Pacific Ocean. The ASTP mission was fully accomplished.



The Sun's corona





A spaceman walks in space

A PARTING WORD

My young friend, I have told you about the Apollo-Soyuz space flight and showed you my drawings of it. This flight initiated a new, international approach to the exploration of outer space. Before long other ships will lift off for the stars, and other people will be at the controls of the clever, dependable and so very useful spacecraft.

Perhaps you, too, will fly in one of these rockets. My young friend, I wish you success from the bottom of my heart.

And may the Sun's wind be a fair wind.

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