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USSR Report

SPACE

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MANNED FLIGHT CHRONOLOGY

[Editorial Report] The Soviet News Agency TASS reports the following information on activities connected with manned spaceflight activity:

8 Feb 84 - Launch of "Soyuz T-10"

"Soyuz T-10" was launched on 8 February 1984. The crew consists of ship commander Colonel Leonid Denisovich Kizim, flight-engineer Vladimir Alakseyevich Solov'yev and cosmonaut-researcher Oleg Yur'yevich At'kov. The flight program calls for docking with the "Salyut-7" station and performance of scientific-technical and medical-biological research and experiments. (Moscow PRAVDA in Russian 9 Feb 84 p 1)

9 Feb 84 - Docking with "Salyut-7"

At 1743 hours Moscow time on 9 February "Soyuz T-10" docked with "Salyut-7". Rendezvous of the craft was performed automatically; the crew performed the docking manually. (Moscow PRAVDA in Russian 10 Feb 84 p 1)

10 Feb 84 - Second Day in Orbit

The cosmonauts' second working day began at 1000 hours Moscow time. The cosmonauts are reactivating the station for manned flight regime, including the life support system, power supply and thermal control systems. In the living sections of the complex, pressure is maintained at 756 mm Hg; temperature is 20 degrees C. (Moscow PRAVDA in Russian 11 Feb 84 p 3)

13 Feb 84 - Fifth Day

The cosmonauts are continuing planned operations to reactivate the equipment and apparatus of the station. In the preceding days they checked the control system in the manual orientation regime and inspected and photographed the viewports of the station. A series of medical experiments has been performed to further study the mechanisms of vestibular disorders in the acute period of adaptation to weightlessness and to evaluate the effectiveness of prophylactic measures. According to the plan of preventive maintenance operations the crew will today install a new purification unit in the system for regeneration of water from atmospheric moisture, replace elements in the "Aelita-01" apparatus and check the radio communication equipment. Work is proceeding in full accordance with the planned program. (Moscow PRAVDA in Russian 14 Feb 84 p 2)

17 Feb 84

Measures to reactivate the "Salyut-7" station have been completed by the crew. Yesterday the cosmonauts performed the first series of geophysical research. A photo survey was made of areas of the Far East and Primor'ye regions with the MKF-6M and KATE-140 apparatus. A number of experiments were performed with the "Astra-1" mass spectrometer apparatus to evaluate parameters of the atmosphere immediately surrounding the station and to study the earth's atmosphere and ionosphere. (Moscow PRAVDA in Russian 18 Feb 84 p 2)

21 Feb 84 - Launch of "Progress-19"

At 0946 hours Moscow time on 21 February the "Progress-19" automatic cargo ship was launched in the Soviet Union in order to deliver expendable supplies of various cargo to the orbital station. "Progress-19" was inserted into an orbit with the following parameters: apogee, 261 kilometers; perigee, 192 kilometers; period, 88.7 minutes; inclination, 51.6 degrees. (Moscow IZVESTIYA in Russian 22 Feb 84 p 3

23 Feb 84 - Docking of "Progress-19"

At 1121 hours Moscow time on 23 February the "Progress-19" cargo ship docked with the "Salyut-7"--"Soyuz T-10" complex. Mutual search, rendezvous and docking were performed by onboard automatic equipment. These procedures were monitored by the Flight Control Center and by the cosmonauts. The cargo ship docked at the instrument module of the station. "Progress-19" delivered fuel, equipment, scientific research materials and mail for the crew. (Moscow IZVESTIYA in Russian 24 Feb 84 p 1)

27 Feb 84 - Twenty Days in Orbit

The cosmonauts have been in orbit for twenty days. During the preceding week the work program included geophysical research, unloading of the "Progress-19" ship and maintenance operations on the station. On 24 February a photo survey was made of the comet Crommelin. Today the cosmonauts began a series of studies of the earth's surface in the interests of solving economic and scientific tasks. Photographic and spectrometric surveys are being conducted over regions of the Carpathians, the Transcaucasus and Siberia. In order to derive information on streams of gamma radiation and charged particles in space the crew has prepared for operation the "Yelena" small gamma telescope and performed the first experiments with it. Orbital correction maneuvers were performed on 25 and 26 February using the engine of "Progress-19". Present orbital parameters of the complex are: apogee, 327 kilometers; perigee, 305 kilometers; period of revolution, 90.6 minutes; inclination 51.6 degrees. (Moscow PRAVDA in Russian 28 Feb 84 p 1)

2 Mar 84

The cosmonauts are in the twenty-third day of their flight. Today they are continuing the cycle of geophysical studies begun on 27 February. These include visual observations, photography and spectrometry of the earth's surface. In particular, ocean currents and the interaction of the ocean with the atmosphere are being studied. The crew members are continuing to unload the "Progress-19" ship. Today's schedule also calls for maintenance operations, checks of onboard systems and physical exercise. To evaluate the cosmonauts' state of health a medical examination of the crew has been performed by Doctor At'kov. Untrasound apparatus was used to determine indices of cardiovascular activity and pulse and arterial pressure were measured. Results show that the cosmonauts are healthy and they feel well. The flight is proceeding normally. (Moscow PRAVDA in Russian 3 Mar 84 p 2)

12 Mar 84 - "Isparitel'" Experiment

During the preceding week the crew has completed a large volume of work unloading the "Progress-19" cargo ship. Cargo has been stowed in the proper places on the station and used equipment has been loaded into the vacated compartment of "Progress-19". The "Rodnik" system has pumped water into the tanks of the station and the tanks of the unified propulsion unit have been refilled with oxidizer. In the program of space materials studies a series of experiments has been performed with the "Isparitel'" apparatus. Metallic coatings are applied to samples by the method of evaporation and subsequent condensation in conditions of space vacuum and weightlessness. During the experiments the working unit of the "Isparitel'" was located in a depressurized lock chamber; the experiments were controlled from a panel inside the station. Yesterday the cosmonauts had their latest medical day. Studies were made of their cardiovascular systems. Results show that cosmonauts Kizim, Solov'yev and At'kov are in good health. (Moscow PRAVDA in Russian 13 Mar 84 p 1)

16 Mar 84 - Sixth Week in Orbit Begins

The cosmonauts have been aboard the "Salyut-7" station for 36 days. Today they are preparing scientific apparatus for upcoming experiments and are continuing to load used equipment in the empty compartment of "Progress-19". Physical exercises are also a prescribed part of the daily schedule aboard the orbital complex. After completion of the operation to pump compressed nitrogen from the tanks of the unified propulsion unit they will be refilled with fuel. Medical monitoring shows that the cosmonauts are in good health. The flight is proceeding normally. (Moscow PRAVDA in Russian 17 Mar 84 p 1)

23 Mar 84 - One and a Half Months in Orbit

Cosmonauts Kizim, Solov'yev and At'kov have been in space for one and a half months. In the past week they performed a large volume of medical research, visual observations and maintenance work. Time was also allotted for rest and for showers. 19 March was the latest medical day for the crew. Studies were made of the cardiovascular systems and psychophysical condition of the cosmonauts. An experiment was performed to evaluate the dynamics of change in the composition of the gas environment in the living compartments of the complex. This morning the "Glucometer" instrument was used in a biochemical experiment to study features of carbohydrate metabolism. A large part of the working time in the second half of the day was devoted to technological experiments with the "Isparitel'" unit. Metallic coatings were applied by the method of electron beam evaporation and subsequent condensation. An alloy of copper and silver is used for the coating material. (Moscow PRAVDA in Russian 24 Mar 84 p 1)

30 Mar 84 - 52 Days in Orbit

The cosmonauts are in the 52d day of their work in space. Operations with the "Progress-19" cargo ship have been completed. Fuel, oxidizer and drinking water have been pumped into the station. All cargo has been transferred to "Salyut-7". The "Sport" experiment is being performed as part of the medical program. While physical exercises are being performed, such as walking, running and work on the bicycle ergometer, each cosmonaut's basic physical parameters are recorded, including arterial pressure, breathing rate and pulse, and an electrocardiogram is made. Analysis of the measurement results at different stages of the flight makes it possible to evaluate the cosmonauts' work capacity and state of health. Data from this research show that the cosmonauts are healthy, that they feel well and the planned flight program is being fulfilled. (Moscow Domestic Service in Russian 0400 GMT 30 Mar 84)

31 Mar 84 - Undocking of "Progress-19"

After completion of the joint flight program, the "Progress-19" craft was undocked today from the "Salyut-7"--"Soyuz T-10" complex at 1240 hours Moscow time. Undocking and separation of the cargo craft were monitored by specialists at the Flight Control Center and by the cosmonauts. The engines of "Progress-19" had been used three times to carry out orbital corrections of the research complex. The cosmonauts have been performing geophysical and medical experiments and preparing for upcoming experiments with the visiting crew which will include an Indian cosmonaut. As part of the earth resources program the cosmonauts have performed a cycle of detailed observations of the ocean using photo and spectrometric apparatus and the "Tsvet-1" manual visual colorimeter. The "Sport" experiment has also been conducted to select optimum combinations of physical exercise for the cosmonauts. (Moscow PRAVDA in Russian 1 Apr 84 p 1)

CSO: 1866/123-P

COMMENTS ON GOALS OF 'SOYUZ T-10' FLIGHT

Moscow PRAVDA in Russian 9 Feb 84 p 3

[Article by A. Pokrovskiy: "The Commander Does Not Change Callsigns"]

[Excerpts] Vostoks, Voskhods, and Soyuz's have succeeded each other at the launch site. These are spacecraft of various designs and purposes. Now Leonid Denisovich Kizim, Vladimir Alekseyevich Solov'yev, and Oleg Yur'yevich At'kov have taken over what is already the tenth Soyuz-T spacecraft in order to begin the journey to the target--the Salyut-7 station.

The core of research work is now truly being transferred more and more from the spacecraft--it is no accident that they are now being called means of transportation--to on board long-duration orbital stations. This is the main path of development in Soviet astronautics. The party made such an assessment in 1969 after the group flight of Soyuz's 6, 7, and 8 when no orbital stations had yet gone into space.

Not a great deal of time has passed since then. However, the serial number of the Salyut which is now awaiting the "Mayaks" in orbit is already number seven. Incidentally, although they have kept their old name, the stations have also changed. For example, Salyut-6, on which the present Soyuz T-10 commander worked together with O. G. Makarov and G. M. Strekalov in December 1980, began the second generation of stations. Its chief feature is that it has two docking units instead of one, as was the case earlier. It is understandable that the possibility of simultaneously receiving two transport craft has appreciably increased the effectiveness of using the Salyuts.

The increase in the efficiency of space technology is a characteristic trait of modern Soviet astronautics. The trend toward this is traced in the evolution of the spacecraft and stations, in the work of the crews, and in a thorough analysis of the results of each flight. The first crew of "Mayaks" also operated on this course--commanders do not change callsigns.

By the time they arrived at Salyut-6, this craft had broken all records for the length of time a station had worked in orbit. L. Kizim, O. Makarov, and G. Strekalov inspected it, carried out a large amount of repair and maintenance work, and issued a guarantee--the station can continue to operate.

Their flight was completed at the juncture of the 10th and 11th five-year plans. The creators of the space equipment and the cosmonauts dedicated the successful conduct of this mission to the coming 26th party congress. Now Leonid Kizim and his new comrades are going on the next trip in order to make their contribution to fulfilling the decisions of this congress which provide for the further study and mastery of space in the interest of developing science, technology, and the national economy. The designers meanwhile have taken care so that the cosmonauts could work with great efficiency--the experience of the first flight of "Mayaks" was taken into account. For example, at that time they had to spend quite a long period of time replacing the temperature control system pumps. Now such a replacement is hardly required and, if the necessity should arise, then everything can be done more simply and quickly.

On the very eve of the mission of the "Mayaks," the USSR Academy of Sciences Institute of Solid State Physics held an all-union seminar on the hydromechanics and heat mass exchange in weightlessness, i.e., on those processes which determine the success of obtaining substances in space which are especially pure and of complex composition necessary in electronics and optics technology, or in widely-used biologically active medical compounds.

At the exhibit one could see models of crystals obtained in weightlessness, could become acquainted with technological installation devices of various purposes, and could hear lectures interpreting the results of experiments already carried out in space and new research being planned. The work of the seminar undoubtedly deserves a detailed story. However, its essence is understood from the words of the academician V. S. Avduyevskiy during the opening of the seminar:

"All of the scientific-technical and social prerequisites are now ready for an even more intensive use of space for peaceful purposes. The industrialization of space, the building of industrial projects there, including those for the production of new materials, seem to be the main task. Success here depends upon the correctness in selecting basic directions, and the elaboration and scientific foundation of programs for mastering space. Our seminar's job consists precisely in discussing space technology problems and preparing its scientific foundation in order to use, to maximum effectiveness, manned stations and automated equipment for the national economy and science."

Leaving the seminar, I met space technology specialists in the institute's lobby who were familiar with the experiments during previous missions.

"So we are preparing for the upcoming mission along with the 'Mayaks.' There is technological equipment on Salyut-7..."

But exactly why is a doctor now included again in the crew? Oleg Yur'yevich himself answered this question for the journalists:

"Yes, the cosmonauts have successfully conducted many medical and biological experiments without specialized medical training. They took appropriate training at Zvezdnyy but generally acted as operators. However, the experiments are becoming more and more complicated and, at times, their results require preliminary evaluation right on board the station. Things become more difficult here without a specialist. Such a person has not only personal experience but also everything he learned from working in medical institutions. An experiment's success is determined not only in orbit..."

How could one forget a conversation here with a person who is at the center of Soviet space medicine. We questioned at length the director of the Institute of Medical and Biological Questions, O. G. Gazenko, about the possible time periods for a person staying in space and about the prospects for continuous orbiting there. He patiently enumerated the various medical factors and then added:

"The early morning hours, the beginning of spring, the first years of a person's life--all times like this have always been tinged with a joyful feeling of what lies ahead for us. Space exploration experiences something similar since this represents man's first steps into space. And precisely because these are the first steps, we should not be self-confident. It is necessary to understand clearly that further progress along this path will raise new and, maybe, even more complicated problems."

Doctor O. At'kov has to deal with solving such problems. His earthly biography indicates that he is ready to meet them. While a senior at the First Moscow Medical Institute, he was awarded a Komsomol prize at age 28 for developing and introducing ultrasonic methods for diagnosing heart illnesses. After becoming an associate at the All-Union Cardiological Science Center, he also authored five inventions and more than 30 scientific works, and defended his candidate's dissertation.

His space biography is just beginning. For several years he devoted himself to examining the health of the cosmonauts, using echo-electrocardiography for this purpose for the first time. Incidentally, an echo-electrocardiograph device is also waiting for him on Salyut-7. For the present, Oleg Yur'yevich has participated in experiments with it from the mission control center, but now he will have direct contact with it. Who should work with it if not a specialist in the field of heart research ultrasonic methods!

8524
CSO: 1866/87

MEDICAL RESEARCH PROGRAM OF 'SOYUZ T-10' CREW

Moscow MEDITSINSKAYA GAZETA in Russian 10 Feb 84 p 1

[Unattributed report: "An Extensive Research Program"]

[Text] And so, a physician, candidate of medical sciences O.Yu. At'kov, is now a member of a space crew. His presence on board has resulted from the extensive program of medical and biological research. At the request of a MEDITSINSKAYA GAZETA correspondent, one of the leaders of the medical support facilities for the mission, member of the USSR Ministry of Health Collegium, doctor of medical sciences Ye.B. Shul'zhenko, talks about some aspects of the program.

About 20 years have elapsed since the first flight by physician-cosmonaut B.B. Yegorov (with V.M. Komarov and K.P. Feoktistov) aboard the three-man "Voskhod" vehicle. At that time it was important to broaden our ideas about the effect of weightlessness and other flight factors on the human body. Now cosmonautics is reaching for new frontiers. And the physician aboard the space vehicle has much work to do.

Among the set tasks are those that are traditional and always on the agenda and planned for every mission. The study of the effect of weightlessness on the human body will be continued. The researchers' attention has been focused on the state of health and the work capacity of the cosmonaut at different stages of flight, and studies are being conducted on the functional status of the mechanisms regulating central and peripheral hemodynamics under the conditions of prolonged missions in circumterrestrial orbit.

Studies of the mechanisms involved in the space form of motion sickness and the interaction of the analyzer systems and analysis of metabolism are extremely important.

In this flight too, we shall constantly observe the state of health of the cosmonauts with the aid of telemetry equipment. The presence of a physician in the crew brings new elements to this part of the program: there will be opportunities for constant medical observations and self-observation, and also for evaluating the state of health and work capacity of all crew members right there aboard the vehicle.

At the same time a number of new experiments have been planned, while some studies conducted earlier are acquiring a qualitatively new significance.

For the first time a determination of the blood electrolytes will be made directly during a flight. Having analyzed blood taken from the crew members, using the "Biokhim" instrument the physician will make current evaluations of their results. This will make it possible to obtain information about the effect of flight factors on the status of mineral metabolism in the body and determine some of the regulatory mechanisms that affect the development of negative electrolyte balance in the blood.

The aim of the "Optokinez" experiment is to study the body's eye movements and autonomic responses during optokinetic and vestibular stimulation. Evaluations have to be made of the functional status of these systems and a determination made of the patterns in the development and manifestation of dysfunctions observed during flight.

Yet another new experiment--the "Glaznoye dno" ["Fundus oculi"]--will make it possible to study blood supply to the eye during flight. It will be possible to assess the hemodynamic shifts in the fundus from changes in the so-called blind spot.

The aim of the "Sport" experiment is to determine the most effective means and optimal regime for prophylactic training for each cosmonaut, taking into account the individual features of his body.

Of course, this is by no means a complete list of the medical problems that must be resolved during the mission. There is much work to be done. I would like to wish the crew members success and a safe return to their home planet.

9642
CSO: 1866/86

GOALS OF COSMONAUT AT'KOV'S MEDICAL STUDIES ON 'SALYUT-7'

Moscow IZVESTIYA in Russian 3 Mar 84 p 3

[Article by IZVESTIYA special Correspondent A. Ivakhnov: "Stethoscope for the Cosmonaut. Report from the Flight Control Center"]

[Text] L. Kizim, V. Solov'yev, and O. At'kov have completed the third week of work in circumterrestrial space. The "Mayaki" are continuing to photograph the earth's surface, gradually transferring to the station the cargo brought from Earth, and conducting medical investigations and experiments. These were the main topic of discussion at the press conference held in the Flight Control Center. Why now, 20 years after the flight of B. Yegorov, has it become necessary to send a doctor into orbit? We directed this question to I. Komordin, chief of the USSR Ministry of Health Administration of Space Biology and Medicine.

"On 9 March," said Igor' Pavlovich, "we will celebrate the 50th anniversary of the birth of Yuriy Gagarin, and five weeks after that, the 23rd anniversary of the first space flight in history. Not a quarter of a century has passed since that historic April day, but cosmonautics has come a long way during that time. More than 100 people, representatives of 30 countries, have been in circumterrestrial orbits. The time spent working in space has increased from 108 minutes by Gagarin to seven months. Earthlings have been in open space for a total of about five days.

"Nevertheless, we cannot say that all questions relating to man's presence in a circumterrestrial orbit have been answered. Therefore, along with the manned flights, we have launched space equipment on board which there are bacteria and tissue cells, higher and lower plants, fish, rats, and monkeys--more than 30 different biological objects.

"Making space flight safe is the main task of space biology and medicine. In order to do this, we have developed a system of measures such as selecting and training the crew according to medical criteria, sanitary-hygienic monitoring of the living environment inside the space craft, medical monitoring of cosmonauts' health, and preventive measures to stabilize the health of the crew and preserve their work capacity.

"I have been asked why it is now that a doctor has gone into space. Since B. Tegorov's flight, space technology has been improved, and flight risk reduced to a minimum. But many new problems have arisen which can only be resolved by a doctor acting as a cosmonaut-researcher.

"The majority of people who have been in space have suffered to one degree or another from motion sickness, and the prolonged weightlessness had some effect on their health. The first of the tasks facing us is to investigate the forms of this sickness. The second task is to observe during the course of a flight the mechanisms of metabolism and the growth and propagation of blood cells. No less important is studying the psychoemotional state of the cosmonauts. And, finally, it is very important to make a sanitary-hygienic evaluation of the living environment: food systems, water supply, and means of personal hygiene.

"In addition, O. At'kov's work program calls for a number of medical-biological experiments.

"The important task, beyond the daily medical examinations, is observing the functioning of the cardiovascular systems of crew members using ultrasonic equipment and other modern equipment, and observing the processes of water-salt exchange. On this flight, venous blood will be taken from the cosmonauts. Physicians will analyze it on Earth. Taking blood from a vein is a relatively complicated procedure, and no specialist other than a physician can carry it out."

"The doctor's flight," continued A. Grigor'yev, first deputy director of the Institute of Medical-Biological Problems, "did not come about only because he has to carry out manipulations which cannot be done by other crew members. In a little over 20 years we have accumulated a great deal of data. In analyzing it, a number of hypotheses have arisen concerning the reasons for motion sickness, the redistribution of blood under flight conditions, and so forth. A physician is needed to check these hypotheses professionally. Every crew member can be taught to operate the equipment and conduct medical research and experiments. But the main thing that a doctor has is his experience--his ears, eyes, and hands. By listening and palpitation, and by sensing in himself the influence of these factors, a doctor, even if he is alone, can correctly evaluate the situation.

"Oleg will also carry out fundamentally new research. For example, there is the task of discovering the reserve capacities of the body, which are especially important on a lengthy flight. For this it is necessary to subject the body to increased stresses. It is dangerous to do this without a doctor. We are talking about the maximum physical load and increased negative pressure in the "Chibis" vacuum pants. Experiments with the "Chibis" have already been done, and Oleg has succeeded in getting a number of figures which we could not obtain previously. In order to do this, great professional skill is needed, which O. At'kov certainly commands.

"Metabolism. We are interested in many figures: the blood concentration of hormones and trace elements--sodium, potassium, calcium, and magnesium. It is very important to study the calcium-phosphorus exchange. During a long flight these substances leave the bone but increase their concentration in the blood, which may have an effect on the body's functional systems.

"Or take the psychoemotional state. We can judge some things by intonations during conversations and the external appearance of crew members. To this is now added the deeper scientific study of psychological capacity to work.

"Another question: on board the orbiting complex, physical exercise takes up more than two hours, although time is precious there and it might seem more worthwhile to use it for other needs. On this flight we have addressed the task of testing four regimes of physical exercises. The first is the one which has already been used, and the other three are experimental. They will be shorter in duration, but more intensive with regard to workloads and energy costs. But here it is impossible to rule out the development of undesirable changes in the body. A doctor is just what is needed to monitor this and choose for each crew member the regime best suited to him.

"The commander and flight engineer fully understand that the cosmonaut-researcher is doing a very important job. And they are doing everything they can to help him. Perhaps they don't enjoy giving blood from their veins, but without this, progress could not be made. And when it is a question of medical-biological research, they both support the doctor unconditionally."

...First Deputy Director of the All-Union Cardiological Scientific Center Yuriy Nikitich Belenkov arrived at our meeting after a communication session during which he spoke with O. At'kov.

"I am not a specialist in space medicine, but a scientist," he said, "so I urge you not to forget that Oleg Yur'yevich is a scientific worker. Without belittling the delights of carrying out his endeavors in space, we nevertheless think of the scientific results which his work in orbit is making it possible to obtain.

"Changes in the human body analogous to those which are observed in space occur even on Earth in certain human illnesses. We have approaches for treating these conditions which can suggest rough plans for preventing motion sickness during weightlessness. And here Oleg holds all the cards, because he has studied this particular pathology"

And the last question: will every crew now include a doctor?

"No, certainly not," replied deputy flight director V. Blagov. "Specialists of many fields are waiting for their chance to go into orbit. And the scientific data which O. At'kov brings back from space will, we believe, be extensive enough that medical workers on Earth will require years and years to evaluate it..."

12255
CSO: 1866/110

MEDICAL BACKGROUND OF COSMONAUT-RESEARCHER AT'KOV

Moscow MEDITSINSKAYA GAZETA in Russian 10 Feb 84 p 3

[Article by Yu. Faybishenko: "The Road into Orbit"]

[Text] On that historic day in April 1961 when the world learned about the flight of Yu. Gagarin, Oleg At'kov was studying in the fifth grade. Like many of his contemporaries, from that time on he started to dream about being a cosmonaut.

But in 10th grade he decided to devote himself to medicine. And this decision remained unaltered, even though he failed to gain admission to an institute at his first attempt. He worked for a year as a medical orderly in the medical-sanitation department of an enterpise in Kherson city.

In 1967 he became a student at the Crimea Medical Institute. Then he moved to the Kiev Medical Institute for family reasons, and he finally graduated from the Moscow First Medical Institute.

He started to be attracted by scientific work while still at the VUZ. He conducted research actively in the student scientific club led by a professor at the USSR Academy of Medical Sciences Institute of Pharmacology, N.V. Kaverina. He dreamed of an assignment to this institute. Fate decided otherwise, but he was grateful to Natalya Veniaminovna for the attention that she had given him.

After graduating from the VUZ he was sent to the USSR Academy of Medical Sciences All-Union Cardiological Center Institute of Cardiology, to the clinical-functional department, led by professor N.M. Mukharlyamov. The 10 years that he worked in this scientific collective became for Oleg At'kov years in which he established himself as a research cardiologist. He went to the institute when his colleagues were developing Soviet echocardiography and introducing it into clinical practice.

"Oleg showed a great interest in this work," N.M. Mukharlyamov told us. "His personal curiosity, persistence and tenacity, and his purposefulness and passion for research attracted attention. He was the first in the Soviet Union to use two-dimensional echocardiography to do real-time studies of heart anatomy and function. In ischemic heart disease the method makes it possible to study the function of the damaged and undamaged parts of the heart and its compensatory abilities."

This research formed the foundation of O.Yu. At'kov's candidate dissertation, which he defended in 1978. In the same year he was awarded a Komsomol prize for the development and introduction of ultrasound methods for the diagnosis of the main heart diseases.

A sociable, kind and sympathetic man by nature, Oleg is always ready to help his comrades, helping to master a new method or explaining a difficult problem to a junior colleague. He is sensitive and attentive to his patients.

"I recall," professor N.M. Mukharlyamov continues, "that we were organizing the first all-union seminar on echocardiography. At'kov delivered lectures and led practical studies. And all this without interrupting his main work. And that, incidentally, is what he still does. The seminars now take place each year. They have, in fact, become an all-union school for echocardiography."

The USSR Academy of Medical Sciences All-Union Cardiological Center has been associated with space medicine for many years. USSR Academy of Medical Sciences academician A.L. Myasnikov stood at the sources of these scientific links.

N.M. Mukharlyamov has been engaged in problems of hypokinesia in cosmonauts since 1961. Specialists at the All-Union Cardiological Center conduct these studies jointly with their colleagues from the USSR Ministry of Health Institute of Medical-Biological Problems. At one stage in the research, work was done to clarify the reserve possiblities of the healthy individual, and echocardiography was the method used. O.Yu. At'kov did this. And so now he was working not in his childhood dreams but in the actual reality, in space, or more accurately, with the problems of space medicine.

The research continued, actively supported by the leadership at the center. With the aid of echocardiography Oleg Yur'yevich studied the response of the cardiovascular system in the lower body negative pressure created in space, using the special "Chibis" suit.

And when the question of a flight by a phsycian arose, At'kov was named among the initial candidates. The state medical commission declared him "Fit for flight."

On the eve of the launch we talked with O.Yu. At'kov.

"My mood is good and I feel fine," he said. "I shall be working in my specialty. I shall try to fulfill successfully everything in the planned research program. I wish the readers of MEDITSINSKAYA GAZETA good health and creative success."

9642
CSO: 1866/86

'SOYUZ T-10' DOCKS WITH 'SALYUT-7'

Moscow PRAVDA in Russian 11 Feb 84 p 6

[Article by Special PRAVDA Correspondent P. Gubarev: "Stars Outside the Windows; A Report from the Mission Control Center"]

[Text] Stars from here actually seem strange and unusual. It was as if someone went through the sky turning on many flashlights and they burn evenly without blinking. You can look at them for a long time trying to find those which blink as they do from the ground, but all shine steadily and coldly.

"A black sky strewn with fiery nails," commented Leonid Kizim and this was his only lyrical digression over the previous days.

Now he has no time for gazing at space landscapes as there is much to do. He would be busy even with six hands. It was a question of "reviving" the station, turning on the instruments and equipment which had been resting since the departure of Lyakhov and Aleksandrov and mothball "Soyuz T-10" which had served them dependably during their flight from earth to "Salyut-7." They had already begun the medical research the basic burden of which rested on the shoulders of Oleg At'kov.

One of the most interesting and still unclear problems is the transition of the organism from the earth's gravity to weightlessness. Each person adapts in his own way to this and who but a doctor could examine this most carefully. And sometimes Oleg's comrades would catch him looking at them and they would feel that they had become the objects of a professional study. But nothing could be done as this was one of the tasks of the researcher cosmonaut and his individual work program onboard the "Salyut-7."

The emotional tension related to the docking had still not abated. The specialists were establishing contact and clarifying the details in the final stage of the rendezvous with the station and Leonid Kizim had to recall the stirring moments of the past day. For him it was not an easy testing but the commander of "Soyuz T-10" emerged from it with honor.

They spotted "Salyut-7" at a distance of 5 km. The station was turned with the docking assembly toward them and everything was going precisely according to schedule. In the docking stage, Kizim assumed control and gently brought the ship closer to "Salyut-7." The TV camera was turned on.

The station looked very attractive against the background of the earth. It was turned almost sideways and seemingly was slipping across a snow-white surface of clouds. Later on a piece of blue sky appeared and the light beacons were flashing.

"I do not see the cross," transmitted Kizim.

"Due to the illumination," commented V. Lyakhov. "The sun is in the way.... You must be very careful and don't hurry...Lenya, more gently," said Vladimir suddenly as if Kizim could hear him.

"More carefully, watch what you're doing," ordered the flight controller Valeriy Ryumin as he was in contact with the crew.

"We have gotten very close," transmitted Kizim, "I am moving the ship away."

He switched on the engines and "Soyuz T-10" moved away from the station.

The two points on the screen in the main hall of the Control Center were rapidly approaching the line over which was tersely written: "Shadow." A few minutes more and the station along with the ship would enter it.

"One of the crew members, Oleg or Volodya, should check fuel consumption..." came the voice of Valeriy Ryumin.

"Roger," repponded Kizim. "I have a good view of the station's lights."

"Good going, Lenya," commented Lyakhov.

"We have played through the situation many times on simulators," said Aleksandr Ivanchenkov joining in the conversation, "so we have no doubt as to the outcome. There is no need to worry...."

But the excitement did not disappear as space, as is known, can come up with all sorts of surprises.

"'Mayaki' report!...'Mayaki' report!" called the Control Center.

But the station was silent. The seconds seemed like an eternity.

Finally, through the static came the voice of Kizim:

"Mating of the objects underway.... We have just linked up."

There was applause in the main hall of the Center. The applause was meant for those out in space. It was praise for their endurance and skill.

...Then a mysterious world opened up for them.

"A sensation of mysteriousness appeared immediately after the docking," related A. Aleksandrov. "At first there was an unusual odor like metal. It seemed to me that it was stuffy in the station but the air there was cool and clean. We turned on our flashlights and floated into an enormous room. It was like a space temple.... We had studied everything on the ground but here the station was new and unfamiliar. ...However, this was an impression of only the first minutes and when the lights came on, the mysteriousness disappeared. Work got underway...."

And the first impression from the station for the "Mayaki"?

"It was a big palace," said Leonid Kizim.

"The previous crew prepared the station well for our expedition," commented Vladimir Solov'yev, "and here it was clean and cozy."

"And easy to breathe!" added Oleg At'kov.

They have a complex and extensive program of work on the orbital complex and the crew of the new expedition on "Salyut-7" has begun to carry it out.

10272
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CHANGES IN 'SOYUZ T-10' CREW WORK SCHEDULE

Moscow IZVESTIYA in Russian 17 Feb 84 p 6

[Article by Special IZVESTIYA Correspondent A. Ivakhnov: "Geophysics Days in Orbit; A Report from the Mission Control Center"]

> [Text] Cosmonauts Leonid Kizim, Vladimir Solov'yev and Oleg At'kov had completely finished activating the orbital scientific station "Salyut-7" and on 16 February began carrying out the program of scientific research and experiments.

Seemingly quite recently we had been escorting the "Mayaki" off on their flight, and at the Control Center we had anxiously watched "Soyuz T-10" rendezvous with "Salyut-7." But the seconds flashed by on the electronic panel in the main hall of the Mission Control Center, they formed into minutes, hours and days, and now it had already been more than a week since the three terrestrials had stepped across the threshold of the space house.

For now the cosmonauts were primarily engaged in preparatory work, reviving the station's systems, checking out the proper working order of the instruments and equipment and readying all of this for work while "Zarya" [Missión Control] was bothering the flight doctor with questions:

"How do your patients feel, as well as yourself?"

"What do you mean patients," said O. At'kov laughing, "they are healthy fellows. We all feel fine. We were told a good deal about the surprises of weightlessness and we were prepared for them but there were no unpleasantnesses. Probably the good training on the ground and the previous experience of the commander were the reasons."

"The crew is getting along fine," reported L. Kizim. "The doctor immediately took us in hand measuring our temperature and pressure and looking for the symptoms of 'motion sickness' although none virtually appeared. The flight engineer who was involved in the development of 'Salyut-7' flew around all the corners of the station and inspected how everything was working. Some instruments in an unmanned mode have gotten a little 'out of the habit' of working but we three have put everything back in order. Now everything is ship shape."

"We are pleased with your work," said "Zarya" praising the "Mayaki." "In the initial stage of the flight you have been the champions in terms of the efficient use of work time and the three of you have done the work of four. But you have a good ways to go and you must work at a pace where you do not become tired."

As the journalists were told by the deputy flight controller, V. Blagov, the experience of V. Lyakhov and A. Aleksandrov had shown that cosmonauts could work much more effectively than was previously assumed. Although not all physicians agreed with this, the present crew had had its workday increased up to 8½ hours, including 30 minutes of preparing the instruments and equipment for work, 6 hours for conducting experiments and observations and an hour of becoming acquainted with documents for the following day's program. Nine of the remaining hours had been allocated for sleeping, 2 hours for physical training and the remaining time for eating, talks with the Control Center, resting and unofficial communications when the crew could learn about family news and share their impressions of their unusual existence.

"The 'Mayaki' are successfully handling the concentrated program," said Viktor Dmitriyevich [Blagov], "and are doing some things beyond it. And this is under conditions where they are still learning about the station. You know how difficult it is moving into a new apartment to get used to the new position of various things in it. And the 'Mayaki' have had their share of disappointments. For example, for 40 minutes they looked for a cable which was 'not in its place.' When on the third day of the flight they 'weighed themselves' it turned out that each man had put on 3 kg. This had never happened before and was impossible. It later turned out that the readings of the mass-meter [scale] had been incorrectly taken..."

There is also another innovation in their flight program. Previously each day the cosmonauts had to shift many times from one type of activity to another, to secure and re-read many logs with assignments, consult various specialists and all of this took up too much time. Now the work will be done in series and for several days running the "Mayaki" will carry out geophysical research while the following several days, for instance, will be given over to repair and reconstruction operations, and so forth. On the 15th of February, when we met V. Blagov, the crew commander had informed "Zarya" the MKF-6M and KATE cameras had been inspected and loaded with film, and the time and the territories which were to be photographed had been ascertained. They were ready to begin the first stage of carrying out the scientific program.

"What will the cosmonaut researcher be doing during these experiments?"

"Oleg," explained the deputy flight controller, "has his hands full. During the entire flight he will watch the temperature, pressure and pulse of his 'patients' and conduct complex medical research, including with an echograph which he helped develop. His mission also includes a careful study of the medical and hygiene conditions onboard the station, so to speak, the crew's environment. Is there a lot of dust in the quarters, where does it come from and where does it pile up, do the fans create drafts which can lead to a cold, are the work areas sufficiently illuminated, are the personal hygiene facilities effective, are the clothing and footwear comfortable--all these are far from minor details and these factors at times determine both the mood of the cosmonauts, their feelings and to some degree the success of carrying out the flight program.

"And if time remains, and this we agreed upon with Oleg, he and his comrades will participate in repair operations, they will replace the air regenerators and so forth. On those days of medical investigations the commander and the flight engineer will be completely under his control."

...About every 30 minutes the orbital scientific complex "Soyuz T-10" and "Salyut-7" made a trip around the earth and during each communications session the "Mayaki" shared with "Zarya"new impressions, often jokingly, and this showed their good mood:

"We flew over Africa and saw Kilimanjaro!"

"And Volodya even spotted a leopard...."

10272
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COSMONAUTS BEGIN RESEARCH PROGRAM ON 'SALYUT-7'

Moscow PRAVDA in Russian 19 Feb 84 p 6

[Article by PRAVDA Special Correspondent V. Gubarev: "The Rhythms of Space; A Report from the Mission Control Center"]

[Excerpt] "Space rhythms are quick, unexpected and different," commented Vladimir Solov'yev. "Peace and quiet was only something to dream of, as the poet said."

The "Mayaki" had already fully readied the orbital station for work and were beginning the first series of geophysical research. With the aid of MKF-6M and KATE-140 cameras they were surveying various regions of Central Asia and the route of the BAM [Baykal-Amur Mainline], Kazakhstan and the Far East.

"Everything is going according to plan," commented the deputy flight controller V. Blagov. "We have somewhat 'hardened' the demands on the crew by increasing their working time. Duties on board have been distributed in such a manner that certain experiments and research are to be carried out in parallel. Now there are three men on board and they can do much more. We see an important task of the expedition of the 'Mayaki' in this, that is, increasing the output of the crew and hence the effectiveness of the work done by the cosmonauts. In particular, now the so-called 'work zone' lasts 8 hours and 30 minutes. Of this time 6 hours are spent on experiments, in the morning 30 minutes are allocated for preparing for them while in the evening around an hour is used for a detailed study of the program for the following day. The night before the cosmonauts fully prepare the equipment for work, loading the films and casettes, selecting the research conditions and preparing the documents. This helps them get right to work in the morning immediately after getting up."

"I would like to mention one other particular feature in the expedition," continued Blagov. "The research program has been organized from 'units.' For example, during the flights of Berezovoy and Lebedev, Lyakhov and Aleksandrov, the geophysical or astronomical research was carried out over an extended time, for 2 weeks, 3 and sometimes even a month. This made it possible to save time and the research was also deepened, as specialists back on earth could more carefully analyze the results and give recommendations to the cosmonauts in the course of the flight. We have maintained this principle also for the 'Mayaki'."

It must not be thought that now merely geophysics has prevailed on board the station. Of course, the commander and flight engineer are giving basic attention to the photographs, but there also is Oleg At'kov. He has his own program and each day he examines the crew, follows up on the medical and hygiene conditions on the station and helps his comrades. In truth, during the communications sessions his voice is heard less often than that of the commander and the flight engineer as so far there have not been any "medical days." But Sunday is the first of them and the crew physician will report in detail on his observations to colleagues on the ground.

"The presence of a physician on board makes the work of the 'ground' medics more effective," said Doctor of Medical Sciences A. Yegorov. "After 2 days, At'kov radioed that the crew's adaptation to weightlessness had essentially ended. For the physician more profound research has been planned in space medicine and biology and he has already begun to carry this out. Generally, we now can have a professional talk from space and this is very important."

Ten days have passed since the launch of the "Mayaki." To a definite degree the character of each crew member has already become apparent. As might be expected, Leonid Kizim is carrying out the flight program very carefully. He allows no one to rest, either his comrades or the Mission Control Center until the day's program is completely carried out. This is particularly important now, at the beginning of the expedition, since the "Mayaki" have still not fully mastered the station. Certain instruments they must look for not for 5 minutes, as the instructions state, but longer. Seemingly this might justify various delays. But Kizim was inflexible.

For Solov'yev the handling of flight documents was a very familiar matter. Operators from the Control Center learned this immediately. They merely had to name a certain page in the flight log and Solov'yev could immediately tell them what was written on it. For he is the author of many flight books, participating in the preparation of the documents for "Salyut" and hence in space he must re-read what he wrote at one time on the ground....

Ten intense days of the flight of the "Mayaki" are over. The rhythm set by their expedition is a very intense one. But neither the cosmonauts nor the Ground intend to ease up on it....

10272
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DOCKING OF 'PROGRESS-19', MAPPING AND SURVEY WORK

Moscow IZVESTIYA in Russian 25 Feb 84 p 4

[Article by A. Ivakhnov, special correspondent for IZVESTIYA: "For the Mayaks: Special Report from the Flight Control Center"]

[Text] The communications session got off to a strange start on the eve of the docking of the "Progress-19" cargo ship with the orbiting spacecraft "Salyut-7"--"Soyuz T-10" complex.

"'Zarya'", drawled space crew commander L. Kizim. "We...see...the...car-go... ship...in...the...mid-dle...of...our...screen. It...is...still...just...a... lu-mi-nous...point."

"Lenya, we have good reception. You can talk in your normal voice," laughed the radio operator at the flight control center.

The cosmonauts laughed too.

"We though we were going to relay our communication through the 'Kosmonaut Pavel Belyayev' using the 'Sapfir' [Sapphire] system.

But the time came to get down to business, and the fun was postponed until later.

"After braking, the ship's speed has dropped to 8 kilometers per hour. It's about 2 kilometers from us," the Mayaks reported. The TV screen had shown its retrorockets flare on. The docking mode was in progress as the craft was over the Mediterranean. At the control center we saw "Progress-19" on the TV screen with the earth rotating in the backgound. It was fast looming larger on the screen, filling it entirely before becoming too large for it to hold. Finally, the picture became motionless.

"There's contact," volunteered one of the Mayaks.

"Everything is fine," the flight director told the cosmonauts. "Go on with what you were doing. The cargo hatch can't be opened until midnight, but the schedule calls for you to be asleep then. So, you can get your goodies tomorrow morning. You'll have to be patient."

When the communications session with the Mayaks was over, the deputy flight director, V. Blagov, came into the room reserved for journalists.

"You want to know, of course, what the cargo ship has delivered into orbit, don't you?"

"There are 2,094 kilograms of the most varied cargo. There are 800 kilograms in the refueling section. This consists of fuel, oxidizer, oxygen and water. The rest is dry cargo, consisting of consumables for the life-support system and more than 300 kilograms of food. I should mention that none of the three is suffering any loss of appetite. They are eating well, and the food caterers are trying to satisfy their every wish. There is mail too, of course: newspapers, letters and parcels from relatives and friends."

"And the third cargo category includes movie and photofilm supplies, lots of new scientific instruments--medical instruments for the most part. At the request of Oleg At'kov, a portable cardiograph of new Soviet design was delivered to the spacecraft. You are already aware that there is an echo-cardiograph on board by means of which the beating heart of a cosmonaut can be seen on the screen both at the space station and on earth in the medical center. Oleg had suggested doing cardiograms in order to furnish earth with more complete information along with these visual displays. The cargo ship also delivered to the station many Indian instruments which will be used by the cosmonaut from India during his work in space."

"Progress-19" will remain in orbit until the end of March. This is why the Mayaks are in no hurry to unload it. Formerly, about 3 days were set aside for the unloading work, and the cosmonauts did nothing else. This time the crew will get instruments and equipment from the cargo as they need them and will basically continue to do the research projects. The 24th of February, in particular, is scheduled for photographing the Crommelin comet, which is approaching our planet. The Mayaks will orient the "Salyut-7" station in space with the utmost precision and then shut down the power units and lighting--in a word, everything that might impede the filming.

Scientists wanted this job done because experience in this kind of work is very important for organizing observations and photographing of Halley's comet next year. After finishing this, the Mayaks will survey the earth's surface. We were told about this by A. Koval', section head at the "Piroda" State Scientific Research and Production Center.

"Journalists usually want to hear figures: how many millions does the national economy receive in benefits from space photography? How many mineral deposits have been discovered as a result of such satellite surveys? You can't spot any underground treasures from space, but when it comes to ring structures, fissures and other geological features of the earth's surface that might signal mineral deposits, well, we have found a good number of them that scientists had not suspected before, both in our own country and in the German Democratic Republic, Cuba and other fraternal countries. Prospecting in these regions has already led to the discovery of a large number of mineral deposits, for instance, in the Fergana intermountain depression, the Volgograd oblast and the Kazakh Republic. The economic benefits of geophysical studies are great, but you'll have to get the exact quotes on these benefits from the organizations that use this information from space. And there are many hundreds of them now.

"But there are projects that, for some reason, journalists write very little about. The most promising of these is the program to make a complete inventory of our country's natural resources. On the basis of photographs and observations made by the cosmonauts, a complete set of maps has been made of several regions, maps that furnish a complete picture of a region's geological formation, vegetation, water resources etc. Depending on the features of a charted region, there may be 10 to 20 such special maps. We have already prepared the first set of maps of this kind, and any branch of industry will find something that is useful in them.

"At the request of our Mongolian comrades a large album of special maps of their country has been developed. These maps help reveal which regions have development potential for agriculture and cattle pastures.

"The second important direction of our efforts is the updating of geographical maps. It once took 20 to 30 years to compile maps of large oblasts or krays. Over that span of time, the hand of man or other forces change the coastal and landscape features and the vegetation, new cities are built, and it happens that the new map does not fully correspond to the reality of the area. These inaccuracies can lead to planning errors and inefficient use of our natural resources. We are trying to update the maps every 5 years.

"The Mayaks' flight program includes surveys of the southern regions of the Ukraine, Transcaucasia and Central Asia. On the eve of the Soviet-Indian flight, the first space observations of India's territory are being conducted. Our Indian colleagues are planning to make a complete study of the natural resources of their country. They are especially interested in the river drainage system of the Himalayan area and sites suitable for the construction of hydroelectric plants, the geological structure of the mountainous regions, the condition of forest tracts, the degree of pollution in coastal water areas etc."

Our conversation came to an end, and the Mayaks' voices could be heard again in the loudspeakers: "We are at work but we keep looking over at the door to "Progress-19". We can't wait to open our airmail packages."

9992
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COMET STUDIES, MEDICAL RESEARCH ON 'SALYUT-7'

Moscow PRAVDA in Russian 27 Feb 84 p 8

[Article by A. Pokrovskiy, special correspondent for PRAVDA: "For A Rendezvous With the Comet: Report From the Flight Control Center"]

[Text] It is not a large collective--the one working in near-earth orbit. But its work, too, has to be scientifically organized. Perhaps even more there, since they have to follow a strict "regular schedule" in carrying out the missions prepared by numerous scientific organizations. Specialists on earth are intently watching the activities of the "Mayaki" in order to understand the potential capabilities of the crew for more effective utilization of the space equipment entrusted to it.

"The crew is successful," concluded V. Blagov, deputy flight director of the initial phase of the work. "Kizim's punctuality, Solov'ev's excellent knowledge of the on-board documentation and instruments and the presence on board of 'the house doctor,' At'kov, have enabled the crew to become a highly productive research team. With the complete consent of the physicians, we have even allowed them to prolong their workday. There have been no ill effects. They have not lost their appetite. Apparently, they have even added weight. This means that they are not working to the detriment of their health."

And on the subject of appetite:"Progress-19", which recently docked with "Salyut-7, has refreshed the on-board food supplies--even catering to the individual tastes of the crew members. So, the Mayaks' needs have been provided for in this respect. But in organizing their work for "modular" performance of uniform experiments, there were some novelties again. The control center recommended that the unloading be carried out differently. The crew is not working at it for several days continuously, as was the rule earlier, but is laying in its supplies in stages, while also carrying out the scientific research projects. And here, in the interests of the cause, curious divisions of labor have occurred. Oleg At'kov, in addition to the medical examinations of his colleagues, had assumed the main chores of "housekeeping" and has now become the chief cargo handler as well. The commander and the flight engineer are devoting maximum time to the experiments.

One of these experiments has a very distant goal. As everyone knows, Halley's comet is going to approach the earth. Scientists are planning to study it from spaceships. Such experiments have never been conducted before and, of course, demand careful preparation. It is therefore very opportune that another celestial wanderer, the Crommelin comet, is approaching our planet along a similar trajectory. L. Kizim and V. Solov'ev are now photographing it, using a supersensitive French device called Piramig. These photographs will permit specialists more accurately to determine the levels of light intensity and other natural conditions during work with Halley's comet.

Because the Piramig requires a certain orientation of the spacecraft, the Mayaks are taking advantage of this situation and changing from astrophysical to geophysical studies as they continue the photographing of our planet.

Meanwhile, At'kov has also found more work to do. "Progress-19 delivered a cardiograph to supplement the on-board echocardiograph. It can read out data on a paper scroll. This means that the doctor on board is able to conduct a detailed examination and make conclusions concerning the state of the crew's health. "Salyut-7" is also equipped with a medical device prepared by the Indian contingent.

It is understandable that during conversations with earth now the Mayaks not infrequently ask how the Soviet-Indian crew is doing. Yu. Malyshev, G. Strekalov (substituting for the ailing N. Rukavishnikov), R. Sharma and the second crew consisting of A. Berezovoy, G. Grechko, R. Mal'khotra are successfully completing their training on earth and are also looking forward to a meeting in orbit.

9992
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FEOKTISTOV: SPACE PROGRAM READY FOR MANUFACTURING SHOPS IN ORBIT

Moscow PRAVDA in Russian 1 Jan 84 p 3

[V. Gubarev article: "A Plus for the Earth's Resources. Cosmonautics at New Year's"]

[Excerpt] Science fiction: the attempt by the human intellect to look into the future, to stimulate the thirst for knowledge. But the belligerent space monsters that appeared so abundantly last year on the American cinema screens have nothing to do with this. And their appearance is hardly fortuitous. An obvious attempt is being made to accustom viewers to the ideas being hatched by the Pentagon to militarize space and take the arms race beyond the confines of our planet. It is remarkable that in each of these movies there are documentary clips showing the launching of the "Shuttles."

"Will the militarization of space do any harm to the development of cosmonautics for peace?" That was a question asked of the "Salyut-7" crew at a recent press conference in Moscow.

"No matter how certain so-called 'specialists' try to prove that the arms race is promoting scientific and technical progress," Aleksandr Aleksandrov replied, "they cannot fly in the face of the obvious facts. Weapons development requires enormous funding, enormous effort on the part of scientists and designers, and stepped-up work by the industrial enterprises. And ultimately all this turns out to be unnecessary and indeed harmful for mankind. And this is particularly true of space. We stand before a secret world where so much is unknown, where man is fully capable of employing his talents and all the achievements of Earth. K.E. Tsiolkovskiy said that the riches beyond Earth should be added to the riches of Earth. This is the meaning of cosmonautics."

Vladimir Lyakhov and Aleksandr Aleksandrov worked aboard the "Salyut-7" for 150 days. So the "first stage of space" is orbiting the Earth.

"A broad search is underway," professor K. Feoktistov remarks. "The basic directions of applied research have already been defined. It is essential to carefully calculate precisely what work is most profitable to carry out aboard orbital stations. Thanks to the long-duration missions of the "Salyut-6" and "Salyut-7" stations we can now definitely say that in orbit it is expedient to organize a whole range of production facilities, for example, to obtain certain semiconductor materials, medicines and so forth. V. Lyakhov and A. Aleksandrov's 1983 mission has confirmed that complex assembly work can also be done by today's cosmonautics. [no closing quotes--ed]

Workshops in weightless conditions are no longer fantasy. Soviet cosmonautics has gained great experience in the field of space technology--the total number of experiments in weightless conditions runs to hundreds. It is now known precisely which kinds of materials and alloys it is expedient to make in orbit.

Foreign scientists are worried about the very frequent cases where astronauts get "seasick": it has happened that during missions crew members lose their work capacity completely. The experience gained in our country shows that the discomfort associated with spaceflight factors can be reduced if provision is made for a whole series of prophylactic measures, and also if use is made of a special method of training for the launch. Even just a few days after their 150-day mission Lyakhov and Aleksandrov felt quite satisfactory, and after 2 weeks, when they flew to Moscow they had "quite forgotten about weightlessness," as the flight engineer put it. This is undoubtedly a major achievement for Soviet medical and biological science.

Enormous experience has also been gained in studies of the Earth's natural resources, in which crews' visual observations play a major role. Comprehensive studies are conducted regularly, that is, studies conducted simultaneously by cosmonauts and by expeditions on aircraft and ships, geologists and so forth. These kinds of studies are essential for the most varied fields of the national economies of the socialist member-countries of the "Intercosmos" program.

"The studies conducted about one month after the start of the mission are particularly informative," A. Aleksandrov thinks. "By then the eyes have fully adapted to the unusual conditions and visual acuity is improved. I am certain that the future of cosmonautics is in long-duration flights."

The 150-day mission of V. Lyakhov and A. Aleksandrov last year was a major event in cosmonautics. The scientific program that they completed was so extensive and varied that it will undoubtedly consolidate the leading position of our science in many fields of space research.

9642
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DEPUTY FLIGHT DIRECTOR BLAGOV ON 211-DAY FLIGHT OF BEREZOVOY AND LEBEDEV

Moscow ZEMLYA I VSELENNAYA in Russian No 5, Sep-Oct 83, No 6, Nov-Dec 83

[Article by V.D. Blagov, deputy mission controller: A Space Marathon"]

[No 5, Sep-Oct 83, pp 9-13]

[Text] The longest flight--211 days--in the history of cosmonautics completed by A.N. Berezovoy and V.V. Lebedev has brought outstanding results. This was largely facilitated by the selfless and highly professional work of all those who prepared the "Salyut-7" station for flight and who worked on it, in particular the specialists at the flight control center.

FCC: the Flight Control Center.

Up to 1967 those who engineered and developed space equipment were the ones who controlled the flight. At that time this was a related specialty for them. In time, space equipment became more complex and the flight duration of the stations stretched to several years; and the engineer-designer could no longer be a pluralist otherwise he simply would not have enough time to develop new space equipment. It was necessary to set up a special service. It included young enthusiasts who had decided to devote their lives to a difficult but attractive matter that requires the most profound knowledge of space equipment and the ability to orient oneself quickly in complex situations and make correct decisions on an operational basis.

By October 1973 there was already a solid collective, with great experience in controlling flights by the "Zond" and "Soyuz" vehicles and the "Salyut" stations, which this year will celebrate its 10th anniversary. It now includes groups for program planning, ballistics and communications with crews, analysis groups for the operation of onboard systems and backup for the operation of the "Del'ta" system, an experimental support group, a station command transmission group, and so forth. There is even a crew psychological-support group, which is engaged in organizing crew leisure: the selection of sound and video recordings for transmission to the station during rest periods, and the organization of crew meetings with their families and well-known figures in science and the arts.

Documents from 60 designated lists dealing with various aspects of the acitvities of "Earth" and the crew pass through the hands of flight control center associates. Before anyone is permitted to control a flight he must spend one or two months in training that simulates hundreds of unusual situations. Everything is done in such a way as to simulate an actual mission. By the end of training the specialist is already so involved in the work that sometimes he cannot tell whether he is still in training or whether a real mission has started.

It takes years to gain this valuable experience, during training and during real missions and the successes and the unusual situations which, unfortunately, still occur during the operation of space equipment. Recommendations for finding solutions to unusual situations are worked out even before a flight. By now several hundred unusual situations have been examined. They have been collected together in what they call the "red book," which the crew and the controller always have to hand. Among the specialist controllers the opinion prevails that if it can be included in the "red book" an unusual situation will never occur in real life. But this is not so. Eliminating such situations is simpler and faster if they have been analyzed beforehand. The reaction to them is directly determined and worked through many times on the ground, and the controller is familiar with them even before a mission. Unusual situations that have not been considered are more complex cases. Personnel have not encountered them previously either in training or during the course of a mission. There is only a certain stereotype reaction; specific recommendations are unavailable and are worked out during the course of the mission, depending on the situation that has arisen. But it is precisely in these situations that the qualities essential for the specialist controller are most fully displayed: the ability to remain unconfused and to establish, using incomplete information, how the malfunction affects crew safety and fulfillment of a program; and to localize the unusual situation in the minimum time possible and offer the crew a recommendation. The solution to an unusual situation is found through the joint efforts of the crew and the "ground."

The Cosmonauts' Home in Orbit.

Late at night on 10 December 1982 the longest expedition in the history of spaceflight ended on the "Salyut-7" station. A.N. Berezovoy and V.V. Lebedev, having successfully completed the planned program, returned to Earth. The crew brought back rich scientific material: still and movie film, magnetic tapes, flight journals with the results of research, biological objects on which experiments had been conducted. From the moment of the launch of the "Soyuz T-5" (13 May 1982) to the landing, the cosmonauts had been in flight for 211 days and 9 hours, or about 7 months (we note that this is long enough for a return flight to Venus).

But the "Salyut-7" station remained in flight. All was prepared to receive the next crew. It took about 3 days to do this. Movable equipment was stowed in its proper place behind the panels. A detailed inventory of the stowage was brought back to Earth. One copy of this inventory was left on the station together with the traditional letter for the new inhabitants. The engine was fueled. Worn-out parts on ventilators and air regenerators were replaced and filters renewed. Equipment that will not be used during the unmanned flight was switched off (the air regeneration system, the water-supply system, some of the scientific equipment, the communications system, the lighting system). The "Del'ta" system, equipped with a minicomputer, which was thoroughly "worked out" during this flight, was switched off.

A television camera was aimed at the entry airlock, waiting for the new crew, which will continue work at the station. Until the new crew arrives, two likeable "matreshki" dolls, Ivan and Mariya, have been left in symbolic charge of the station...

We recall that the "Salyut-7" station was put into orbit on 19 April 1982. By the time the expedition was complete the station had been in orbit for 235 days, circled the Earth 3,722 times and flown 158 million kilometers, which is more than the average distance from the Earth to the Sun. More than 3,500 communications sessions had taken place, more than 1 trillion bits of scientific and service data had been received via the telemetry channels, and about 1.5 million data bits had been transmitted to the station.

Until June 1982 the "Salyut-6" station with the docked "Cosmos-1267" was also in orbit. The flight control center worked in turn with the two stations. The planes of the orbits for "Salyut-6" and "Salyut-7" were about 90° apart. When the "Salyut-6" station was flying over the western part of the Soviet Union the "Salyut-7" would only just be coming into the zone of visibility for the tracking stations located in the eastern part of the country. This insured an even workload for the ground tracking stations and the flight control center. The "Salyut-6" flew for twice as long as originally planned. Many station systems were replaced or repaired during the process of work aboard it, and as a result the station remained suitable for work in manned mode, although with reduced effectiveness because a number of irreplaceable systems and units had worn out (solar batteries, ports, the external passive heat shield, the submillimeter telescope).

The "Salyut-6," however, continued its flight in order to test out its systems to the limits, under critical loads and unusual situations simulated from the ground. At the completion of these tests on 29 July 1982 the "Salyut-6" station ended its existence in orbit and fell into the southern part of the Pacific Ocean.

The first manned staged aboard the "Salyut-7" has ended, but life aboard the station continues: many of its instruments have been operating, maintaining temperature conditions, taking telemetry readings, and measuring trajectory parameters. The solar electric power station has been operating continuously, and also some scientific apparatus: the system for recording micrometeorites and charged particles and the microload monitoring; and research has continued on the effect of external conditions on samples of biopolymers and structural materials mounted on special platforms outside the station.

Not for a day, even in the unmanned stage, has the flight control center ceased its work. Some specialists left the flight control center and after a short holiday set about preparations for the next expedition, while others were divided into shorter shifts and remained working at the flight control center.

When the station is switched to unmanned mode, the volume of scientific information being obtained from it drops significantly (this is natural since the station was designed mainly for operation with a crew). For example, during the course of 1 day, two or three communications are held (compared with 16 sessions in manned mode). At this stage the main task for the controllers is monitoring the operation of onboard systems, economizing as much as possible on station resources, and maintaining the necessary orbit height with the aid of corrections. There are several reasons for the mandatory interval between the first and second expeditions. First, it is necessary to process and analyze the materials from scientific studies and the telemetry data brought back. And all the notes made during the mission must be examined and recommendations drawn up for the next expedition. Second, according to the results from the experiments conducted, amendments must be made to the scientific research program for the next expedition and the methods to be used to carry it out. It should be said that during the flight process there were many suggestions from both the crew and the specialists on improving the methods for conducting individual experiments and operations. Experiments that are ineffective are excluded from the program and replaced with others that are more effective. Third, it is necessary to order and fabricate additional apparatus, prepare ground and onboard documentation for the next stage, and carry out additional crew training and training for control personnel.

Thus, for several months of flight in unmanned mode the station is not fully used and the heat-regulation and electric power supply systems just idle.

Therefore, the specialist developers and controllers are always looking for ways to improve efficiency in the operation of the orbital stations. One possible way is increase the duration of the expeditions and decrease the unmanned parts of flight. But this brings its own problems. For example, the measures that have been worked out minimize the adverse effects of spaceflight factors on the human body but unfortunately, still do not eliminate them completely. I think that in the future the duration of expeditions may increase, but for this it will be essential to improve the effectiveness of prophylactic measures and comfort aboard the station, and to develop additional means that reduce the adverse effects of weightlessness on man.

Another way seems more realistic to me: consecutive work aboard the station by several expeditions of middling duration with crew changes taking place aboard the station. This will mean virtually continuous manned flight. Loss of working time resulting from the need to mothball the station before the previous crew leaves and then bring it back to operational status when the next crew has arrived is eliminated. The crew--the station bosses--familiarizes itself with newly arrived scientific apparatus and the features of working with it right there aboard the station, and can give the replacement crew a handover briefing, just like they do at the flight control center.

The designs of the "Salyut-6" and "Salyut-7" have much in common. But the experience gained by the long-duration expedition aboard the "Salyut-6" required the introduction of a number of changes in the "Salyut-7" station (see ZEMLYA I VSELENNAYA No 6, 1982, p 11--journal editor).

The "Niva" onboard television was developed in order to record the results of experiments. This enables images to be recorded on video tape and later transmitted to Earth via a television channel. Thus, specialists at the flight control center can familiarize themselves with the results of visual observations and medical and biological experiments on an operational basis during the course of an actual mission. In addition, the "Niva" has also been used as a means of psychological support: it includes a set of video films sent from Earth, which is being constantly renewed.

But perhaps the main feature distinguishing the work both of the flight control center with the station, and of the crew is the use of new methods for orienting and monitoring scientific apparatus with the aid of the onboard "Del'ta" system. It was also mounted aboard the "Salyut-6" but was used there mainly for work to check out its various modes. The availability of an onboard minicomputer has freed the crew from secondary operations, giving additional time for scientific studies. In accordance with a program written in from Earth or by the crew, the "Del'ta" controls radio equipment during the communications sessions and orients the station on any given source in the sky, and then saves fuel and time by bringing the station onto a second or third course along the shortest route, thus saving fuel and time; this cannot be done manually. The "Del'ta" computes the coordinates of any observed source from data obtained by the cosmonauts with the aid of a sextant. The "Del'ta" has considerable capacity for calculating the parameters for the movement of the station from measurements made by onboard facilities. The crew uses these data when conducting scientific experiments. Thus, it was possible virtually to eliminate the transmission of ballistic data from Earth. On the other hand, the flow of digital data transmitted to the "Del'ta" via a radio channel for carrying out orientation regimes has been considerably increased, and so the load on the ground services has also increased. It has become possible to write programs to the "Del'ta" on an operational basis. Technology for planning flight operations has also changed: it is possible during the course of a flight to improve the methods for conducting experiments, but special test benches are needed back on the ground to check the new regimes. No new regime has been realized on the station without a mandatory check of it on a test bench analogue of the "Del'ta."

I note two other features of this flight. Twice (when a visting expedition was present) five cosmonauts were working on the station. Program planning and the distribution of functions between them in the main confirmed the correctness of the preflight decisions. Some things had to be amended during the course of the flight. In particular, the scheme for locating the "PSN" [Photographie du Ciel Nocturne--ed] and "Piramig" instruments and the astrotracker and the sextant at the ports on the station was altered because when they were working in accordance with the scheme adopted earlier the cosmonauts got in each other's way. During training sessions on Earth this was not obvious.

During the descent, when the "Soyuz T-7" braking engine was operating, for the first time there was direct communication between the crew and the flight control center via a geostationary "Raduga" satellite.

As a result of the analogue-to-digitial conversion of signals and subsequent reverse synthesis (at the flight control center) the cosmonauts' voices acquired a metallic tone similar to the synthesized voice of a robot. A certain skill is required to understand this kind of speech. For this purpose, for several days special training was carried out. In short, each flight brings something new, enriches the experience of specialists at the flight control center, and improves efficiency in the use of space facilities in the interests of science and the national economy.

Planning the Flight Program.

The flight program for this expedition (like the others) was worked out long before the launch. Input data for it were requests for experiments from the scientific organizations, the ballistic scheme for the flight, obtained from the planners (characteristics of station orbit and their variations, range and number of orbit corrections, the light-and-darkness situation, the visibility of celestial bodies and ground landmarks and so forth), the dates for the launch and the duration of the expedition's flight, fuel reserves, and the schedule for the delivery of freight. First the dates were planned for the dockings, refuelings, maneuvers and landings. In accordance with the rules established at the flight control center, in order to insure high reliability for the crew's descent from orbit, one condition must be strictly met: at the moment when the braking engine of the "Soyuz T" vehicle is switched on the surface of the Earth at the subsatellite point (the southern part of the Atlantic Ocean) must be illuminated by the Sun so that the crew can monitor the correctness of the vehicle's position through the optical sighting device (the vector for engine thrust must be set against the vector for the vehicle's orbital velocity). It is easy to imagine the uncorrectable consequences that could result, for example, from a braking burn in the opposite direction. The interval within which this condition is met lasts about 28 days and is repeated every 56 days.

There is another condition, but this, true, is not as strict as the first. It is desirable that it be light in the calculated landing area at the moment when the crew lands; this makes the work of the search and recovery service easier. The duration of these intervals is also about 28 days, and the intervals are repeated every 56 days. The flight organizers try when possible to take this condition into account. But because of the relative shift of the intervals during which the surface of the Earth is in daylight in the braking region (the Atlantic Ocean) and in the landing area (Kazakhstan), the total interval in which both conditions are met is of short duration (about 5 days), and it is not always possible to meet this.

Then, proceeding from the conditions for the completion of experiments, possible ranges ("windows") for conducting each experiment are determined. Consideration is given to the constraints imposed by the station's onboard systems and the external situation on the fulfillment of experiments, and also to what can be done by the crew, and crew labor and leisure. As a result a matrix is obtained for experiments and service operations. Then the experiments are spread through the flight time, starting with the experiment that has the highest priority. In this way a flight plan, as we call it, is created.

Because the list of experiments proposed is usually too long, experiments that do not fall within the flight plan are listed as reserve experiments. Two or three backup plans are similarly compiled.

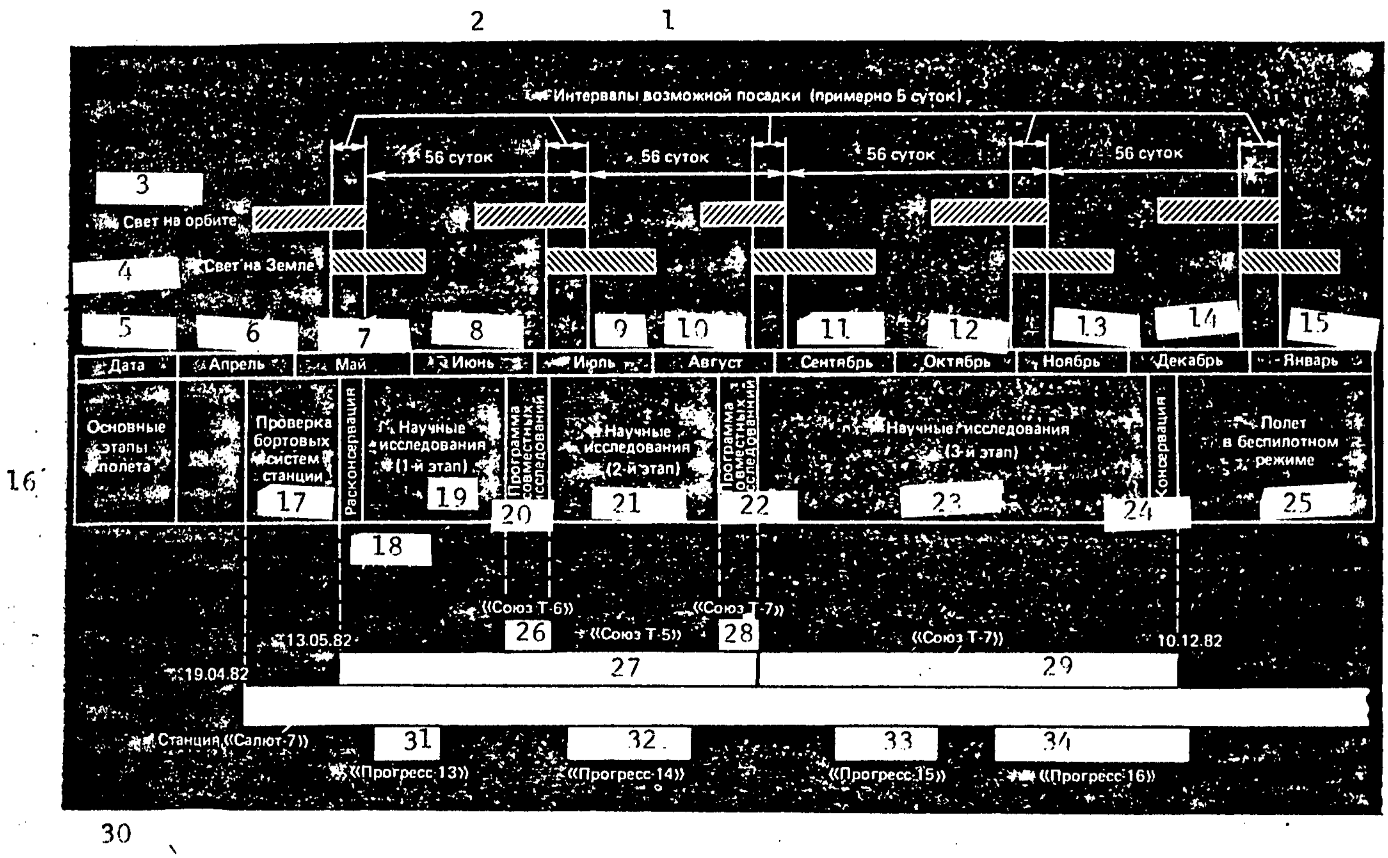

Figure 1. Flight Plan for A.N. Berezovoy and V.V. Lebedev.

Key:
1. Intervals for possible landing (5 days)
2. 56 days
3. Light in orbit
4. Light on Earth
5. Date
6. April
7. May
8. June
9. July
10. August
11. September
12. October
13. November
14. December
15. January
16. Main stages of flight
17. Check of station onboard systems
18. De-mothballing
19. Scientific research (first stage)
20. Program of joint research
21. Scientific research (second stage)
22. Program of joint research
23. Scientific research (third stage)
24. Mothballing
25. Flight in unmanned mode
26. "Soyuz T-6"
27. "Soyuz T-5"
28. "Soyuz T-7"
29. "Soyuz T-7"
30. "Salyut-7" station
31. "Progress-13"
32. "Progress-14"
33. "Progress-15"
34. "Progress-16"

During the course of a mission the need may arise for revise the plan because of changes in external conditions (for example, heavy cloud cover above a region to be photographed), the unforeseen malfunction of scientific apparatus, and operational reevaluation of the priority of experiments from results obtained in an earlier stage, or any changes in the duration of the mission. Because of this the cycle of long-term planning is also repeated many times during the mission (about every 3 or 4 weeks).

[No 6, Nov-Dec 83, pp 18-22]

[Text] The scientific program consisted of three stages of research for the main expedition and two for work completed jointly with a visiting expedition.

After the station had been put into orbit, in the first, unmanned part of the flight its onboard systems were checked: orientation, stabilization, the combined engine installation, the heat-regulation system, electric power, the onboard radio complex, onboard automatic devices, scientific apparatus. A particularly careful check was made of the "Del'ta" system because of the great hopes that were being placed in it. The checks showed that the onboard systems were operating normally, but in some cases the method for work with the "Del'ta" had to be made more precise. From the results of the tests permission was given for the launch of the "Soyuz T-5" vehicle. On 14 May the "Soyuz T-5" docked with the station. After transferring to the station and conducting an external examination of its compartments, the crew transferred the containers for the biological experiments to the station and started to de-mothball and check the radio communications and life support systems, the station's system control boards and scientific apparatus, and the manual regimes for controlling the station and the operation of the "Del'ta." When de-mothballing of the station was complete, the cosmonauts started the scientific program: they studied the Earth's surface and atmosphere, conducted astrophysical and medical and biological studies and technical and technological experiments and made visual observations. On the third day the crew launched the "Iskra-2" artificial Earth satellite developed by students at the Moscow Aviation Institute via an airlock--a space first. The satellite is for use by amateur radio enthusiasts in the shortwave range. Crew adaptation to weightlessness proceeded normally and both the crew and the flight control center "settled in."

The "Progress-13" vehicle, launched on 23 May 1982, delivered to the station additional scientific equipment (the "Kristall" furnace and instruments for the Soviet-French experiments), movie film materials, fuel for the combined engine installation, and consumable elements for the life support system. After the freight had been unloaded and the station refueled, an orbit correction sent the "Progress-13" away from the station and it fell into the southern part of the Pacific Ocean.

Within the framework of the Soviet-French scientific program, together with the flight control center the crew carefully prepared the French apparatus that had been delivered by the "Progress-13" and tested the complex of all the systems involved in completion of the research.

One serious problem that the cosmonauts and the flight control center encountered was the need to improve the orientation accuracy for the "PSN" and "Piramig" camera equipment on the objects to be photographed, and also station stabilization during exposure so as to exclude image blurring. As a result, a method was worked out based on the following. The initial bearing of the "PSN" and "Piramig" camera equipment, mounted securely on the station ports, was done by the "Del'ta" system using data computed either on Earth or aboard the station. Then, using the astrotracker instrument and manual control, A.N. Berezovoy made the orientation on the stars more accurate and passed over control to V.V. Lebedev. Working with a sextant, Lebedev insures that the equipment was brought accurately to bear on the object being studied and the orientation was maintained by using a method of low-thrust pulses suggested by cosmonauts L.I. Popov and V.V. Ryumin. In order to insure that the pictures were of high quality A.N. Berezovoy and and V.V. Lebedev suggested that at the exact moment when the exposure was made the stabilization motors should be switched off since the engine bursts would fog the film. Work with the astro instruments required complete dark on the station, and in order to read documentation it was necessary to use a small electric flashlight. When photography of one region of the sky was complete, control was handed back to the "Del'ta," which brought the station to bear on the next region. This method made it possible to orient with an accuracy of 2-5' and stabilize at angular velocities of 5.10^{-4} degrees per second, and obtain high quality pictures of stars down to magnitude 12.5. It was possible to photograph up to three regions during one sojourn in darkness.

The "Soyuz T-6" with a Soviet-French international crew was launched on 24 June 1982. The crew consisted of V.A. Dzhanibekov, commander, A.S. Ivanchenkov, flight engineer, and Jean-Louis Chretien, cosmonaut researcher. Because of the detection of certain features in the operation of the algorithm for automatic rendezvous it was decided to switch to manual control from the 900-meter mark. After the docking and transfer, with the active participation of the main crew, in 6 days the visiting crew fully completed its own scientific program. Thanks to the "PSN" and "Piramig" instruments interesting data were obtained on the distribution of cool stars in the nearest galaxies, the polarization of zodiacal light in the infrared, and the structure of the emission layers of the upper atmosphere. The photography from space made it possible to see that the position of the plane of symmetry for the Andromeda Nebula on infrared photographs is different than on pictures taken in the visibile range. This confirmed the results of ground observations and dispelled scientists' doubts about the possibility of this shift. Using the updated "Kristall-Magma" furnace the cosmonauts studied diffusion of melted lead in solid copper and crystallization of alloys of aluminum and indium which do not mix on Earth.

Using the "Argument" (USSR) and "Ekhograf" (France) instruments, ultrasound location of the heart was performed for the first time in space. In the "Poza" experiment a study was made of muscle response in maintaining an upright posture under weightless conditions, and the "Tsitos-2" and "Bioblok-3" instruments were used to conduct biological studies with microorganisms, spores and seeds (see ZEMLYA I VZELENNAYA No 2, 1983, p 18--journal editor).

After completion of the joint program and the goodbyes to the visiting expedition, the second stage of the scientific research began. One of the main tasks in this stage was an EVA for work outside the station. Out in space V.V. Lebedev removed cassettes with organic and structural materials and the "Meduza" bioinstrument from the surface of the station, along with a panel with traces of micrometeorites impacts, and he set up new cassettes and thermomechanical joints and worked with a special instrument with removable threaded pairs.

Synchronized observations of X-rays sources conducted simultaneously on the station with an X-ray spectrometer and by ground observatories in the optical and radio ranges, were of great interest. About 20 sources were studied in the constellations Cygnus, Scorpius and Sagittarius. A powerful burst of X-ray radiation was first recorded in galaxy NGC 4151 in the constellation Canes Venatici from the station and then in the visible range after an interval of more than 40 days. Data from these studies will be used to construct models of the processes causing bursts from X-ray sources.

Many technological experiments were conducted on the "Kristall-Magma" installations and the new-generation "Korund" installation (this was delivered by the "Progress-14" vehicle). This was the next step in obtaining industrial and technological materials under space conditions. The capsules for the "Korund" are much larger: 300 millimeters long with a diameter of 30 millimeters, and up to 1.5 kilograms of material obtained. The complex electronic and thermomechanical installation required much preparatory work on Earth and in space. There were several disappointments and misfires and it required accurate regulation of the process, but finally through the combined efforts of the cosmonauts and specialists at the flight control center the "Korund" operated smoothly and provided a number of samples of cadmium sulfide and indium phosphite that were returned to Earth and will be used in instruments in the electronics industry. Interesting photographs of Comet Austin were obtained with the French "Piramig" equipment. The cycle of biological experiments was continued. The feasibility of five cosmonauts working together on the station was checked.

On 19 August 1982 the "Soyuz T-7" vehicle was launched from the Baykonur cosmodrome with a crew made up of L.I. Popov, commander, A.A. Serebrov, flight engineer, and S.Ye. Savitskaya, cosmonaut researcher. For the first time in the history of cosmonautics a woman cosmonaut worked on the station. And, naturally, the main attention of the physicians in the scientific program for this expedition was on medical and biological research on the effect of spaceflight factors on the female body. The expedition continued studies started by the Soviet-French crew: the "Ekhografiya," "Koordinatsiya" and other experiments were conducted. The "Tavriya" and "Gel'" biotechnological experiments were conducted aboard the "Salyut-7" for the first time.

The aim of the "Tavriya" experiment was to look for efficient methods for separating biological preparations using electrophoresis to obtain highly pure biologically active substances. The basis of the method is the difference in the rate of movement for charged biological particles in a special dispersed medium called a gel. This leads to separation of complex biological preparations into a number of components. As a result of this experiment it was possible to separate out albumin--one of the most valuable human blood proteins--into five components, which had never been done under conditions on Earth. The processes taking place in the "Tavriya" installation were recorded on the "Niva" video equipment and the images were then transmitted to Earth. In the first experiments some layers of the separating components blurred together because of high-frequency vibration passing from the hull of the station to the "Tavriya." A.A. Serebrov, who had participated in the development of this installation, altered its mounting and in subsequent experiments the effect of the vibration was virtually eliminated. Back on Earth a study of the video recordings of the electrophoretic processes had already yielded certain features. In order to confirm the results and continue these studies the "Progress-16" delivered new containers with the biological preparations for the "Tavriya" to the station.

The group of biotechnological experiments also included the "Gel'" experiment whose aim was to study the effect of spaceflight factors on the structure of biopolymer matrices in gel. Polyacrylamide gel was synthesized on the station; it possessed greater structural homogeneity and this enhances its resolution during the process of electrophoresis. The findings obtained indicate certain features in the formation of the gel under weightless conditions that differ inherently from the gel obtained in laboratories on Earth under gravity conditions. The capsule with the "space" gel was returned to Earth for further studies. The biotechnological experiments confirmed the feasibility of obtaining highly pure biologically active substances in orbit that are inaccessible to technology on Earth. In the future, highly homogeneous gel obtained in space may be used in biotechnological installations on Earth for better purification of biological preparations.

After the Soviet-French expedition had left A.N. Berezovoy and V.V. Lebedev redocked the "Soyuz T-7," moving it to the docking assembly on the forward compartment and freeing the second assembly to receive the next freight vehicle--the "Progress-15." After a short rest the third stage of the scientific program began. It was opened with a series of studies of the gamma background at the station using the portable "Yelena" gama telescope. The intensity of visual observation of interest to geologists and agricultural specialists increased. Specialization was now noticeable. A.N. Berezovoy dealt more with the agricultural problems and V.V. Lebedev with geology.

Geological parties worked in accordance with the recommendations passed on by the crew. Sets of maps with notes made by the cosmonauts were were sent back to Earth with the visiting expeditions. After the necessary analysis, copies of these maps were returned to the station with additional instructions. A large number of video pictures were made in accordance with these instructions and transmitted to Earth via the "Niva." As a result, on the basis of data obtained from space, geological groups in the field were assigned tasks for surveying work, as a result of which sectors promising in the search for minerals were found in the northern Caspian area, Central Asia and in the region of the Baykal-Amur Main Railroad Link.

In accordance with instructions from the agricultural specialists observations were conducted on test regions in Krasnodar Kray. Here three tasks were resolved: determining the dynamics of development for agricultural crops, from the spring sowing to maturity; clarifying whether or not it is possible to distinguish diseased plants on a sector from their coloration; and assessing erosion processes (ZEMLYA I VSELENNAYA No 3, 1983, p 27--journal editor).

From the results of visual observations the crew passed on 78 reports for geologists, oceanologists, meteorologists and agricultural and forestry specialists. About 20,000 pictures of the territory of the USSR were delivered to Earth.

The complex of biological experiments was continued with the "Magnitogravistat," "Biogravistat," "Oazis," "Vazon," "Fiton" and "Svetoblok" installations. Up to that time plants grown on the station had not completed a full cycle of development or borne fruit.

During this mission one of the test plants, arabidopsis, for the first time completed a full cycle of development from seed to seed. The seeds of arabidopsis were sown in the "Fiton" installation in a special nutrient medium, and round-the-clock light was created and the "Fiton" atmosphere was isolated from the station atmosphere using air filters. The plants flowered and about 200 seeds were obtained. Back on Earth some of them were held for a certain time and then planted, and shoots grew. This makes it possible to think that given appropriate conditions plants will be able to go through their complete cycle of development in space and provide valuable seeds. Some seeds will be returned to the station to continue the study.

The crew also had its own garden--the prototype of future space greenhouses. In the "Malakhit" installation the cosmonauts grew dill, lettuce, radish, borage and onions. In the cosmonauts' opinion the biological experiments are not only of scientific but also psychological significance.

During the mission an extensive program of technical experiments was carried out to develop new instruments and control facilities, and studies were made of the dynamic characteristics of the complex in various configurations. Using the "Astra" spectrometer the composition and dynamics of changes in the Earth's atmosphere around the station were determined. The atmosphere turned out to be 1,000 times more dense than previously thought.

The crew launched a second satellite--the "Iskra-3"--delivered to the station by the "Progress-16."

... Day 200 of the space marathon. All planned experiments and even additional requests from scientific organizations had been completed. It was time to start preparing for the return to Earth. Despite the fact that during the mission it had been possible to carry out much laborious and emotionally tense work (seven dockings, one redocking, two visiting expeditions, extravehicular activity, and the reception and unloading of four "Progress" vehicles), the results of medical studies showed that throughout the entire mission the crew's work capacity had remained high; and this means that the crew's work and leisure regimes had been correctly organized and that the prophylactic measures worked out for this unprecedentedly long mission on the basis of experience gained in earlier long-duration flights, had been effective. The last days were given over to training in the "Chibis" vacuum suit, taking inventory of the equipment, checking the "Soyuz T-7" and mothballing the station. Together with the flight control center the descent was rehearsed. A test bench on the ground on which control of the reentry vehicle through the dense layers of the atmosphere was modeled, took part in these rehearsals. Results from the modeling were transmitted to the "Soyuz T-7" via a television channel. The crew simulated manual control in the descent.

On 10 December 1982 the "Soyuz T-7" undocked from the station. The braking engine was burned above the southern part of the Atlantic Ocean. Using direct communications via a "Raduga" geostationary satellite, the crew reported continually on the descent directly to the flight control center. The descent apparatus with the long-time inhabitants of space A.N. Berezovoy and V.V. Lebedev landed at 2203 hours 150 kilometers southeast of Dzhezkazgan. Postflight medical examinations of the cosmonauts showed that the process of readaptation was proceeding normally; all parameters gradually returned to their preflight values and no irreversible phenomena in their health were detected.

Thus, the 211-day space marathon has ended, but the exploration of space continues.

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FOOD SPECIALISTS DISCUSS COSMONAUT DIET

Moscow PRAVDA in Russian 22 Sep 83 p 3

[Article by A. Mal'tsev, designer, and M. Frumkin, candidate of technical sciences: "Space Diet"]

[Text] "Tastes are up to the individual...". We often had to convince ourselves of the wisdom of this saying as it applies to the cosmonauts long before the scheduled long-term expedition on "Salyut-7". Usually several crews train for a space flight, and at a certain stage of this training the specialists determine from the cosmonauts what it is that they themselves would prefer on board the spacecraft--a few more juices, meats or starches, what special favors they have to ask of us, the food specialists. As much as possible we try to take into account the tastes of each cosmonaut in coming up with the food ration. By itself this fact reveals a great deal: the methods and means have been developed recently to provide good quality high-calorie foods for long-term space flights taking into account the individual inclinations of the people who will be on these flights.

Later, during the flight, we are very interested in how satisfied the cosmonauts are with the ration which has been provided them.

According to the balanced diet developed by Soviet scientists, a person must have the following daily rations to maintain normal body function and work activity: water: approximately 2 liters; proteins: 80 to 100 grams (with half of the proteins from animal origin, including meats, fish, eggs and milk products); fats: 80 to 100 grams (including 20 to 25 grams from vegetable origin); carbohydrates: 400 to 500 grams (including 50 to 100 grams of sugar), together with minerals and vitamins.

These figures may vary considerably depending on sex, age, physical activity and other factors, but in general they reflect the body's need for food products.

There is a widely held misconception that it is possible to subsist on a diet in space consisting largely of pills. Moving ahead a bit we will say that all space flight crews take pills, more accurately lozenges, containing only vitamins, which we, by the way, also do in much the same manner on earth by a doctor's perscription. But one of the cosmonauts put it accurately during tests on space food: "One cannot subsist for long on tablets in space. Something more substantive is needed." What he meant was that standard earth food is needed in space. However, space flight has left its mark, and on food as well; hence, the food differs somewhat from standard earth food. Specifically, the shifting of cargo during a flight makes it necessary for the packaging and wrapping to protect the food products from such activity. Also, zero gravity makes it impossible to use such table implements as plates, cups and glasses. When eating in zero gravity conditions it is not necessary to separate the liquids (bouillon, water, milk etc.) from the food products, but this does not mean that the food must be dry, solid, in briquette or tablet form. No, food products must most closely approximate their standard form on earth.

How is it possible to combine these seemingly incompatible properties of the products and the conditions of human habitation?

For more than twenty years, food industry technologists, scientists and specialists have studied and developed various forms, types and groups of food products, and as a result, specialized food production industries were developed for the cosmonauts. All of this literally began from zero. Nine food products with very limited storage lives were developed and tested for Yuriy Gagarin. One of the tasks of the first man in space was to attempt eating in zero gravity. It turned out that it was possible.

A food ration was then proposed for flights lasting from 1 to 4 days. Also included in this ration were products with very limited storage lives: canned meats, the first dinner foods and fruit juices in aluminum tubes and bite-sized pieces of bread.

The "Soyuz-9" spacecraft, which was launched on 1 July 1970 with a crew that included Andriyan Nikolayev and Vitaliy Sevast'yanov, completed an 18-day flight, and contained a device for heating food products in aluminum tubes. This made it possible to prepare hot foods on-board the spacecraft in the form of meal foods and drinks (coffee with milk, etc.).

In 1974 aboard the "Salyut-4" space station a device was developed which made it possible to simultaneously heat products in aluminum tubes, and cans as well as bread, which significantly improved the dinner table of the crews.

Today food technologists, scientists and specialists have expanded the variety of food products, increased their quality, and extended their shelf lives. A six-day ration has been developed which provides a daily four meal course (first and second breakfast, lunch and dinner). Over 70 different products are included in this ration, including twenty types of meat, fish, poultry and cheese in 100 gram cans, together with pureed first and second courses (10 types) in aluminum tubes. There are fourteen types of dehydrated (by freeze drying) first and second courses and garnishes for the canned meats, which may be rapidly reconstituted by adding hot water, bakery products and deserts made from twelve types of semi-dehydrated fruits. The drink selection included fruit juices, tea, coffee, milk and fermented milk products.

Such a wide variety made it possible not only to provide highly nutritious food, but also to take into account the tastes and individual wishes of the crew members.

The make-up of the rations are developed on the basis of the flight duration, the complexity of the program, the anticipated energy use, the food storage, heating and dispensing equipment, the features of the water supply systems and the water reclamation systems, as well as other equipment. Between 16 and 19 types of products are included in the daily ration; these fully meet the food and taste requirements of the individual and provide compensating energy.

It should be said that in space, as on earth, certain food products and even product groups get, as they say, old after a while; hence, in long-term space flights the crew members may select their favorite courses without a significant change occurring in the caloric content of the ration as a whole.

Nonetheless, in long-term space flights, the relative monotony of the diet does become annoying to some degree. In order to eliminate this it was decided as an experiment to send specially prepared fruits and vegetables on the transport and cargo ships.

The first such shipment with fresh apples, onions and garlic was designed for the cosmonauts G. Grechko and Yu. Romanenko. Actually the issue is more one of psychological support, since in terms of the composition and calorie make-up, the cosmonauts' primary ration met their bodies' requirements fully.

It is of no small importance, however, that the diet of the crew in the orbital space station took on a greater variety.

Later, the variety of fresh fruits and vegetables was expanded. Oranges, lemons, melons, honey, cranberries and even fresh cherries were sent at the request of V. Ryumin.

Fresh vegetables and fruits were sent into space on a cargo spacecraft to Vladimir Lyakhov and Aleksandr Aleksandrov. They were no small comfort to the crew which had already spent three months in space.

The carefully developed and balanced diet containing irreplaceable components, and the well balanced calorific state of the ration make it possible for the crew members to maintain a good mood as well as good functional capacity during the entire duration of the difficult and complex work in space.

The high quality and wide variety of the products made it possible to use them in a number of cases on earth as well. They were used to assemble food rations for the participants in the ski expedition to the North Pole, and for the high altitude expedition to conquer Mt. Everest.

As the scope of space research expands, the efforts in the field of food technology are growing and developing; the nutritional value of food products is studied in greater detail, and rations are created with a preventative purpose and a controlled selection of products depending on the various durations of the crew in space, as well as the volume and nature of the work to be accomplished.

12576
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FEOKTISTOV RECOUNTS PLANNING FOR GAGARIN SPACEFLIGHT

Moscow IZVESTIYA in Russian 9 Mar 84 p 2

[Article by Konstantin Feoktistov, professor, Hero of the Soviet Union, pilot-cosmonaut of the USSR, leader of the "Vostok" vehicle design group: "We Have a Launch!"]

[Text] In essence Yuriy Gagarin had two birthdays, 9 March 1934 when a new person was born on Russian soil, and 12 April 1961, when the first cosmonaut on our planet was born. And as we mark the 50th anniversary of Gagarin's birth, mankind celebrates a jubilee in cosmonautics.

It seems to the uninitiated that the road to Gagarin's launch was as straight as an arrow. It was conceived and then done. But it was not quite that way. Yes, the idea of a manned flight in space on a rocket, which many thinkers starting with K.E. Tsiolkovskiy had predicted, became a reality. The idea became the reality with Gagarin's flight. But the road to it was not clear and direct: many technical roads were considered and "smoothed down" before the one road, Gagarin's road, became that historic road.

At first the Korolev design bureau considered not an orbital flight but sending a cosmonaut to a great altitude, followed by a ballistic return to Earth. It was easier technically to perform such a flight but it would be only a timid, fleeting reconnaissance in space. In a ballistic flight of this kind the state of weightlessness would last only a matter of minutes. Even a single revolution in a near-Earth orbit means 1.5 hours of weightlessness.

Even so, U.S. specialists decided to start with a flight along a ballistic trajectory. The United States made two such flights in the Mercury project (on 5 May and 21 July 1961), called suborbital flights, but after Gagarin's flight.

But here, following stormy discussions, it was decided to develop a manned sputnik capable of operating in near-Earth orbit for up to several days and of returning to Earth. All the necessary conditions had to be created for normal life for a human aboard this sputnik.

The task was daring and complex; less than a year had elapsed since the launch of the first Earth satellite. A manned flight called for the highest reliability of the carrier rocket and of the sputnik itself, and for control, life support, and the return to Earth, in essence, all the elements of what is now referrred to as the rocket-space complex. Many of these tasks were being tackled for the first time in history. The problem of the cosmonaut's return from orbit was particularly complex.

To brake an apparatus flying at a speed of 8 kilometers a second--29,000 kilometers per hour--and land it back on Earth was at that time, a task that seemed almost fantastic. Remember that at that time aviation had not long since attained supersonic speeds. And here we had 25 times the speed of sound!

When the apparatus entered the dense layers of the atmosphere a powerful shockwave would be formed ahead of it, and the air in this shockwave would be heated to temperatures on the order of 6,000 to 10,000 degrees. This is hotter than the Sun's surface. What must be done to insure that the apparatus remained whole during this and that the cosmonaut inside was not "fried"?.

This task was a hard nut to crack. And in order to solve it it was proposed that a kind of almond nut design be used. The metal hull had to be tucked inside a "casing" which would burn up and evaporate during the descent while allowing the apparatus itself merely to warm up.

The question was, what exactly should be brought back, the entire vehicle or only part of it? Analysis showed that if the entire vehicle was to be landed intact the weight of the heat shield required for it and the parachute system would exceed all sensible limits. Therefore, the idea arose of dividing the vehicle into the descent apparatus in which the cosmonaut would be located, and an instrument and power unit compartment that would contain the braking engine with its fuel tanks, the control system and the other service systems essential for functioning in orbit.

Given this kind of design for the vehicle it was necessary to provide a heat shield only for the descent apparatus. It is now known that a spherical form was chosen for this.

The question arose of whether the cosmonaut could withstand the g-loads that would inevitably occur during a ballistic descent. The calculations showed that given a smooth entry into the atmosphere at an angle of one of two degrees, g-loads would not exceed 9 or 10 units and would last only about 1 minute. According to data from aviation medicine, healthy individuals could withstand these kinds of g-loads.

The question of the final stage of the landing was extremely complex and controversial. Of course, the ideal would be to resolve the matter with a soft landing. But this is a very complicated matter. It should be noted that the Americans decided not to land their vehicles on dry land, choosing instead the splashdown because it is so complicated to make a soft landing. More time was still needed to reliably develop this.

After several years the soft landing was made here with the "Voskhod" and "Soyuz" vehicles. But for the "Vostok" it was proposed, let us say it directly, to employ a hard but forced method--ejecting the cosmonaut from the vehicle at a height of 7 kilometers. Then the vehicle and the cosmonaut would each land separately.

These then were the main decisions made in April 1958, and by May all the necessary calculations and design developments for the satellite vehicle were complet

Work on the carrier rocket that carried the first satellites into orbit was proceeding in parallel. In 1959 a third, liquid-fueled stage was added.

In November 1959, following numerous discussions the project was submitted to the judgement of a council of chief designers led by S.P. Korolev. After a detailed exchange of opinions it was decided to start on the test and design work for the project.

By the end of the year the first actual vehicle had been fabricated so that all its complex electrical circuits and instruments could be ground tested in order to learn how to handle it. It was quite a stunning sight. The vehicle was specially stripped down so that it was possible to deal separately with the body of the descent apparatus, the instrument compartment and the engines. The instruments were ranged on stands. Outwardly the "Vostok" appeared very simple. But when you looked at its "innards" all laid out they took up a lot of room and gave the impression of jungles made up of numerous cables. In the collective they called this part of the shop the "Tarzan office."

It was here that the collectives of testers and the developers of the onboard systems themselves learned how to handle the new machine. In the winter of 1959-1960 intensive airborne testing of the landing system was conducted. Several "backup versions" of the descent apparatus were fabricated. They were loaded onto aircraft and then dropped while the automatic devices in the landing system were activated, the seat with a dummy strapped in it ejected, and the parachute systems tested. In August 1960 a flight of the vehicle was completed with its first "testers" aboard--the dogs Belka and Strelka. All stages were checked out, from the launch to the landing. A fundamentally new space system, the most complicated ever up to that time, had been developed and tested in less than a year-and-a-half. This unique timetable, of course, was kept only through tremendous work and truly heroic efforts on the part of all those involved in the project, from the worker to the chief designer. Everyone understood that they were part of a new and unprecedented project, and they worked selflessly.

Following the flight of the unmanned vehicle carrying Belka and Strelka, at a meeting with S.P. Korolev there was discussion of how to make a vehicle for a man. New ideas were put forward: it was proposed to simplify the design of the vehicle even more, something dictated by the designers' chief enemy--the strict weight limitations. Korolev was not immediately reconciled to these enforced sacrifices. He asked them to reconsider everything. Then a second meeting took place and the proposals were accepted. This was at the very end of August 1960.

The designers were given only one month to complete the project. In early March 1961 the first flight took place--an automatic flight with no cosmonaut, but using the vehicle in which man was to fly. A dummy--Ivan Ivanovich--sat in the cosmonaut's seat.

And on 12 April 1961 those historic words resounded round the planet: "We have a launch!"

9642
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NIGHT LANDING OF 'SOYUZ-23' COSMONAUTS IN LAKE TENGIZ RECOUNTED

Moscow LITERATURNAYA GAZETA, in Russian 25 Jan 84 p 10

[Article by Gennadiy Bocharov, special correspondent for LG: "A Return From Space"]

[Excerpts] Space flights, like all remarkable human acts, acquire with time an everyday, routine character, even though they remain the sign and symbol of the age. This is natural, for the new cannot stay new forever; it must give way to what is newest.

We have witnessed the birth of space science and know that with all its unusualness, its dash and power, it has not been an exception to this rule. Even the cosmonauts leaving for a flight say: "I'm off to my space job." The road to outer space has of course never been easy, not in its very beginning nor in later years. The way to the stars has always demanded of man the greatest concentration, effort and courage. These demands existed in the past and continue to exist today. Tomorrow will be no different. The challenges of the future will be even more difficult.

We will relate here one of the episodes of this journey, an episode that reveals the meaning of the familiar idea of "heroic efforts."

Since the events described here, the techniques, the entire search and recovery procedure connected with a descent capsule's return to earth, and all space science have been further developed and improved. It is axiomatic that the need to overcome obstacles is the best incentive to progress.

The readers of LG can see from this report what kind of unexpected situations and difficulties can occur for those whose job it is to cope with the distances of outer space. The readers will also see with what courage, concern and self-sacrifice the cosmonauts and their faithful helpers function--the search people, helicopter pilots, communications personnel, doctors--whenever circumstances and the elements of nature suddenly turn against man, thwart his calculations and place unexpected obstacles in his path.

A Report From TASS

"At 9:58 pm on 15 October, the "Scyuz-23" space craft was switched to the automatic approach mode for docking with the "Salyut-5" space station. Due to a malfunction in the craft's approach-control system, the docking with the "Salyut-5 was cancelled.

"The crew is terminating the flight and preparing to return to earth."

The landing area: The descent capsule of the "Soyuz-23" space craft was on its way back to earth with V. Zudov and V. Rozhdestvenskiy on board. It was night in the touchdown area.

The crew of the search plane reported that they had spotted the craft and its descent was normal. The cosmonauts were informed that snow covered the area, that there was wind of squall force and that it was -22°C (this was October). It was not the first night landing. There was some experience with that. But of course there is always the factor of chance. And experience is often no match for chance.

The descent capsule: The cosmonauts were aligning themselves for landing, but the craft swerved in a "soft" air pocket. So? After opening one of the breathing ports, they discovered icy water. Water? Where had they touched down?

There was no doubt that they had touched down on Soviet territory. The question was where exactly. The violent pitching and slashing of waves confirmed that the craft was at sea. The Caspian? They could not have underflown the landing site by that much. The Aral? Not very likely. There had not been a substantial course deviation.

Zudov blasted off the parachute.

There was nothing so amazing in the fact that they made a wet landing. Our space craft--unlike the American--usually make a dry landing on returning from space. But this did not mean that a splash down--even an accidental one--had been ruled out, altogether. Not at all, for each of the cosmonauts always undergoes special training, including training for the event of a wet landing. The descent capsule itself is safe in water. Anything can happen, which is why there is an international agreement on recovering cosmonauts who have come down far from their native shores.

There was no problem with communications.

"We have landed in water. We are unharmed," Zudov radioed to the search plane.

"Rodony!" (Soyuz-23's callsign), the airplane responded, "We have you in sight. You have landed in Lake Tengiz."

The cosmonauts exchanged glances: Tengiz! All around there lay the unending steppe as flat as a tennis court. But chance always has its own peculiar trajectory.

They heard the clatter of the helicopters--now distant, then closer, then farther off. After a while, their sound faded and was gone.

"They can't find you," the plane's radio broke in. "There's a dense fog over the lake. Your flashing light is visible from high altitude but not from low altitude."

After a moment: "You're several kilometers from shore."

A sudden snowfall and freezing temperatures following on 20° C weather had created meteorological havoc over the lake. Surface transportation as well as helicopters had run up against complications, for the marshy shoreline had not yet frozen solid. They were bringing boats to the water, which was covered with icy sludge.

"The situation is clear," summed up Zudov, the commander of the space crew.

Zvezdnyy Gorodok: A festive table was set at the Zudov's apartment, consisting first of the command post and then a somewhat larger room. Everybody was there: Vyacheslav's wife, Nina, their two daughters, Natasha and Lena, Valeriy Rozhdestvenskiy's wife, Svetlana, their daughter, Tanya, the cosmonauts Volynov, Sarafanov, Zholobov, and other friends and comrades. The telephone line from the Flight Control Center was being kept open. They were expecting notice of the landing any moment. No one went up to the table--tradition forbid that.

The telephone rang. They have landed! Then the one speaking with the Flight Control Center lowered his voice, got the details and announced to everyone: "They have landed in water. The recovery will take some time. We'll wait."

The phone was silent. The chandelier difused bright light. A damp fall twilight was gathering beyond the windows. It was midnight at the landing area.

The landing area: "Rodony, Rodony," the plane repeated, "they still can't spot you from the copters. The fog is getting thicker and reaches 50 to 70 meters high. The situation is under study."

"We're removing our space suits," said Zudov.

Easier said than done. Managing a space suit is no simple matter even in the usual standing position in a spacious room. And even less so in a descent capsule being violently pitched. But the decision stood: start removing the space suits!

The landing area: The search team was reenforced. It can be said without exaggeration that the flyers were a magnificent group. Among them was Nilolay Kondratyev. By the time he first flew his copter into the milky fog over Lake Tengiz, most of the copters had tasted the bitterness of defeat. There were also 5 or 6 boats on the lake with rescuers. They were having problems with the rubber boats being ripped by the ice that was rapidly forming along the shore, and on the open water the boats had to be careful of the jagged ice sheets churned by the storm-driven waves.

During these hours everything was against them--the darkness, the freezing temperatures, the snow, everything.

They took off. At the controls was Kondratyev. They set out along the capsule's course, just as those before them had done. Unlike the others, however, they were able to spot Soyuz's flashing light. Descending to 4 to 5 meters and hovering above the black "smoking" waters, they turned on the powerful searchlight and examined the capsule, that part of it that remained above the water. They reported that they had found the capsule.

The report went off to Moscow immediately. The final stage of a space flight--the recovery of the crew--had never before been conducted under such unusual conditions. The report from the helicopter, hidden tousands of kilometers from Moscow in the mist of a stormy night, was transmitted immediately to the mission control. Decisions, suggestions and the situation were also constantly being reported.

Kondratyev circled the capsule twice and headed for shore. A regular camp had already been set up there: camp fires were burning, tents had been pitched for the doctors, a fuel depot had been established. Back on the ground, Kondratyev said: "I can't remember ever seeing a fog like this. It's steam. The water is steaming because of the difference in temperatures."

The descent capsule: While trying to unhook the oxygen and ventilation hoses of the commander's space suit, Valeriy Rozhdestvenskiy lost his fine Okean timepiece.

The space suits were taken off anyway. The effort had totally exhausted the cosmonauts. After all, they had not yet readjusted, and each movement required great exertion. The space suits were just too much. But when asked then how they were feeling, they replied with their usual "fine."

Meanwhile the situation with the air-intake was becoming acute. After the red-hot temperature caused by friction with the dense layers of atmosphere, the capsule was now cooling rapidly in the cold water and ice sludge.

There was a regenerator on board as a precaution against problems of this particular kind. It could produce air suitable for breathing. Zudov and Rozhdestvenskiy were fully aware that the regenerator could not run indefinitely for it had operated during launch and in orbit.

Energy--that was the problem. The regenerator required power. The on-board supply of power was limited.

The landing area: The command post was notified that frogmen were on the way to Tengiz and would arrive any moment. The gusts of squall velocity--up to 20 meters per second--did not intimidate the experienced pilot heading the search-rescue team. In 35 years of flying, he had never seen anything like this either. But he was disturbed by something else: how could they handle the capsule if the storm did not abate, if the fog did not lift, if the wind did not die down?

He had as much confidence in the pilots as in himself, especially in Nikolay Kondratyev. Kondratyev's endurance, resourcefulness and skill met the highest standards of the aviation profession. But nature does not always bow to a man's skill, nor recognize his degree of professionalism. She is blind.

The task nevertheless remained: evacuate the cosmonauts and bring them to shore. The weather did not permit it. But Kondratyev kept saying: "If it's not permitted, it has to be done." Someone has to do it! Someone must. Everyone felt concern for the cosmonauts. They understood that being on a lake at night in a raging storm is not quite back home on earth. The capsule is not the best place to rest. Nor the safest place to be if something goes wrong.

The frogmen arrived.

The descent capsule: They shut down the power source, shut off the secondary instruments and trimmed the lighting, leaving only the service light on the flexible cable.

People, it seems, are unaware of the limits to their games. At times, the game becomes risky: a capsule flies into a stormy lake. At times, it is sensible: in the capsule is the only one among the cosmonauts with basic training as a sea diver and naval sailor. Rozhdestvenskiy was this man!

Now his experience was to be put to work. At certain moments a person's personal experience is indeed important. It can even be experience unique among all mankind.

The landing area: The halyard, capable of bearing 20 metric tons, was loaded onto the Mi-8 helicopter.. The frogmen boarded the Mi-6. It was decided that Kondratyev would make both trips to the capsule, one with the Mi-6 and one with the Mi-8.

The mist had not lifted, and the wind had not died down. None of the directors could bring himself to prohibit the pilots from flying over the lake on this night, for they understood and felt the plight of the people. The copters circled over the huge inky lake (the lake's surface measures 1,590 square kilometers) until one of them, Kondratyev's copter, fixed the precise coordinates of the capsule. But these same directors could not order Kondratyev to fly now. They could not say: "Take off right away!" Everyone knew Kondratyev and that he would take off at the slightest hint of clearing. He would not allow an opportunity to slip by. But such an opportunity had not yet arrived.

Each of the pilots at the Tengiz camp had generally the same experience, the identical aspiration and ardent wish to help the cosmonauts. But probably the greatest common denominator among them was something else: the awareness of a feeling of debt, a feeling of participation in the efforts and causes of their people, in the achievements of the new space age. This was surely the case.

"Who are you taking along to help?" they asked Kondratyev, feeling that he was about ready to take off.

"Oleg Nefedov," he answered without hesitation.

They waited for the first rays of daybreak.

On board the capsule: The monotony of the operation and the pitching of the water were beginning to cause alarm. There was the risk of apathy and loss of control. The commander tried to fight back the torpor by saying: "We have food and water. What are we waiting for?" "That's true," agreed Rozhdestvenskiy. They ate some preserved meat. Eating indeed gives you an appetite. They had a drink of good-tasting water. Thus fortified, they donned their aviation uniforms, the ones we see them in on the TV news.

Man cannot stay a storm, halt the wind or hasten the course of night. Man can only stand up to and resist them. But is this so little?

The landing area: The rays of the long-awaited dawn seemed like fireworks to them. Kondratyev turned on the helicopter engine. The Mi-6 took off from the ground, illuminated by the light of the nearby campfire and by the distant morning glow, and disappeared in a damp, bluish haze of fumes.

On board the descent capsule: The cosmonauts were keeping their watch.

Cosmonauts have to know a lot. To function in spite of all that might and inevitably will happen to them, they have to know virtually everything. And they do! The Gold Star of Heroes rewards not just routine achievements but distinguishes a person's great efforts, the strength of his mind and will. For Zudov and Rozhdestvenskiy--two cosmonauts, two communists, two Soviet citizens--the situation was difficult, of course. What could they do? But the unending hours of rocking, the cold, the hoping and enduring were approaching an end. Everything receives its just due.

The clatter of the helicopter! Close to the side and loud. Human voices could be heard over the noise. Kondratyev's copter left the frogmen in the waves and, turning around, made straight for the shore. He dashed behind the controls of the Mi-8. The decisive phase of the evacuation was underway.

"Well, Valera," Zudov said, "it's time to put on the hydrosuits."

On board the Mi-8: Kondratyev started the engine of the Mi-8 helicopter. He asked Nefedov to sit on the right to watch the altitude and the water. He took the left seat himself.

The news that they were in the air went out to everyone concerned, as always. The Mi-8 took its bearings and disappeared in the fog. They hovered over the capsule, threw the halyard to the frogmen below and, while they were securing the halyard to the capsule, Kondratyev calculated the operation of the unusual flight. How would the capsule act? And the helicopter? It was almost 8 kilometers to shore, after all.

On board the capsule: They felt the capsule moving. They were clear of the water. They could see light and water through the porthole. During the night, the salt had eaten away the reentry scorch.

As unseen, powerful, long-awaited force pulled their headlight-shaped structure towards shore surely and steadily.

On board the Mi-8: After dragging the capsule about 5 meters, Kondratyev attempted to carry out a maneuver. He decided to put the capsule on its bottom, thinking it might hit a shoal while being dragged. It did not work. After observing the capsule, Nefedov called out: "It's sinking, Commander!"

Kondratyev dragged it on, gripping the controls tighter and biting his lip. He realized that towing demanded extreme caution. The enormous wind-swept world, the great din of the machine, all of life's variety was reduced for Kondratyev to three factors: temperature, speed and rpm's. That was all.

"OK, Commander," he heard Nefedov report. The copter's air speed was 5 to 8 kilometers per hour--the hovering mode.

But the copter did not hover. With great deliberation, it flew in the windy sky, struggling along, tied by the halyard to the capsule with two members of the human race returning home from space.

"OK, Commander." Ten minutes of "hovering," then 15; 20 minutes. What a flight! Kondratyev felt the strain not only of the engine and the rotary wing but of each rivet in the plane. It even seemed at times that the halyard was not fastened to the screaming copter but that he was holding it with his bare hand, in his fist, white-knuckled from the effort. Through the taut halyard, it seemed he could feel the heavy breathing of the cosmonauts, their pulse.

Twenty-five minutes.

Thirty minutes.

There was the upper layer of the fog, the bright sunrise, the cold, white world. Nefedov did not take his eyes off the capsule. In spite of the open window and icy wind, his face was covered with perspiration.

"Still 2,500 meters," Kondratyev reported.

This figure, as always, was sent to PKP [expansion unknown], TsUP and Moscow.

"Still 1,500 meters," Kondratyev reported.

The data went to the capsule, the shore and to Moscow.

Now 250 meters! Looking good," Nefedov reported to Kondratyev. "OK, commander."

They had maintained the hovering mode for 40 minutes, 41, 42.

"Fifty meters!"

They reached the shore. One last maneuver and the capsule was lowered to earth and the halyard removed.

When Kondratyev alighted from the step rung, Zudov and Rozhdestvenskiy were already outside the capsule. They were being wrapped in warm clothing, the warmest to be found. Their unexpected captivity had come to an end.

The leader of the search-rescue team notified Moscow that the crew was ashore. The news from the landing area relieved the torture of waiting and gladdened the hearts of many people.

"Congratulations," said the group leader to Kondratyev. "Congratulations on an outstanding job!"

"And I congratulate myself," thought Kondratyev. "After all, today is my birthday. I'm 34. And I couldn't wish for a better birthday present than to see the smiling faces of Zudov and Rozhdestvenskiy." (For his work in evacuating the descent capsule, N. Kondratyev was awarded the Order of the Red Star.)

So the episode ended, only one of the episodes along the obstacle-strewn road to space, a road with a beginning but no end. Time will never run out here.

9992
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RESEARCH ON 'PROGNOZ-9' AND 'ASTRON' SATELLITES

Moscow PRAVDA in Russian 1 Jan 84 p 3

[Article by V. Gubarev: "Adding to the Earth's Riches: Cosmonautics in the New Year"]

[Excerpts] The staff members of the Center for Long-Range Space Communications eat breakfast, lunch and dinner in turns. They are pressed for time--there are no breaks because immediately after the "Venera's", "Astron" and "Prognoz-9" await their attention--outer space equipment operating in the "third floor of space".

Stars and galaxies, the past and future of the universe--how many generations of astronomers devoted themselves to studying them! There, in the depths of the Universe, they searched for answers to the basic mysteries of nature: How do stellar worlds originate and die? How is energy transformed? What is our place in this stellar chaos?

But before cosmonautics, astronomy was separated from the stars and galaxies by the planet's air envelope like an insurmountable barrier. Concerning 1983, we have the right to say that another powerful breakthrough has been made beyond the boundaries of the atmosphere. A most complex astronomical instrument is located aboard the space observatories "Astron" and "Prognoz-9", able to view much of what is taking place in the depths of the universe.

Scientists at scientific centers in the country and aboard are following with interest the work of the largest optical telescope ever taken into space, of a powerful x-ray telescope and of record-sensitive equipment of "Prognoz-9".

The entire flow of information coming from the universe is concentrated in two of the country's academic scientific institutions--the Space Research Institute and the Crimean Astrophysical Observatory. Here work the scientists under whose direction the experimental equipment installed on "Astron" and Prognoz-9" was built. Here is what the program's research supervisors said about the initial results of the research.

"Our telescope is working without failure," said A. Boyarchuk, corresponding member of the USSR Academy of Sciences. "Over 110 contacts have been made and observations have been made of 61 various types of stars, 17 galaxies and quasars and 19 fields of galactic background. Processing of the data has brought important results for astrophysics. This can be said with confidence. In particular, analysis of the chemical composition of atmospheres of stars showed that in some of them there are hundreds of times more heavy elements--lead, tungsten and uranium--than in the Sun. The outflow velocities of matter have also been measured, exceeding 1,000 kilometers per second. Energy distribution in the ultraviolet portion of the spectrum of nonstationary stars has been studied in detail. In certain galaxies there has been detected a large excess of ultraviolet radiation which indicates differences in the composition of their stellar 'population'."

Doctor of Physicomathematical Sciences V. Kurt adds to what his colleague from the Crimea said:

"In 8 months about 40 observation sessions of remnants of supernovae, binary X-ray sources and single neutron stars have been made by the X-ray telescope installed on 'Astron'. Active galaxies, quasars, a supernova in the adjacent galaxy and other objects have also been studied. The most interesting have been the observations of bursters--bursting binary sources located in the center of the galaxy. A curious effect of 'switching on' of a source has been detected in the constellation Hercules, observed for the first time in 10 years of research. The experiment, 'Relikt' was conducted on the satellite 'Prognoz-9' for studying relict radiation--the remnants of an early stage of development of the universe. Already in the first observations an asymmetry was detected in the distribution of radio brightness, related to the movement of the galaxy. On the whole, thanks to work of Soviet space observations, the past year has brought many valuable results."

There is no doubt that this year will be just as interesting for science--for new space equipment will be added to those on duty today in near and far orbits. Work on "Salyut-7" will be continued in the final training phase of the Soviet-Indian crew and interplanetary stations are being prepared which are not only to get to know the secrets of Venus but also to study Halley's comet. The plans of Soviet cosmonautics are extensive and diverse and it is taking broad strides on the road outlined by the decisions of the 26th CPSU Congress. But there is no room in its exploration for "star wars" which are so widely being shown in the adventure movies coming out in the West and the preparation of which the present US administration is quite seriously announcing. Mankind has a great task--to get to know the endless universe and do it in the name of peace and for the good of people.

12567
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DEVELOPMENT OF SPACE HOLOGRAPHY

Moscow PRAVDA in Russian 1 Dec 83 p 3

[Article by Academician V. Tuchkevich, director of the USSR Academy of Sciences Applied Physics Institute, and Professor S. Gurevich, doctor of physico-mathematical sciences: "'SALYUT-7': OUR COMMENTARY": "Holography Goes Out Into Space"]

[Text] Work in space is an unaccustomed field of endeavor for man. It is clear that conditions there demand both new equipment and new methods of using it. These must take into account the particulars of conducting the work as well as the uncommonness of the tasks. Resort to the means and methods of conducting research which have appeared in recent years is natural in this case. Holography occupies a prominent position among them.

It is well known that the image of an object obtained by holography (a special method of recording light waves) is significantly more informative, if only because it is three-dimensional or volumetric, than photography, which is two-dimensional or flat.

The capability to transmit information about transparent objects is a valuable asset of holography. Thanks to this, one may investigate a wide variety of the physicochemical properties of such objects. The high resolution (great detail) achievable in holography due to the absence of lens optics which distort an image, the high sensitivity to change in position or condition of an object being investigated, the possibility of superimposing several recordings on a single hologram and some other possibilities have major significance.

Unfortunately, quite a few difficulties are encountered on the way to using the listed qualities of holography, and the number of difficulties becomes even greater when attempting to realize the advantages of holography in space.

For the exploitation of holographic installations in space, it was necessary to select a suitable laser and appreciably reduce the size and mass of the installation (by tens and hundreds of times!), to make the installation simpler in tuning and use, to increase its reliability of operation, and to provide such vibration resistance as to make the apparatus suitable for placement in orbit. Moreover, it was important to have rapid transmission to earth of the information being obtained by the holographic installation for interpretation and use by specialists. The ideal installation would have been a kind which, in combination with television technology, would have permitted following the course of a process or observing an object in real time, and intervening in an experiment if necessary.

Clearly, an organization having a great deal of experience in conducting holographic research was needed here. Such experience has been accumulated over many years in the USSR Academy of Sciences Applied Physics Institute imeni A. F. Ioffe. It is natural, therefore, that staff members of that institute, V. B. Konstantinov, D. F. Chernykh, M. S. Cheberyak, N. M. Ganzherli, S. A. Pisarevskaya, I. A. Maurer and V. M. Levushkin, undertook the posed problem.

In developing the equipment, it was decided to depart from the traditional two-dimensional placement of parts of the holographic installation, and arrange them inside, and connected to, a vibration-resistant shell. Such installations have no analogues in the world. For example, the holographic equipment for space constructed in the United States and tested in weightlessness aboard an aircraft in 1982 (already after the work of Soviet holographic equipment on the "Salyut-6" space station) has the traditional arrangement characteristic of laboratory installations, with a baseplate, and substantially large mass and volume.

The Soviet helium-neon laser LG-78 was used in the first version of the space holographic installation. Dimensions of the instrument were 458 x 214 x 120 millimeters; mass was no greater than 5 kilograms, the power requirement was 60 watts and shutter speed was from fractions of a second to tens of seconds. Soviet photographic plates and film were used as the photographic material. In the second version a special additional attachment was available to permit the same instrument to switch over to the Yu. N. Denisyuk circuit with an opposing reference beam.

The third version was prepared for the "Tavriya" experiment. It was notable for large holographing capacity, the inclusion of a glass plate to create an interference zone carrier frequency, and a recording device which permitted obtaining a sequence of holograms with double exposure and with time variation between the first and second exposures. This afforded the opportunity to observe the dynamics of a process being studied.

The fourth version of the installation was coupled with a television camera and permitted instantaneous observation of the phenomena being investigated. It presented to specialists on earth a broad range of options for participating in the control of holographing processes along with the cosmonauts conducting an experiment aboard the space station.

Proving that the equipment would work was paramount in the first space holography mission in the history of science. The experiment "Gologramma lv" removed all doubts in this regard. Holograms of flat and three-dimensional objects were obtained for the first time. The reconstituted image in the latter case also proved to be three-dimensional, although the recording was done on a flat plate.

Investigation of how crystalline particles of sodium chloride are dissolved also entered into the experiment's program. Here the results proved very interesting and, to a certain extent, unexpected--the time of solution was increased approximately 20 times in weightless conditions. This experiment was conducted by the joint Soviet-Mongolian crew, consisting of V. Kovalenok, V. Savinykh, V. Dzhanibekov (USSR) and J. Gurragcha (Mongolian People's Republic), on 27 March 1981.

An experiment, "Gologramma-2", also was devised for obtaining a three-dimensional image of the external surface of a porthole with defects which had appeared due to bombardment by cosmic microparticles. Thus the possibility of using holographic methods for monitoring the operation of separate assemblies of a space station was introduced.

In August 1982, the station "Salyut-7", cosmonauts A. Berezovoy, V. Lebedev, L. Popov, A. Serebrov and S. Savitskaya conducted sequential holographing by the double exposure method, within the framework of the "Tavriya" experiment, of various stages of an electrophoresis process.

And finally, in 1983 cosmonauts V. Lyakhov and A. Aleksandrov studied heat and mass transfer in a liquid medium under weightless conditions by means of a holographic installation. To do this they took a series of double-exposure holograms. Due to absence of the usual convection currents, heat and mass transfer in orbit must differ substantially from that on earth. The experiments conducted by V. Lyakhov and A. Aleksandrov will help determine what this difference is.

V. Lyakhov and A. Aleksandrov also conducted a number of experiments with equipment intended for direct observation of the heat and mass transfer processes as they were occurring.

The successes of holographic experiments on the "Salyut-6" and "Salyut-7" stations permit the assertion that other terrestrial "occupations" of holography also will find application in space.

Dynamics of the growth and dissolving of crystals in weightless conditions still await detailed study, as do certain other electrophysical and physicochemical processes.

Much can be done by means of holographic methods, for example, in studying characteristics of the behavior of liquids in weightless conditions. Capillary processes, wetting and the phenomena of hydrodynamics take place on earth largely under the influence of terrestrial gravitation. In weightless conditions, the customary behavior of liquid appears to be substantially disrupted. Holographic equipment affords the possibility of recording the surface configuration and nature of flow of transparent liquids in weightless conditions. The investigation and recording of small displacement and vibration deformations offer a broad field for holography.

The application of holography to microscopy is interesting. A series of holograms taken in space gives a complete picture of the changes in various micro-objects. At the same time, direct use of the microscope in space is not always possible or effective and, in pictures made by conventional photographic equipment, it is impossible to see the micro-objects photographed under the microscope due to the insufficient resolution of the optics.

Of course, this is by no means a complete list of the prospective uses of holography in space.

So far we have spoken of what holography offers to cosmonautics, but feedback exists, too. Holographic instruments and methods intended for space also can prove extremely useful on earth. Indeed, the previously existing instruments were suitable only for use in specially equipped laboratories. Space holographic equipment can find a place even in the workshop and school, and can give the very same amazing results as even the massive laboratory installations. And, finally, comparing the weights of the new holographic equipment and conventional photographic equipment, we discover that we are on the threshold of creating miniaturized holography for mass consumption. One may, therefore, be assured that the labor expended on the creation of instruments and methods for space will pay for itself not only in orbital research, but also in solving various terrestrial problems.

12319
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JOINT SOVIET-AMERICAN PROJECT FOR DETECTION OF GRAVITATIONAL WAVES

Moscow IZVESTIYA in Russian 21 Nov 83 p 3

[Article by V. Dubinsky: "On Threshold of Discovery"]

[Text] There is an interesting phenomenon to be observed during a solar eclipse: stars going behind the disk of our sun "go out" later than our most accurate calculations predict they should. If a radio or any other electromagnetic impulse is sent to earth from a space ship that is behind the sun, then--like the light from the star in our first example--it will arrive here with a delay of approximately two-tenths of a millisecond. For ordinary perception, this is a negligible quantity, but in that amount of time, the signal traverses 60 kilometers.

These phenomena are explained by the fact that, passing by the sun, electromagnetic impulses are drawn to it and their path is bent. There is nothing surprising about this for scientists, for it all takes place in accordance with the theory of gravitational interaction stated in Einstein's general theory of relativity.

There is an interesting consequence of this theory. In addition to the static curvature--that which exists around the sun, earth, and other suns and planets--there exists a variable curvature which can become detached from the source and fly off into space. It moves with the speed of light and decreases in proportion to the distance it travels from its source. Such pieces of variable curvature that have flown off from their sources are called gravitational waves.

Gravitational waves can arise during the formation of new stars in our own and other galaxies, in the birth of black holes, in their collisions with one another or with neutron stars, etc.

Unfortunately, we can at present make only theoretical judgments about the existence of such waves. In several countries--the Soviet Union, the United States, France, China and others--around 20 teams of scientists are designing and building antennas to detect these waves. This project has two aims: first, demonstrating the existence of a qualitatively new structure of matter, and, secondly, discovering methods for obtaining yet inaccessible information on the universe.

Gravitational waves possess an important property: as they interact with all conceivable bodies--including the sun, the earth, the reader, the newspaper--these bodies deform, that is, they lengthen and shorten. The magnitude of the deformation is infinitesimally small. It is measured by a number multiplied by about -10 to the 19th power. Nevertheless, scientists will try to exploit this very property to detect gravitational waves.

There are several ways to solve the problem. The first consists in taking two equal objects of oblong shape--called "ingots"--locating them at different points on the planet, isolating them from seismic and acoustical effects, cooling them to the lowest possible temperature and observing whether they each quiver at the same time. About 10 years ago, such an experiment was set up, but due to the inadequate sensitivity of the instruments, it was not successful in detecting gravitational waves.

The quality of the ingots, that is, the ability of the material to preserve the "memory" of the impulse, was identified as the problem. In a piece of iron, for instance, vibrations fade away more slowly than in a piece of lead. Crystals, especially the sapphire cultivated by artificial means, possess suitable memory properties. A lower temperature, greater mass, higher quality--these are the specifications of present-generation antennas.

We have already mentioned that the antennas must be placed as far from one another as possible. This requirement was one of the reasons for making the agreement for scientific collaboration between the Moscow State University team--headed by Prof V. Braginskiy--and the California Institute of Technology team--headed by Prof K. Torn. The distance between Los Angeles, where the institute is located, and Moscow--about 8,000 kilometers--is just what is needed for obtaining the desired results. The receivers are different. The antenna at Moscow University is made of sapphire. In Los Angeles, a laser system modelled on the principle of the lighthouse will be used. The sensitivity of the instruments is approximately the same.

Why is one antenna not sufficient to register gravitational waves? This is explained by the fact that if quivering of the ingots occurs in one location, it would be impossible to demonstrate that it was a result of gravitational excitation. Only synchronous quiverings will be taken into account.

Soviet and American physicists hope that the first positive results of these experiments will be obtained even before the end of the present decade. Their joint effort is only one of the examples of fruitful collaboration among the scientists of our two countries, collaboration that is continuing even now despite obstacles placed by the administration in Washington.

9992
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UDC 629.015 + 531.38

NUMERICAL-ANALYTICAL METHOD FOR COMPUTING MOVEMENT OF 12-HOUR ARTIFICIAL EARTH SATELLITES IN NEAR-CIRCULAR ORBITS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 28 Sep 82) pp 819-823

VASHKOV'YAK, M. A.

[Abstract] A description is given of an approximation numerical-analytical method for computing the movement of artificial earth satellites in near-circular orbits with a period of revolution of about 12 hours. The method is based on the principles developed by Zhuravlev et al for predicting the movement of 24-hour satellites. The rapid method described is based on an analytical consideration of short-period perturbations of orbit components associated with the orbital movement of the satellite and the earth's rotation, and numeric integration of equations not involving fast variables. Perturbation effects resulting from the noncentral nature of the earth's gravitational field are discussed and the methods used to impart accuracy to the calculations are shown. Results obtained from calculations using the proposed numerical-analytical method and from using numeric integration of strict movement equations are compared for a 50-day interval. It is shown that the accuracy of the calculations done in accordance with the proposed method, taking into account full gravitational perturbations, is the same as for the case of calculating perturbation from the noncentral nature of the earth's gravitational field, being on the order of several hundred meters on the orthogonal coordinates, several centimeters per second in terms of the components of the velocity vector, and several tens of meters in terms of radius vector. Figures 1; references 4 (Russian).
[78-9642]

UDC 629.015 + 531.38

SPACE IN KEPLERIAN ORBITS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 25 Jun 82) pp 824-837

AVERBUKH, A. I.

[Abstract] The three-parameter family of Keplerian orbits in a plane in the field of a single attracting Netwtonian center is mapped in the half space of

a three-dimensional Minkowski world and the properties of geometric objects in this space and the corresponding families of orbits are considered. The equations for the Keplerian orbits are shown and the Keplerian orbit space is discussed from the viewpoint of points, sections and distances, and from straight lines. Planes and conical cross sections of the Keplerian orbit space are also considered. Transfer from one Keplerian orbit to another without altering the direction of movement along the orbital path is examined. It is pointed out that it is also possible to examine transfers that do involve alterations in the direction of movement along the orbital path merely by changing the signs of the formulas used to calculate transfer not involving change of direction along the orbital path. References 11 (Russian).
[78-9642]

UDC 531.01

NUMERIC EXTENSION OF PERIODIC SOLUTIONS TO LAGRANGIAN SYSTEM WITH TWO DECREES OF FREEDOM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 31 Jan 83) pp 851-860

SOKOL'SKIY, A. G. and KHOVANSKIY, S. A.

[Abstract] A predictor-corrector method for numeric extension of periodic solutions for an autonomous Lagrangian system with two degrees of freedom is considered. The problem is stated, proceeding from the system $\mathcal{L} = \mathcal{L}_2 + \mathcal{L}_1 + \mathcal{L}_0$. Movement equations are shown and the predictor and corrector are examined. The stability of the constructed periodic movements is considered, taking into account terms that are nonlinear relative to perturbations. To illustrate the use of the method an investigation is made of a two-dimensional canonical system describing the relative movement of a dynamically symmetric satellite in circular orbit. A numeric solution is found as an extension of short-period Lyapunov movement from the vicinity of a hyperboloidal precession. Numerical solutions are calculated on a YeS-1045 computer using FORTRAN-IV. Numerical results are shown in graphic form and indicate that the stability of the method is good at sufficiently low values for h. Figures 3; references 15: 14 Russian, 1 Western.
[78-9642]

UDC 629.197.2

FLIGHTS TO ASTEROIDS WITH SPACE VEHICLE MANEUVERS NEAR VENUS, EARTH, MARS AND JUPITER

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 14 Jul 81) pp 861-867

LIVANOV, L. B.

[Abstract] New flyby trajectories for space vehicles from Earth orbit to the major asteroids are considered, using low-eccentric orbits that include flyby of the terrestrial planetary group in various combinations as follows: Earth-Mars-asteroids, Earth-Venus-Earth-asteroids, Earth-Mars-Earth-Jupiter-asteroids. A three-stage perturbation maneuver near Venus and a powered braking maneuver at aphelion of the space vehicle's orbit with subsequent perturbation maneuver near Earth are examined. The relative advantages of the orbits are discussed from the viewpoint of energy. The mathematical apparatus is shown for the method of calculating energy consumption for the flyby in the plane of the ecliptic using perturbation maneuvers near the planets, and different versions of the flyby configuration are discussed. Calculations for flyby using multiple perturbation maneuvers for actual orbit elements involving Venus, Earth, Mars, and Jupiter will be published in the future. Figures 3; references 4: 2 Russian, 2 Western.
[78-9642]

UDC 521.2

GUARANTEED ACCURACY IN DETERMINING ORBIT OF HALLEY'S COMET

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 12 Apr 82) pp 868-875

SUKHANOV, A. A. and EL'YASBERG, P. Ye.

[Abstract] An a priori evaluation is made of expected accuracy in determining the position of Halley's Comet at computed perihelion, using results from the observations made in 1909-1911 and the observations planned for 1985-1987. The proposed method includes 44 measurement parameters (36 orbital elements for the comet, Earth and the four giant planets, the masses of five celestial bodies (the Sun and the giant planets), and the three parameters of the Marsden model), and each parameter is assigned an a priori value and maximum error. Linear programming shows that some a priori parameters can be assumed to equal actual values while others should be made more precise by astronomical observations of the comet's ascension and declination. Optimal time frames for these observations are delineated. Calculations are done making allowance for observation errors and it is assumed that such errors can be corrected. The basic results of the evaluation of achievable accuracy in determining the comet's position at perihelion are found from the 1909-1911 and 1985-1987 observations, with adequate consideration of factors affecting the accuracy of subsequent observations. Figures 2; references 8: 2 Russian, 6 Western.
[78-9642]

UDC 550.385.41

DIFFUSE AURORAL ZONE. PART VII. DYNAMICS OF EQUATORIAL BOUNDARY IN FIELD OF DIFFUSE ELECTRON SPILL IN EVENING SECTOR

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 12 Jan 83) pp 876-884

NIKOLAYENKO, L. M. GAL'PERIN, Yu. I., FEL'DSHTEYN, Ya. I., (SOVO, Zh-A.) and (KRAN'YE. Zh.)

[Abstract] The dynamics of the diffuse precipitation boundary in the evening sector as a function of the level of geomagnetic disturbance and of conditions in the interplanetary medium are studied using data from observations conducted aboard the "Oreole-1" and "Oreole-2" satellites. It is found that the diffuse precipitation boundary in the evening sector is closely associated with the level of geomagnetic disturbance, more so than with the parameters of the interplanetary medium. The reasons for this are discussed in the context of the geometry of force lines in the magnetosphere in the evening sector and the level of geomagnetic disturbance. A new geophysical effect is found, namely an association between the position of the diffuse precipitation boundary and the level of geomagnetic disturbance during the period covering several hours before intersection of the diffuse precipitation boundary, resulting from the slowness of the process of particle dissipation from the inner magnetosphere over a period of several hours. Good agreement is found between the results of these observations and observations made from other satellites (the ISIS2 and the DMSP/F2), indicating the representativeness of observations of the diffuse precipitation boundary in the evening sector. Figures 8; references 18: 2 Russian, 16 Western.
[78-9642]

UDC 523.72

FURTHER ANALYSIS OF PLASMA BURSTS IN HIGH-LATITUDE BOUNDARY LAYER OF EARTH

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6; Nov-Dec 83 (manuscript received 13 Jan 83) pp 885-891

OMEL'CHENKO, A. N., VAYSBERG, O. L. and RASSELL, K. T.

[Abstract] Using data available from observations conducted aboard the NEOS-2, ISEE-1,2 and "Prognoz-7" and "Prognoz-8" satellites an attempt is made to select from among the mechanisms proposed for the impulsive penetration of plasma beneath the magnetopause in the boundary region of the high-latitude magnetosphere. Instrumentation used on the various satellites is discussed and measurement data are compared. It is shown that dispersed plasma bursts take about 5 minutes to build up and then 15 minutes to fall back to threshold values, while the strength of the magnetic field falls to about 50 gamma compared with 70-80 gamma outside the period of plasma burst. At the same time the orientation of the burst changes, moving from the typical field of force

lines entering the magnetospheric tail to a direction approximately perpendicular to the plasma flow. It is concluded that plasma penetrates beneath the magnetopause during periods of magnetospheric plasma depletion. Penetration is into the magnetospheric tail and results from the reconnection of the magnetic lines of force in the interplanetary magnetic field with the frontal tail lines of the terrestrial dipole. Figures 7; references 13: 3 Russian, 10 Western.
[78-9642]

UDC 550.388.2

ION KINETICS, MINOR NEUTRAL AND EXCITED COMPONENTS IN D-REGION WITH HIGH LEVEL OF IONIZATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 25 Dec 82) pp 892-896

VLASKOV, V. A., SMIRONOVA, N. V. and KOZLOV, S. I.

[Abstract] The following components of the ion composition in the D-region during periods of disturbed condition are analyzed with respect to their effect on variations in the D-region: effective coefficient of recombination, relationship between concentrations of negative ions and electron concentration, the relationship between the concentration of ion bonds and the concentration of simple positive ions, the relationship between the concentration of complex negative ions and the concentration of simple ions, and the relationship between the concentration of NO^+ ions and the concentration of O_2^+ ions. The behavior of the components is studied on a seasonal and daily basis and on the basis of altitude and temperature. The model used for the calculations includes 13 ion components and 15 neutral components. It is shown that the neutral components can exert a marked effect on changes in ion makeup and electron concentration in a disturbed ionosphere. Changes depend on temperature, time of day, season, and the intensity of the ionization source and its duration. At low intensities, the temperature of the neutral atmosphere is a major factor in observed changes. Increases in the ionization rate can result in changes in the oxygen components in the lower part of the D-region. Figures 5; references 14: 11 Russian, 3 Western.
[78-9642]

UDC 581.521

CUTOFF FOR SOLAR COSMIC RAYS IN EARTH'S MAGNETOSPHERE IN MAGNETICALLY QUIET PERIODS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 17 May 83) pp 897-906

BIRYUKOV, A. S., IVANOVA, T. A., KOVRYGINA, L. M., KUZNETSOV, S. N., SOSNOVETS, E. N., TVERSKAYA, L. V. and KUDELA, K.

[Abstract] Results are presented from an observation of the cutoff for protons and electrons in solar cosmic rays during a period of increasing solar activity 22-25 November 1977 conducted simultaneously by the "Cosmos-900" and the "Intercosmos-17" satellites. This was the first time that virtually all the MLT values have been recorded during a single period of rising cutoff. Details are provided of satellite positions and instrumentation used during the observation. Proton and electron streams were recorded across an energy range of 1 MeV to greater than 100 MeV. It is shown that an association exists between the pressure of the solar wind on the magnetosphere and the position of the cutoff for protons at energies greater than 1 MeV. Electrons at energies greater than 30 MeV and protons at energies of 1, 4, 10-13, 30 and 100 MeV are cut off at lower latitudes than shown by calculation. The structure of the cutoff boundary is determined by splitting of the drift envelope and nonadiabatic effects as the particles move in an asymmetric geomagnetic field. Results are discussed at length in the context of earlier observations of solar cosmic ray cutoff. Figures 4; references 21: 9 Russian, 12 Western.
[78-9642]

UDC 551.510.535

ION MAKEUP IN UPPER ATMOSPHERE AFFECTED BY SOURCE OF X-RAY RADIATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 17 Feb 82) pp 907-911

AVAKYAN, S. V.

[Abstract] A study is made of the Auger effect in the formation of multiple-charged ions of oxygen atoms and molecules and nitrogen molecules in the upper atmosphere at altitudes of 90 to 450 kilometers affected by pulsed bursts of X-ray radiation. The mechanisms of ionization under these conditions are analyzed. Calculations are made of the rate of formation and loss of O^{++}, N_2^{++} and O_2^{++} ions and it is shown that large numbers of these ions relative to single-charged particles are formed under the effect of X-ray radiation; from a few percent of altitudes of 200 to 250 kilometers, and several tens of percent at altitudes above 300 kilometers, with a lifetime of 10^3 seconds. Figures 1; references 24: 9 Russian, 15 Western.
[78-9642]

UDC 521.61

QUASICIRCULAR EQUATORIAL ORBITS OF ARTIFICIAL EARTH SATELLITES WITH ALLOWANCE FOR LIGHT PRESSURE

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 1, Jan 84 (manuscript received 9 Dec 82) pp 100-106

POLYAKHOVA, Ye. N. and TIMOSHKOVA, Ye. I., Leningrad University

[Abstract] This article is a direct continuation of an earlier article by the authors (VESTN. LENINGR. UN-TA, No 7, pp 150-156, 1977). It gives a further development of the analytical theory of motion of equatorial artificial earth satellites in quasicircular orbits. In formulating the analytical theory only gravitational perturbing effect were used in the computations (eccentricity of the earth's gravity field and gravitational lunar-solar perturbations). The further development of the theory is intended for predicting the perturbed motion of an artificial earth satellite having a great "sail effect" and as a result experiencing the perturbing effect of light pressure. The screening effects of the earth's shadow are not taken into account and the orbit is assumed to be completely illuminated by the sun. The following sections are presented: #1. Equations of motion of artificial satellite in linearized form; #2. Photogravitational potential of sun in satellite problem. #3. Solution of linearized system of equations. #4. Determining arbitrary integration constants. The spherical coordinates of the satellite are determined with allowance for terrestrial, solar and lunar gravitational perturbations and radiation pressure. The formulated theory is correct for short time intervals. References: 3 Russian.
[96-5303]

UDC 521.1

FORMULATION OF THEORY OF ARTIFICIAL EARTH SATELLITE MOTION BY HORI-DEPRIT METHOD

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 12, Dec 83 (manuscript received 30 May 83, after revision 4 Jul 83) pp 750-754

TUPIKOVA, I. V., Institute of Theoretical Astronomy, USSR Academy of Sciences, Leningrad

[Abstract] After a review of the work done in the field of study of artificial earth satellite motion, with emphasis on the investigations of G. I. Hori (PUBLS ASTRON. SOC. JAPAN, 18, 287, 1966). A. Deprit (CELEST. MECH., 1, 12, 1969) and W. A. Mersman (PERIODIC ORBITS, STABILITY AND RESONANCES, Dordrecht, Reidel, p 232, 1970), a technique is proposed for eliminating both short- and long-period terms from the artificial earth satellite problem by use of a single canonical transformation. The proposed method for simultaneous exclusion of these terms can be used in combination with different variants of the averaging method. For example, if a semianalytical theory of motion of

resonance satellites is formulated the secular and resonance terms are retained in the Hamiltonian F'_1 and the averaged system with this Hamiltonian is integrated numerically. The osculating elements are found from the mean elements using the formulas for replacement of variables derived in this article in which the generating function S characterizes aperiodic perturbations. The question of convergence of the presented algorithm remains open. References 6: 1 Russian, 5 Western.
[91-5303]

UDC 520.27

THREE-ELEMENT RADIOINTERFEROMETER WITH VERY LONG BASELINES

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 7, Jul 83 (manuscript received 16 Mar 83) pp 415-420

MATVEYENKO, L. I., SAGDEYEV, R. Z., KOSTENKO, V. I., KOGAN, L. R., MOLOTOV, Ye. P., IGNATOV, S. P., SEVERNYY, A. B., MOISEYEV, I. G., YEFANOV, V. A., SOROCHENKO, R. L., MARTIROSYAN, R. M. and ASLANYAN, A. M., Institute of Space Research, USSR Academy of Sciences, Moscow; Crimean Astrophysical Observatory, USSR Academy of Sciences, Nauchnyy settlement; Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow; Institute of Radiophysics and Electronics, Armenian SSR Academy of Sciences, Yerevan

[Abstract] Details are given of the technical features and operation of a very-long-baseline three-element radiointerferometer based on the existing Simeiz-Pushchino radiointerferometer with the addition of a third earth station located near Yevpatoriya. All antennas at the ground station complexes employ identical sets of equipment operating at a wavelength of 1.35 cm. At Simeiz and Pushchino 22-meter antennas are used, while the one at Yevpatoriya has a diameter of 70 meters. Antenna characteristics and operation are described. The length of baselines is as follows: Yevpatoriya-Simeiz 108 km, Simeiz-Pushchino 1,150 km, Pushchino-Yevpatoroya 1,116 km. First observations with the radiointerferometer were conducted in June 1982, using H20 lines from Orion-KL, W51M, W49N and W30H to check out the system and calibrate amplitude and phase. The system makes possible studies of objects measuring 83 to 2.3 milliseconds of arc. Maximum sensitivity on the short leg (Yevpatoriya-Simeiz) is 20 mJy at 250 kHz and integration time of 100 secs. Figures 5; references 6 (Russian).
[98-9642]

UDC 523.945

LOCALIZATION OF X-RAY BRIGHT SPOTS RELATIVE TO CELLS IN SOLAR CHROMOSPHERIC GRID

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 12, Dec 83 (manuscript received 24 May 83) pp 745-749

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[Abstract] Results are discussed from a comparison of X-ray pictures from the "Atlas of X-ray Pictures of the Solar Corona" (Zombeck et al, 1978) and X-ray pictures obtained aboard the "Skylab" with simultaneous filtered pictures of the K Ca+ and H alpha (0.5 Angstrom) lines, selecting pairs of pictures taken within the same time range of $\pm$1.5 hours. The positions of X-ray bright spots were superimposed on transparencies of the contours of active fields and then enlarged to D_{sun} = 200 mm and carefully correlated on the basis of as many details as possible. The location of X-ray bright spots was determined relative to the chromospheric grid. Results are shown in tabular form. A total of 199 X-ray bright spots was studied. The findings show that in the overwhelming majority of cases the X-ray bright spots are located at the boundaries between grid cells, with ionization increasing with altitude through the solar atmosphere, indicating an association with fields of high vertical magnetic activity in the cell field. The fine structure of the X-ray bright spots is discussed. Figures 1; references 12 (Western).
[91-9642]

'VENERA-15, -16' RADAR IMAGERY OF VENUS

Moscow ZEMLYA I VSELENNAYA in Russian No 1, Jan-Feb 84 pp 2-5

[Article by O. N. Rzhiga, doctor of physical and mathematical sciences: "A Look Through the Clouds"]

[Text] The Soviet unmanned space stations "Venera-15" and "Venera-16" are the world's first to receive radar images of the north polar region of Venus. These images show relief details measuring as small as several kilometers.

During the last 2 decades, scientific devices installed on spacecraft have been used in an intensive study of the planet Venus. Flights of Soviet and American interplanetary space stations have made it possible to reconstitute a detailed picture of the physical conditions of Venus' surface, its atmosphere and its proximate space. Even now, however, we do not have the customary map of the surface of Venus, although such maps have been compiled for the moon, Mars and even Mercury.

This situation may seem anomalous at first but it can be explained by the fact that the optical opaqueness of Venus' atmosphere hinders direct photography of its surface from the earth and from the orbit of an artificial satellite. For radio waves of a certain length, however, the atmosphere is transparent, thus making it possible to receive the first information about Venus' surface.

On analysis of the spectrum of radio signals reflected by Venus in the 1960s, extensive areas of its surface were discovered to be dispersing radio waves more intensively than the surrounding area. This was the first indication of the heterogeneity of the planet's surface. Subsequently, at the largest American radar installations located in Arecibo and Goldstone, images of Venus' hemisphere turned toward earth were received with a resolution of 10 to 20 kilometers during the period of inferior conjunction (ZEMLYA I VSELENNAYA No 1, 1982, p. 8--ed.). In 1980, the American interplanetary spacecraft Pioneer-Venus used a radio altimeter to construct a hypsometric map of Venus' surface between 60° south and 75° north latitudes (ZEMLYA I VSELENNAYA No 1, 1982, p. 16--ed.). The profiles of elevations were measured every 50 to 150 kilometers, thus producing a map showing details on a continental scale. Mountain ranges, craters and rift valleys turned out to be indistinguishable, just as these details on the moon are indistinguishable when observed from earth with the naked eye.

Scientists who study the origin and development of planets are interested in whether Venus is as geologically active as the earth, or whether it is dead like the moon or Mercury.

The principal purpose of the space experiment conducted by the "Venera-15" and "Venera-16" unmanned interplanetary spacecraft is a cartographic survey of the planet's northern hemisphere with a spatial resolution of 1 to 2 kilometers. (Approximately with such resolutions, mountainous formations can be seen on the moon by observations from earth through powerful optical telescopes.) "Venera-15" and "Venera-16" are equipped with side-looking radar units working in the centimeter wave range. The radar units were created by the Special Design Bureau of the Moscow Institute of Power Engineering according to ideas worked out at the USSR Academy of Sciences Institute of Radio Engineering and Electronics.

The resolution of an optical telescope is, of course, proportional to the ratio of the lens diameter to the wave length on which the observations are conducted. This is true for a radio telescope as well. Conventional radar antenna, however, cannot provide the spatial resolution produced by optical instruments because of the great difference in wave length. In radio astronomy, therefore, new methods have been worked out which make it possible through special processing of the reflected signal to create (synthesize) an imaginary antenna of very large dimensions and to achieve the necessary resolution.

With a transmitter and antenna mounted on an artificial satellite orbiting Venus, a part of the planet's surface to the side of the satellite's path is "illuminated." The details of the surface within the area "illuminated" by radio waves are at different distances from the satellite and shift differently in relation to the satellite. This is why the signals reflected by the details of the relief and received on the satellite arrive late in relation to one another and also differ in frequency owing to the Doppler effect. This is also used for dividing the radio waves reflected by separate surface details and for producing the image.

The processing of the reflected signal and the construction of the radar image are done at the USSR Academy of Sciences Institute of Radio Engineering and Electronics, where there is a special computer-equipped unit. To divide the reflected signals according to their delay time and their Doppler frequency shift, a special digital mechanism is first used. This is designed by the Institute of Electronic Control Machines of the Ministry of Instruments in collaboration with the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences.

As the satellite passes through its pericenter a radar survey is made of a strip of the surface of Venus about 100 kilometers wide and 7,000 kilometers long. The image is constructed with a phototelegraphic device, whereby the whole strip is "cut" into pieces of about 1,000 kilometers in length. Two such fragments of a strip received during the first survey of the surface of Venus from the artificial satellites "Venera-15" (16 October, 1983) and "Venera-16" (20 October, 1983) are reproduced on pages 3 and 4 of this article. The region of the survey begins in the northern hemisphere at 80° latitude, runs at a distance of 4° to 5° from the pole and ends at around 30° latitude. The angular distance from the pericenter, measured in degrees from the center of the planet, is indicated on the reproductions along the horizontal axis (one degree on Venus' surface equals 105.6 kilometers).

The satellites first flew a course over ancient folded terrain (pericenter distance from 35.5° to 29°), covered with dilapidated impact craters. Remnants of these craters of about 30 kilometers diameter can be seen at the 32.3 and 31.5 degree mark. The slopes facing the beam appear light, and those turned away from the beam appear dark. Remains of some overlapping craters 70 to 80 kilometers in diameter can be seen at the pericenter distance of 30 to 29 degrees. The folded formations are apparently younger than the craters, since they run through the center of one of the craters measuring about 100 kilometers in diameter (the center of the crater is at the 32.5° mark). The sections of the crater floor with a more placid relief are dark.

The folded relief becomes a plain having almost no detail. The plain stops suddenly at the 24° mark, and a young folded terrain begins, extending for about 600 kilometers. The majority of the parallel mountain ranges extend along the strip for hundreds of kilometers. Inside the acute angle formed by two groups of folds, a large elliptic crater is visible. Its dimensions are 80 by 60 kilometers, and it has a mound at its center (20.7 degrees pericenter distance).

Further on, the relief becomes smoother. Here only two mountain formations are distinguishable, stretching along the strip for 80 kilometers (from 17.3 to 18° pericenter distance). They measure 15 to 20 kilometers at their base. The slopes turned toward the space vehicle appear light, those turned away appear dark. At the 18.7 and 18.3 degree marks, there are two dilapidated craters measuring 15 and 20 kilometers in diameter. Both are visible on the image received by "Venera-15". When "Venera-16" passed above this region, one of these craters left the line of observation because Venus revolved 6.5° on its axis during the time between surveys. On the image received by "Venera-16", parallel ranges can be seen (17 to 15.5 degrees pericenter distance) located at a 45° angle to the course of the satellite and ending as round hills whose base measures 6 to 8 kilometers in diameter.

The radar survey of Venus is continuing. These data will make it possible to construct a map of the north polar region of the planet.

9992
CSO: 1866/94

PROCESSING OF 'VENERA-15, -16' RADAR MAPPING IMAGERY

Moscow PRAVDA in Russian 26 Feb 84 p 6

[Article by A. Pokrovskiy: "Erase the Stray Features"]

[Text] Venera-15 and -16. Our commentary.

Oleg Nikolayevich recalls in detail that conversation held long ago with M.V. Keldysh. In addition to the oral report, he had also prepared three typewritten pages then--the president of the USSR Academy of Sciences was very busy and he might want to find out the details at a time more convenient for him. But Mstislav Vsevolodovich did not try to put him off:

"Tell me about it."

Mstislav Vsevolodovich remarked at once about the exceptional nature of the project about which staff worker Doctor of Mathematical-Physics Sciences O. N.Rzhiga of the AN SSSR [USSR Academy of Sciences] Institute of Radio Engineering and Electronics had reported to him. And he defined his attitude precisely:

"Cooperation with reliable partners is necessary here. I promise you help in this...."

Getting ahead of myself, I will say that he kept his word. The project of mapping Venus by radar moved from the preliminary scientific-survey stage to the period of organizational preparation.

But just why did this case require a special approach? Indeed, maps and even a globe had been made of the Moon by means of space equipment. What prevented the use of already tested resources?

Venus has been called the planet of riddles not just for the sake of flowery speech. It has several times astounded researchers by the uniqueness of its natural peculiarities and it has not been considerate toward "celestial cartographers." It simply is concealed from optical observation by a dense cloud cover.

Meanwhile, there is now an increasingly persistent demand for a map of our solar-system neighbor. Not, it would seem, for tourist travel.

The beginning of interplanetary flights helped in becoming directly acquainted with the Earth's nearest relatives. This acquaintanceship has proved to be so promising that even a new branch of knowledge has emerged--comparative planetology. In addition to that, it opens up prospects for a deeper penetration into the geological history of "man's cradle" and forecasting its future with the use of natural models--the Moon and the neighboring planets. But a map of each of them is needed for this purpose--more correctly, a set of maps for various purposes. However, Venus's "reluctance" to be photographed for this purpose has left a conspicuous blank spot in the scientists' constructions.

Then the idea appeared of getting around the Morning Star's caprices and taking its picture not with light but with radiowaves. The idea was worked out in the AN SSSR Institute of Radio Engineering and Electronics, where radar research of the planets from the Earth has been performed for a long time, under the supervision of Academician V. A. Kotel'nikov. But the radar method first used for mapping the Morning Star's surface from space also required the creation of equipment that had no counterpart in the world. A collective was brought together under A. F. Bogomolov, corresponding member of the AN SSSR, for this purpose.

I had met with Aleksey Fedorovich several times before this. Lean and lively, although he had already left his 70th birthday behind him, he was well known, not only as a thorough specialist in the area of radar but also as an energetic, penetrating organizer who looked thoroughly into each detail. And I recalled for a long time his solemn mien, when, at the station at Medvezhye Lakes, he had shown a strip of radar photography of a part of the surface of Venus, never before visible to the human eye. The complicated radar equipment aboard the automatic interplanetary spacecraft Venera-15 and Venera-16 and the equally complicated receiving installations on the Earth worked faultlessly.

Since then, for several months now, fragment after fragment of Venus's future portrait has been arriving at Earth, across the many millions of kilometers of space that separate the two neighboring planets.

...Just like combines in a grain field, Venera-15 and Venera-16 are circling above the planet, pouring into their "hoppers"--on-board tape recorders--a harvest of scientific information. And then, at the appointed time, they transmit it to a magnetic tape of the Long-Range Space-Communications Center. Packed into boxes, like parts of a multiple-series film, it is sent to the AN SSSR Institute of Radio Engineering and Electronics.

It stands to reason that not only is pure "grain" arriving but also "weeds" that are imprinted on the tape in the form of fragments of the radiosignal, various sorts of noise, and so on. There are not many of them--mere fractions of a percent--but it is still necessary to sort out the granules, grain by grain, in order to furnish the scientists with a faultlessly pure product. It is easy to say, "sort out."

"Just how many such points are contained in one picture?" I ask Candidate of Mathematical-Physics Sciences Gennadiy Mikhaylovich Petrov, manager of the laboratory where this "threshing" is going on.

"Let's do some figuring," he says, taking up a pencil. "A Venera sends us each day pictures of parts of the planet about 7,000 kilometers long and 150 kilometers wide. Thus, about 2 million points are 'drawn' on each section. In order to synthesize them on Earth, about 100 million bits of information are transmitted."

"It would take years to handle this much work without special apparatus," says Candidate of Engineering Sciences Yu. N. Aleksandrov. "But previously, several years before the launch of Venera-15 and -16, we made up a program for processing their future output and prepared, if you will, an electronic harvester, which consists of a computer, a Fourier processor whose productivity is 50-fold that of the well-known BESM [high-speed electronic computer], and a number of peripheral appliances."

"Anyhow," institute deputy director Doctor of Mathematical-Physical Sciences N. A. Armand sums up the conversation, "the automatic spacecraft take pictures for 15-16 minutes, and we have to spend 12 hours 'stirring.' Add to that another 4 hours for collating it with the altimeter data. In all, we have to arrange for the simultaneous operation of two such complexes in two shifts. Nevertheless, we barely keep up with the Veneras. And then the information is reinscribed on magnetic disks, already prepared for later use...."

I sit at the operator's position of one of the computer complexes, since man's intervention is not required right now. Like the seconds on an electronic clock, the number of the developed frames, which consist of two and a half thousand signals each, are being highlighted on the display. Then the machine sums up and prints out the results of the session: how many frames have been checked, how many of them are faulty, and their numbers. The time has come to give up my place to the operator: for now a direct man-to-machine dialog will begin. The man will help the computer once more, to check the frames that have failed the strict programs laid down for them. Perhaps it will still be possible to find ways jointly to decode it, for it would be a pity to lose information that has conquered tens of millions of kilometers of space.

"Shall we continue the collation?" the machine volunteers.

"Let us begin," the operator presses a key.

Again a small green ray runs along each point of the radiosignals, occasionally stumbling in doubt.

"We shall try to blend it with its neighbors," the operator suggests.

The small ray either runs on or asks that another way out be found. And now the radar image of the next section of Venus is finally ready. Above is an indicator of which AMS [automatic interplanetary spacecraft] took the picture and the number of the session, and below is the date and Moscow time of the photo and the AMS's orbital parameters.

"This will be useful later," explains supervisor of the Radar Information Processing Center, Candidate of Technical Sciences A. I. Sidorenko. "And right now let's take a look at the results of the survey on the television screen--there they will show the effects."

Is this the Caucasus I see before me? Mountain ranges float past on the screen, cracks open up into valleys--it is difficult to rid oneself of well-known similarities. I saw a so-called hypsometric map of Venus's surface that had been prepared by American scientists on the basis of just altimeter data. There the lowlying places, just like on the Earth, were flooded with the blue color of the oceans, barely higher were the flatlands, which had been colored green, and above them rose the brownish masses of continents. However, the details of the relief of this map were impossible to make out.

The experiment of Soviet scientists, which was exceptional in complexity and importance, was also called upon to erase stray features from the face of the puzzling celestial neighbor. Its next step is being completed--processing of the data that arrives from near-Venus orbit. Then it will be necessary jointly to combine the information that arrives from the radars--they, as is known, are making surveys at certain angles to the plane of the orbit--and from the altimeters, which are taking measurements along the vertical. And then we shall visually see a world which, while it is not beautiful, is puzzling and, therefore, alluring.

11409
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UDC 550.81:523.42

ROUGHNESS OF SURFACE OF VENUS FROM BISTATIC RADAR DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 21 Jul 82) pp 921-928

MILEKHIN, O. Ye., KUCHERYAVENKOV, A. I., PAVEL'YEV, A. G. and YAKOVLEV, O. I.

[Abstract] Results are presented from a determination of roughness on the surface of Venus in two regions at approximately 26.2° latitude 214.2° longitude and 26.3° latitude and 222.0° longitude using data from a bistatic radar installed on the "Venera-10" probe. Practical difficulties in recording the data are discussed and the methodology for determining roughness values is shown. Analysis of experimental results shows that within the regions studied the roughness of the relief as characterized by the root-mean-square of the angle of slope (gamma) and a parameter characterizing the roughness of the dispersed surface (S) was slight. This is confirmed by the existence of a coherent component in the reflected radar signal. It is calculated from measurements of the strength of the coherent component that dispersion of random unevenness does not exceed 20-30 centimeters in height, with a horizontal spread of 30 to 300 meters. The results obtained indicate the effectiveness of using bistatic radar to study planetary reliefs. Figures 5; references 16: 8 Russian, 8 Western.
[78-9642]

UDC 551.510.53+550.388.8

UNBALANCED INFRARED RADIATION AND NATURAL LASER EFFECT IN ATMOSPHERES OF VENUS AND MARS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 21, No 6, Nov-Dec 83 (manuscript received 8 Jun 82) pp 929-939

GORDIYETS, B. F. and PANCHENKO, V. Ya.

[Abstract] A theoretical study is made of partial variable temperature and CO_2 excitation in the 15 micrometer band and the infrared range below 4.3 micrometers in the atmospheres of Venus and Mars and an analysis is made of infrared radiation in the 10.6 and 9.4 micrometer bands for CO_2 in the context of the features of infrared radiation capture. Studies are done for altitudes

of 80-130 kilometers for Venus and 35 to 120 kilometers for Mars. The model and analytical method employed in the study are described. It is found that in the near-infrared (4.3 micrometers) there is direct conversion of absorbed radiation into planetary atmospheric radiation at 10.6 and 9.4 micrometers. A layer of unbalanced infrared radiation exists in these fields at an altitude of approximately 108 kilometers on Venus and about 60 kilometers on Mars at intensities of 2,300 and 320 erg. cm^{-2} per $second^{-1}$ respectively. Inversion settling occurs at 10.6 micrometers at the $00^{0}1$ to $10^{0}0$ boundary at altitudes of 110-125 kilometers for Venus and 70-80 kilometers for Mars. The findings indicate that Venus and Mars are the first known natural laser objects in the infrared range. Figures 4; references 19: 10 Russian, 9 Western.
[78-9642]

UDC 550.312+523.42+523.43

INTERPRETATION OF GRAVITATIONAL ANOMALIES ON MARS, VENUS AND EARTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, Dec 83 (manuscript received 18 Mar 83) pp 3-15

TARAKANOV, Yu. A., KAMBAROV, N. Sh., PRIKHOD'KO, V. A. and BONDARENKO, D. R., Institute of Earth Physics imeni O. Yu. Shmidt, USSR Academy of Sciences; Moscow State University

[Abstract] New findings based on gravimetric observations are presented on the interpretation of gravitational anomalies on Mars, Venus and Earth and results for the three planets are compared. Interpretation is based on Stokes constants using figures for field characteristics in a finite number of isolated points, based on earlier work by Tarankov et al. Details of interpretation of gravitational anomalies are given for each of three planets. The main conclusions are: that there is substantial difference in the structure and nature of compression on the three planets; that the earth's lithosphere is sufficiently thin and flexible to retain the shape of a hydrostatic balanced body; that the probable source of gravitational anomalies on Venus is variation in the depth of the second-phase mantle boundary; and that 11 of the 13 major anomalies detected on Mars result from irregularities in the lithosphere-mantle disjunction. Figures 4; references 22: 7 Russian, 15 Western.
[79-9642]

UDC 523.3-336

GENERALIZED MODEL OF LUNAR GRAVITATIONAL FIELD

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 4, Oct-Dec 83 (manuscript received 18 Apr 83) pp 195-201

TADZHIDINOV, Kh. G., State Astonomical Institute imeni P. K. Shternberg

[Abstract] Following the work of Bills and Ferrari (1980), an attempt is made to construct generalized models of the Moon's gravitational field using the following data: the Doppler observations of the Apollo-15 and -16 and Lunar Orbiter-5, in the form of the 16th harmonic suggested by Ferrari; the model of Ferrari et al constructed for the low-frequency part (down to n = 5) of selenopotential in the form of an expansion from the spherical functions, using data from laser and Doppler measurements made by Lunar Orbiter-4; the Akim and Vlasova model (1983) using data obtained from the "Luna" series (10-24), in the form of a set of harmonic coefficients; the 83-point model of Brovar, Ogorodova et al approximateing the gravitational field of the equatorial part of the visible lunar surface, using data obtained by the Lunar Orbiter series (1-5) and Apollo-8 and Apollo-12; a set of four profiles of beam accelerations above the central part of the visible lunar surface obtained during low passes by the command modules of the Apollo series (14-17). The latter have not previously been used in modeling the lunar gravitational field. Two methods are used to construct the models: determination of the harmonic coefficients by numeric integration of values for the radial product of the potential, and constructing a model by using a weighted least-squares method. Details are shown for each method and the 16th degree harmonics and relative values for a 225-point mass are shown in tabular form. The models are compared with earlier models. Figures 1; references 8: 5 Russian, 3 Western.
[90-9642]

UDC 523.3-652

OPTICAL STUDIES OF MOON ROCK SAMPLES AT VARIOUS DEGREES OF MATURITY

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 4, Oct-Dec 83 (manuscript received 20 Dec 82, after revision 14 Mar 83) pp 201-209

AKIMOV, L. A. and SHKURATOV, Yu. G., Kharkov Astronomical Observatory

[Abstract] A study was made of the effect of degree of maturity in lunar regolith on the optical effects of phase dependence of polarization and brightness and color at low phase angles. Two pairs of samples obtained at the "Luna-16" and "Luna-24" landing sites were used in the study. Samples were similar in composition but differed in terms of maturity; details of physical properties are listed. Measurement of phase dependence for brightness and polarization was done in three intervals of the visible range (lambda 0.45, 0.50 and 0.65 micrometers). Scattered light was recorded using a low-angle

receiver at various angles of incidence. Scattering angle was measured at 45°. Minimum phase angle was approximately 3°. Measurement of the scattering function was done at intervals of $3/4^{\circ}$. $BaSO_4$ and MgO screens were used to standardize measurements. Results are shown in tabular and graphic form. The findings showed that the opposition effect is greater in more mature samples, particularly in red light. Phase dependence for sample color was also found to depend directly on the maturity of samples, with the color index increasing in step with increasing phase angle. Negative polarization increased slightly in mature samples. Results are compared with earlier studies and theoretical models are examined. Figures 4; references 20: 12 Russian, 8 Western.
[90-9642]

UDC 523.43.834

DISTRIBUTION OF CRATERS OF VARIOUS AGE ON MARTIAN SURFACE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 4, Oct-Dec 83
(manuscript received 18 May 82, after revision 1 Apr 83) pp 210-215

RODIONOVA, Zh. F. and DEKHTYAREVA, K. I., State Astronomical Institute imeni P. K. Shternberg

[Abstract] Using published maps of the Martian surface a study was made of the four groups of craters according to age, using as a base albedo and hypsometric level. Of the 12,700 craters distinguished, 7% were assigned to the greatest age, 15% to ancient, 15% to new and 60% to very new. Craters were also categorized into four groups according to size (less than 20 km, 20-60 km, 60-100 km and larger than 100 km). It was calculated that most craters assigned to the categories of greatest age, ancient and new lay within the 20-60-km range, while for the very new craters most were less than 20 km in diameter. Generally, the distribution of craters was found to be denser on dark areas and less dense on light areas (average density 65 craters per 1 million square km on light areas and 173 on dark areas), except for the Mare Acidalium which is dark but has a crater density of only 16 per 1 million square km. In studying crater distribution according to hypsometric level, a carbon dioxide pressure of 6.1 millibars was taken as a baseline; it was found that the highest crater density is at +3 to +4 kilometers (130 per 1 million square km) and the lowest at -2 to 0 km (40 per 1 million square km). It is concluded that the ageing process takes place more rapidly in craters with diameters of 10-60 km in the lower fields, while the most ancient craters with diameters in excess of 60 km in the lower fields remain for longer periods than craters in other categories, indicating two different ageing mechanisms. Figures 4; references 8: 7 Russian, 1 Western.
[90-9642]

UDC 523.31: 523.4-86

FEASIBILITY OF FORMATION OF DISCRETE DUST BELTS AROUND EARTH

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 4, Oct-Dec 83
(manuscript received 1 Oct 82) pp 232-237

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[Abstract] Patterns in the distribution of meteor dust around the Earth are studied on the basis of earlier theories on the existence of a dust field around the Earth and the debate about the permanence or transitional nature of both individual particles and particle conglomerates. A model is constructed that predicts material will be distributed according to the relationship between the length of the radial standing wave constant for a given system one of whose harmonics is an element of the linear commensurability of the radii of typical rings (a_o) and the mass of the central body in the system (M). It is calculated that for Earth a_o = 2,155.5 km, and on this basis a search model is constructed for the possible distribution of isoenergetic complexes and subcomplexes around the Earth. The theoretical calculations are compared with data obtained from the Geos-2 satellite during the period 7 February 1972 through 2 August 1974, and it is shown that the predicted a_o = 2,155.5 km for Earth agrees well with the distribution of meteor particles recorded during this period. Figures 1; references 20: 17 Russian, 3 Western.
[90-9642]

UDC 523.31:523.4-86

EARTH'S DUST ENVELOPE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 4, Oct-Dec 83
(manuscript received 1 Oct 82) pp 238-243

BARSUKOV, V. L. and NAZAROVA, T. N., Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy

[Abstract] The indeterminate results from attempts to clarify the mechanisms involved in the formation of dust belts around the Earth prompted a reworking of data obtained from the "Elektron-1" and "Elektron-3" satellites. Data obtained from these satellites during the periods 31 January through 5 March 1964 ("Elektron-1") and 11 July through 3 August 1964 ("Elektron-3") were used in the study. Orbital parameters and recording methods are detailed. The findings indicate that meteor material in the Earth's dust envelope is unevenly distributed and also forms concentrations of particles that move in more or less stable orbits at definite distances from Earth. Dust rings around the Earth do not lie in a single plane but cover a broad band around the Earth. It is concluded that long-duration, systematic studies are required in order to obtain sufficient experimental data to clarify the fine structure of the Earth's dust belt and its shape. Figures 3; references 23: 11 Russian, 12 Western.
[90-9642]

SPACE BIOLOGY AND MEDICINE: YESTERDAY AND TODAY

Moscow ZEMLYA I VSELENNAYA in Russian No 5, Sep-Oct 83 pp 4-8

[Article by academician O.G. Gazenko]

[Text] Over the past 26 years a colossal amount of information has been acquired about space, the Earth and man himself. This has been facilitated largely by the unique possibilities possessed today by space biology and medicine.

Initial Successes.

It is probably correct to consider 3 November 1957 as the day when space biology was born. This was the day when the second Soviet artificial Earth satellite with the dog Layka aboard (the first living organism sent into space) was launched. And the birthday of space medicine was 12 April 1961 when Yu.A. Gagarin completed his space flight aboard the "Vostok." These historic milestones were preceded by events that, in my opinion, can be arbitrarily divided into three moments.

The first was during the Thirties when interest was growing in our country in studying the upper layers of the atmosphere. This was the first kind of "prelude" to practical space research since, as the pioneers of practical cosmonautics rightly thought, without mastery of the stratosphere and a knowledge of its properties, neither the development of high-altitude jet aviation nor the conquest of space would be possible. At the all-union conference on the use of jet flying machines to study the stratosphere (1935) there was talk of the possible use of rockets. In his report, S.P. Korolev touched on the problems of providing a pilot with everything needed for work at great altitudes, in particular, pressure suits and "life reserves," and he spoke of the effect of overload on man and the conditions of a sealed cabin.

The importance that the developers of rocket and space technology attached to the "human factor" can also be seen in the fact that the program for engineer training at the engineering-and-design courses in 1932 in the Moscow Group for the Study of Jet Engines included a course on the physiology of high-altitude flight. It was presented by one of the founders of aviation medicine, N.M. Dobrotvorskiy. N.M. Dobrotvorskiy was also the first to formulate the main conditions characterizing human activity in flight, together with the main medical measures that must be implemented in order to insure safe flying work.

The second moment was during the Forties and Fifties when the foundation was laid for the development of research connected with manned spaceflight. The work of the school of physiology of academician L.A. Orbeli and the work of V.V. Strel'tsov, A.V. Lebedinskiy and other scientists who laid the scientific foundations of space biology and medicine were of great importance.

Apparatus convenient for work was developed (the centrifuge, the altitude chamber and the anechoic chamber, and ground sources for ionizing radiation) and with its help the effect of spaceflight factors--acceleration, various kinds of temperature and gas conditions, noise and vibration--was studied by modeling them on Earth. Protective means--g-suits, pressure suits, high-altitude oxygen equipment--were developed on the basis of the data obtained.

It was also important that by the time of the advent of spaceflight a qualitative shift had taken place in biology and medicine to more refined and accurate quantitative methods for evaluating the condition of living organisms, including human beings. Questions associated with the transmission of various physiological and biological parameters across large distance (biotelemetry) were successfully solved and it became possible to control experiments automatically and make use of movies and television.

The third moment was in the late Forties and Fifties when a series of experiments was conducted with animals and other biological subjects on rockets launched to heights of 110-450 kilometers. For the first time we were able to study the effect of short (8-10 minutes) periods of weightlessness on the living organism. Here a substantial contribution was made by research conducted under the leadership of A.V. Pokrovskiy by the researchers V.I. Yazdovskiy, V.I. Popov, A.D. Seryapin, A.M. Genin and Ye.M. Yuganov.

Another Step Forward.

On 3 November 1957, one month after the launch of the world's first artificial Earth satellite in the USSR, the first living organism born on Earth made a spaceflight on a second satellite. During the period 1957 through 1961, several artificial satellites and space vehicle satellites with various kinds of biological subjects aboard were launched in our country. One very important step on Man's road to spaceflight was the return of animals (dogs) to Earth. In these flights a study was made of spaceflight factors on the living organism, and the life support systems that were to insure the possibility of a human being's existence in the cabin of a space vehicle were developed and tested.

Thus, by the time that S.P. Korolev and his colleagues placed on the agenda the question of manned spaceflight, the level of our knowledge of biology and medicine was high enough to solve the problems connected with such a flight. Major scientists--academicians V.A. Engel'gardt, N.M. Sisakyan, P.K. Anokhin, V.V. Parin and V.N. Chernigovskiy--time and again discussed this matter. And finally, at the turn of year in 1960-1961 a scientifically substantiated conclusion was drawn: manned spaceflight with the required degree of safety was possible.

Now, the biological research that is conducted aboard satellites, manned vehicles and orbital stations is an important, integral part of the space program. There is undoubted interest in the biological satellites designed specially for conducting experiments in orbital space flights with various representatives of the animal and plant worlds, and also with isolated plant and animal cells and tissues. During the period 1973 through May 1983 five special Earth biosatellites of the "Cosmos" series were launched in the Soviet Union. On the "Cosmos-690" satellite a study was made of the combined effect of weightlessness and radiation on living systems. It was established that the development of radiation sickness in irradiation of animals (rats) under weightless conditions, using a radiation source aboard the satellite, is virtually the same as its development under terrestrial conditions. An experiment with a centrifuge aboard the "Cosmos-936" showed that the creation in weightlessness of artificial gravity equal to that of Earth largely prevents the development of many of the adverse changes occurring in the body under the effect of weightlessness.

The detailed studies of animals completing space flights on biosatellites added significantly to our knowledge of the mechanisms of adaptation to weightless conditions. These studies make it possible to look deep inside the body and investigate phenomena occurring at the organ, tissue and cellular levels. The results can be applied in practice since they enable constant improvements in the principles and methods of medical and biological support for spaceflights. Moreover, biological experiments under spaceflight conditions constitute a unique tool for studying the role of gravitation in the realization of basic biological processes such as cell division, the transmission of hereditary information, and growth and development of the organism. It is possible that biological experiments on spaceflights will also help in answering the question of the significance of gravitation in the origin and evolution of life on Earth.

The Search Continues.

In the 22 years of manned flight Soviet cosmnautics has traversed a road from the short-duration flights on the "Vostok," "Voskhod" and "Soyuz" vehicles to prolonged sojourns in space by humans on the "Salyut" orbital stations. The approach to the basic problems of space medicine has also changed substantially, as for example in cosmonaut selection and training. Whereas in the early stages the need was for so-called "iron" health, these views have now altered somewhat. We can to a certain degree make the requirements less stringent for the physical condition of cosmonaut candidates. This is connected with the improvements in space technology, the development of quite comfortable conditions aboard space vehicles, and significant improvements in the system of medical monitoring and prophylactic measures. The system of cosmonaut selection and training has also been improved. The greatest attention is now given to revealing the functional possibilities of a person's body and adapatability, since even though not possessed of clearly expressed indexes characterizing the functional status of any given system in the body, a person may have the ability easily to adapt to changing environmental conditions, and this is a very important biological response.

In connection with the increasing duration of flights and the volume and special nature of the work done by cosmonauts in space, increasingly stringent requirements are now being placed on the level of people's professional training and their maximum effectiveness in orbit. The need is arising to send on spaceflights highly qualified specialists and this, naturally, can be associated both with the constantly extending frontiers and with the participation of women in spaceflights. Individual medical selection and training of candidates for each specific spaceflight is of special significance.

Questions of hygiene assessment of the living environment occupy a special place. These include temperature and gas pressure control, partial oxygen and carbon dioxide pressures, the quantitative and qualitative composition of organic impurities secreted by humans and structural materials, and also sanitation-microbiological monitoring of the living environment, and skin and oral and nasal microflora.

Progress in sanitation-everyday support for cosmonauts has been significant. A rich assortment of special hygiene facilities are used for these purposes, from various kinds of napkins and towels to the shower cabinet. A cosmonaut in flight can now clean his teeth daily, shave and change his underwear regularly.

On today's prolonged flights the diet differs little from that on Earth. The cosmonauts can heat their food and they have a varied menu of hot first and second course dishes. The products that they want, including fresh vegetables and fruit, are delivered to the crews of long-duration expeditions aboard the transport vehicles.

In recent years, in order to save onboard water supplies increasing use has been made of water recycling systems, in particular water obtained from complete recycling of atmospheric moisture. Another question on the agenda is that of replenishing food supplies on board through the use of biological-technical life support systems (see ZEMLYA I VSELENNAYA No 6, 1980, p 20).

The organization of medical monitoring in spaceflights has also changed substantially. During short-duration spaceflights the greatest attention was given to human "survivability" and the need to determine critical changes in the environment or the state of health so as to resolve questions of whether possibly to continue a flight or cut it short. Here use was made of a relatively small number of facilities for recording the physiological status or the environment.

Today the emphasis is on determining the stages and effectiveness of human adaptation under flight conditions and predicting the feasibility of continuing a flight for a prolonged period. The research methods have also been considerably expanded. It can be said that aboard the orbital stations there is a well-equipped office for comprehenisve studies of a cosmonaut's state of health. It includes complexes for recording the function of various organs and systems, instruments for detailed studies of the cardiovascular system, and various devices for investigating the organs of sight and vestibular apparatus, oxygen status and the water-salt balance.

Long-duration flights have required a solution to the question of preventing the adverse effect of weightlessness on the body of a cosmonaut. The fact is that a prolonged sojourn in space by a human demands of the body not only resistance to extreme effects but also plasticity and adaptability to new conditions and aggressive action by the adaptive mechanisms. Some of the physiological changes occurring during the process of adaptation to weightlessness present no danger to the health of cosmonauts. But the situation is not simple: the more complete the adaptation to weightlessness the more intense and difficult the readaptation after the return to Earth.

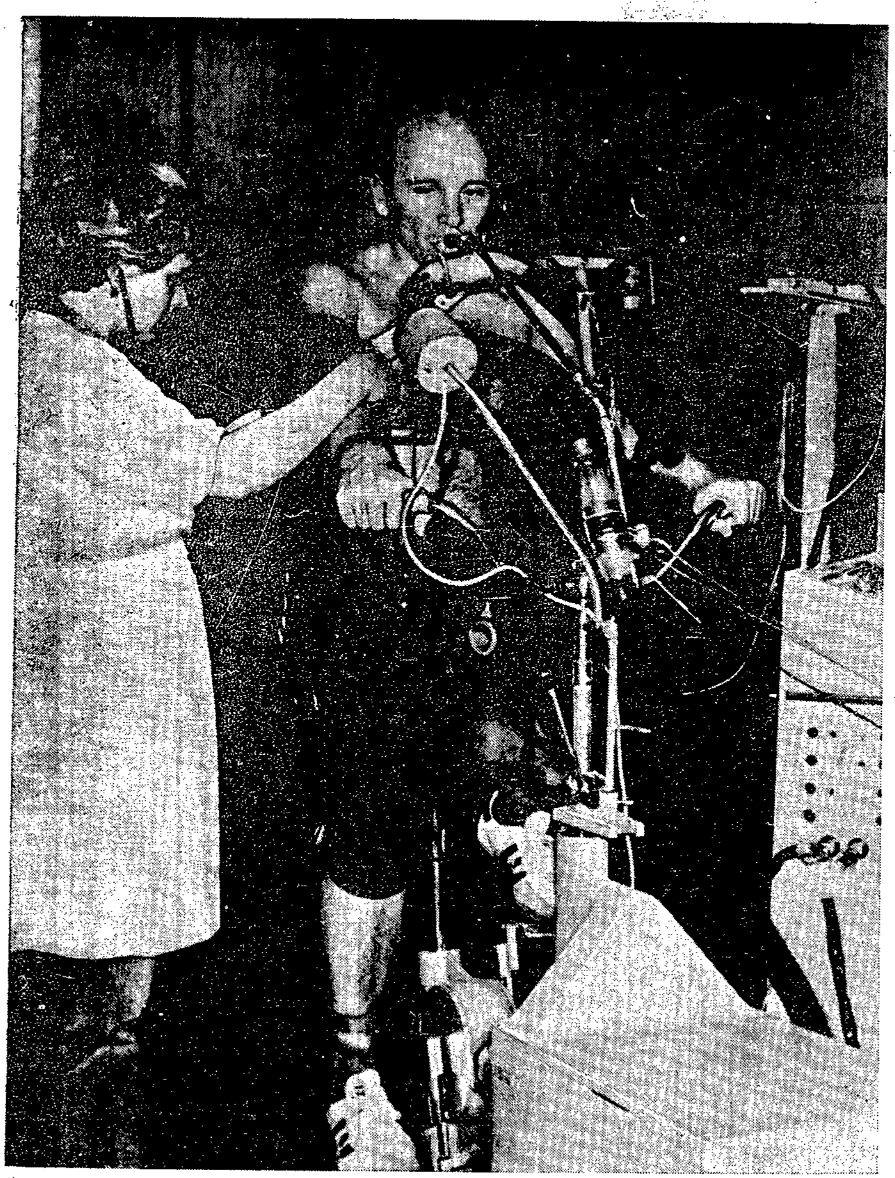
Perhaps this situation was seen most clearly when A.G. Nikolayev and V.I. Sevastyanov completed their 18-day spaceflight aboard the "Soyuz-9." The cosmonauts adapted to weightlessness without any kind of difficulty. But the return to Earth's gravitational force was not without difficulty. There was a feeling of body heaviness, great effort was required to maintain the vertical pose, and motor functions were altered, particularly during the first days after the landing.

By the time that flights were being made on the orbital stations the physicians had developed a set of prophylactic facilities and methods that are now being used successfully during long-duration flights. The task is to use the prophylactic facilities not to make the body's systems "forget" their terrestrial design but "remind" them of their role on Earth.

Working out on the bicycle ergometer and the treadmill places considerable load on the muscles. Wearing a special suit into whose fabric elastic is sewn pursues the same goal. During movement the elastic forces the various muscle groups to work. The "Chibis" vacuum suit, which creates negative pressure in the lower half of the body, forces the blood from the upper parts to move into the vessels of the legs and thus simulate the circulation that is normal for the human body on Earth.

In order to insure radiation safety, the radiation situation along the flight path is carefully monitored. Dosimeters are installed on the vehicle in order to determine the radiation dose, and each cosmonaut wears one on his clothing. So far flights have taken place in conditions of a relatively quiet radiation situation and the dose of ionizing radiation received by cosmonauts has not exceeded 5 rem (roentgen biological equivalent). Flight orbits are still below the Earth's radiation belts and accordingly the latter present no obvious danger for humans.

Increasing the time that humans spend in space has forced the resolution of very complex psychological problems. Psychologists participate in organizing the work and life of the cosmonaut: they help to determine rational working and leisure conditions at various stages of the flight, and also the forms of leisure that best promote restoration of work ability and dispel emotional tension. "Psychological support" (meetings with families, specialists, favorite artists) aimed at creating good mood and optimal work ability among crews, has justified itself.



Above: Testing the "Chibis" vacuum suit

Left: V.V. Lebedev working out on a bicycle ergometer

The completion in late 1982 of the longest--211-day--flight by A.N. Berezovoy and V.V. Lebedev on the "Salyut-7" again showed convincingly that the strategy chosen by Soviet specialists of gradually increasing the length of time that humans stay in space is completely justifying itself and making it possible to live in space with increasing confidence. As in previous long-duration flights, the physicians gave their primary attention to studying those bodily systems that undergo the most substantial changes during long periods of weightlessness.

It should be noted that a complex of cosmonaut medical studies was completed aboard the "Salyut-7." The new "Aelita" multifunctional apparatus makes it possible to make comprehensive recordings of physiological indexes of the body's condition. And this is a notable step forward in raising the qualitative level of medical support in space.

For the first time the "Ekhograf" instrument has obtained data characterizing important indexes for the activity of the cardiovascular system, such as vascular diameter and volumetric flow in various parts of the body, the volumes of the cardiac chambers, and the stroke volume. It has been established that it takes about 4 weeks of flight for the reactions of the cardiovascular system at rest and under functional stress to stabilize.

Studies conducted during the first days immediately following the flight revealed no changes in cardiac function.

The drop in the number of blood red cells noticed earlier during long-duration flights did not progress as the duration of flights increased up to 7 months. The main thing is that the red cells fulfill their main function normally, namely oxygen transport. This enables an optimistic assessment of the ability of the blood system to adapt itself to the conditions of prolonged flights and to recover after flight. In A.N. Berezovoy and V.V. Lebedev the readaptation period was favorable. There was no substantial difference in their state of health from the state of health of cosmonauts who had earlier completed long-duration orbital missions.

The fundamental result of this flight is obvious: increasing the duration of a manned sojourn in space up to 7 months did not lead to the manifestation of any qualitatively new functional shifts in the cosmonauts' bodies (compared with flights of shorter duration).

The work on the "Salyut-7" by S.Ye. Savitskaya, the second woman to go into space, was undoubtedly important for space medicine. The reactions of a female body during the 8-day stay under weightless conditions were of interest to physicians. The main conclusion drawn from the results of studies conducted during the flight and afterwards is that no significant differences are found in the reactions of males and females. This makes it possible to look forward with confidence to the participation of women in future space journeys.

What, then, have we learned in the last 22 years about the human body under spaceflight conditions? Today we know a great deal about the body's responses to weightlessness, and in general we understand the mechanisms that produce the responses. The impression is that man can adapt satisfactorily to the prolonged effect of weightlessness. We have a sufficiently clear idea of the general course of the process of adaptation to weightlessness, the individual phases of this process, and the physiological systems that are involved at any given stage of adaptation.

The achievements in the area of stabilizing cosmonauts' health are substantial. Principles and methods have been developed that make it possible to control a subject's state of health when he makes a spaceflight. I cannot claim that they are 100-percent effective. Much remains to be done in order to gain a deeper understanding of the individual physiological reactions of each person. Since we are talking about humans and their health and safety, each new step in space must be scrupulously weighed. Regardless of how far we have advanced in our knowledge, it should be understood that by no means everything that must be done has been done and that everything that we do must be for the good of mankind.

9642
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DEVELOPMENT OF EQUIPMENT FOR 'COSMOS-1514' BIOSATELLITE

Leningrad LENINGRADSKAYA PRAVDA in Russian 23 Dec 83 p 4

[Article by T. Chesanova: "Unusual Biocosmonauts Provided Comfort in Orbit by Leningrad Designers and Workers"]

[Text] Today they have a holiday. The work to which so much talent and energy had been devoted has successfully concluded. They have been waiting patiently, as have hundreds of people involved in bringing about the flight of the biosatellite, for that moment when after the space odyssey Abrek and Bion would again be in the hands of physicians and biologists.

If so, then they--the designers and engineers, technicians and workers of the Leningrad Special Design and Technological Office (SKTB) "Biofizpribor"--have done their work. They have done everything in order that the unusual bio-testers could not only live but also work in orbit as prescribed for cosmonauts, thereby giving invaluable information for science. Just how did the system originate which provided the travelers with quite earth-like comfort in weightlessness?

THE TASK. No, the chief designer had neither urgent summons to Moscow, nor express telegrams, nor telephone calls. There was simply everyday hard work which with each passing year, each passing day, brought the collective of the Leningrad SKTB closer to the new boundary.

Now it is hardly possible to name the exact day when the decision was made to send the "laboratory doubles of man", as the physiologists call the higher monkeys, into orbit. In any event, it did not spring up suddenly and did not come to the researchers and designers unexpectedly. The task matured gradually, as the physicians and biologists made more and more progress in the knowledge of the delicate adaptation mechanisms of living beings to unusual conditions and, above all, to weightlessness.

This research began with the famous Belka and Strelka over a quarter of a century ago. In recent years a whole series of specialized biosatellites have continued--"bioses"--with a large family of laboratory animals--white rats on board. The Leningrad engineers and workers have provided all the biocosmonauts with comfort in orbit.

Here already in the previous "bios", instead of hostile weightlessness, the animals felt the customary gravitation. The Leningrad engineers offered them the services of a centrifuge which created an artificial force of gravity in orbit. Then this seemed inconceivable--to feed and water the animals, to look after their hygiene and do all of this automatically, in a rotating system on board the satellite. They did it.... Next came events that were even more incredible.

"We became bolder," Anatoliy Aleksandrovich Zlatorunskiy, chief designer of the SKTB, told me. "When the need arose for the physiologists with the help of implanted sensors to look into the innermost thing--the 'microcosmos' of a living cell of our 'laboratory doubles', the engineers were already ready to form an alliance with the physicians."

DIFFICULTIES. Macaque-rhesus monkeys turned up at the designers' vivarium. These are the same kind to which mankind is thankful for saving many thousands of children. The once sadly famous Rhesus factor was first detected in the blood of these very monkeys, hence the name of the insidious antigen. Now they were to be of new service to science.

At first, people ran from all the departments to have a look at the shaggy big-eared creatures. They were astonished: the animals turned out to be quite aggressive. You see, many picture monkeys as they are in movies, the circus or at the zoo where the apes are practically tame. But these are "street" monkeys, even though they are from the famous Sukhumi Monkey House. They are belligerent, ready at any moment to stand up for themselves and to smash and break everything they get their hands on. They are extremely active and inquisitive.... What would a person do, having detected a wire on himself implanted somewhere under his skin? Of course, he would be afraid to breathe on it. What would even the most intelligent monkey do in this case? Of course, he would pull it out.

Here are two such brave, restless beings and two fidgets had to be made to sit firmly. All right, let them break all of others' things. They must not break yours. Feed and water them and supply them with subtropical conditions, clean air and even a light breeze. Naturally and automatically. Not to mention the constant monitoring of their condition, transmission to Earth and recording on board of the necessary physiological information and much, much more.

But ask the builders of the new equipment: What contributes to the emergence of original ideas most of all? They will answer--difficulties. Only not those which we sometimes create for ourselves, but those which inevitably face a researcher on the thorny path of knowledge.

IDEAS. There was no shortage of them from the very beginning. It only remained to be determined which of them were, as Niels Bohr once said, "crazy enough to be correct".

For a long time the designers puzzled over how to position each animal so that its posture would be most comfortable and customary and not annoy or traumatize the tester, but please him--it was by no means simple. The idea of individual, swinging space couches, cushioning the blows and literally repeating the body curves of the monkeys was considered for a long time.

Then the idea of a table came up. It turned out to be a sort of space desk. On the one hand, it had to restrict movement so that the paws could no longer be pulled out from under the table. Otherwise the moneky would certainly pull off all the sensors and try them out "on a tooth". On the other hand, the paws are completely free under the table--not only for mischievousness, but also for work. A "cosmonaut" in flight must busy himself with camera activities.

While still on the ground, the tester-candiddtes were trained to solve very complicated problems--for a reward, naturally. But in order to get it, the monkey had to make out the small red letters on the light panel and, according to them, press special pedals. On Earth the macaques solve such problems instantly to receive their favorite delicacy. It is not a banana, not pineapple, but the sap from the northern dog rose. But it was important for the scientists to check on how this motor and spatial orientation is preserved under conditions of weightlessness. That is how the idea of an operator's console came about as well as the idea of "seat belts" which could be used to fasten the bio-testers safely during orbit-insertion g-forces and during landing. After all, for the designers it was namely this that was paramount--to return the biocosmonauts home safely.

THE DECISION. The space home certainly turned out wonderfully well also. Each tester had his own personal home. But the rooms' walls were transparent so the neighbors were able to see each other well. I peek into one of them. It is a mock-up, but these very quarters had already received their space christening.

There is the couch, trimmed with natural mouton--soft and warming. There is the operator console. The pedals are visible through the transparent table.... When feeding time came, metal feeding bottles came out--one with a nourishing gruel and the other with their favorite delicacy. True, it was necessary to work in order to get the juice and at that moment the sensors monitored the reaction of the vestibular apparatus to weightlessness.

The day began at exactly 8 o'clock in orbit--and the passengers had to be awakened by rocking the couches. Night fell at 2400 hours. An automatic device, cleverly built into the testers' couches, monitored the conditions inside the room. A centrifuge, hidden in the grated floor, helped maintain cleanliness.

Now did the passengers like their unusual journey? TV cameras installed in each little space house made it possible to watch their behavior with one's own eyes from Earth.

TESTS. Nevertheless, complexes are complexes. They are the height of engineering strategy. One can brilliantly solve an individual technical problem--create a converter, actuator or instrument. But how will it look in space? The optimum technical solution can be achieved only by drawing together many, occasionally entirely diverse specialists. "Biofizpribor" has had to deal with not only "its own" instruments. How many "foreign" designs has it essentially given a new life.... Such was the case with a sensor designed to measure the rate of blood flow in the monkeys' blood vessels. The designers and workers found a way to mount it so that the instrument began to record the information, vital for physicians, on changes in blood flow under conditions of weightlessness, a phenomenon which causes many concerns for real cosmonauts.

Many institutes, design bureaus and plants, not only from our country but others as well, took part in building the scientific research equipment for the satellite. Space biology has a great future.

PEOPLE. Now the space travelers are on Earth. It seems that for the entire past five years the Leningrad specialists have been working for this one moment. All these years they were always making some kind of thing without which it was impossible to proceed further. They ended up with a peculiar race with intermediate finish lines like cyclists have. The race is exhausting and at the same time exciting.

But it is very likely the profession of real designers to hurry. Just like all mortals, each of the builders of the new "bios" were allotted 24 hours in their days. They worked 10-12 hours a day.... Together they found a way out of every situation. Naturally, the ones who developed all the design elements already in metal were fellow engineers and technicians. The workers are full-fledged co-designers of the new satellite. When the rocket had already been launched, one of them said sadly: "Still, it grieves me to part with that small sphere...."

Five days later an "express telegram" was posted at the SKTB: "The flight of 'Cosmos-1514' has concluded successfully! The scientific research program has been carried out completely. This is our joint success!"

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RESULTS FROM STUDY OF EARTH RESOURCES FROM SPACE

Moscow PRAVDA in Russian 12 Sep 83 p 3

[Article by L. Zlobin, deputy general director of the "Priroda" State Center and Yu. Kel'ner, division chief of the "Priroda" State Center: "By a Unified View"]

[Text] The readers have undoubtedly already noticed that in reports on space research, surveying of the earth's surface is often mentioned. These surveys are conducted using stationary systems and moving cameras from spacecraft and orbital space stations. For example, the cosmonauts V. Lyakhov and A. Aleksandrov, during their flight on board the "Salyut-7" space station, have already taken approximately four thousand shots in all.

Space-based studies of the earth are of enormous importance for the national economy. The 26th CPSU Congress and resolutions of the May (1982) Plenum of the CPSU Central Committee, have provided for the implementation of important general government measures aimed at increasing the effectiveness of natural resource management, as well as preserving and reclaiming natural resources. In this regard, particular attention has been devoted to an expanded study of the environmental potential of the country, and the classification of data on the presence, reserves and territorial distribution of the primary natural resources. Data from space-based photographs make a significant contribution to the effort to solve these problems. Research and the experience gained in recent years have demonstrated that data from space-based photographs have unique properties and may be used in a variety of tasks. They contain data which is useful in mineral and raw material exploration, land use management, studies on the condition of forest cover, determining the reserves of surface and ground waters, in engineering analyses of localities and in the studies on the degree of seismic, mud slide and avalanche danger.

To what form do these data reach the customer? One of the most widely used methods of presenting the data contained in the photographs to the customer is in the form of various maps; these maps present the data obtained from space with the greatest spatial clarity. The greatest scientific advantage and savings may be achieved in natural resource management by the comprehensive and integrated utilization of space photograph data. Here, a single type of natural resource is not examined in isolation; rather, the natural combinations of these resources within various regions are examined. This makes it possible to essentially conduct an inventory of all the important natural resources in a given territory simultaneously. The series of composite resource maps and maps of natural conditions represent in this case a unified system of interdependent informational documents. Each of the documents preserves its significance to its special industry entirely, while in combination they provide a comparison and an independent evaluation of the data on natural resources, as well as serve as the foundation for systematic monitoring of the change in the environment.

The Main Administration for Geodesy and Cartography of the USSR Council of Ministers in conjunction with the industry ministries and departments and the USSR Academy of Sciences have been conducting experimental and industrial operations aimed at the comprehensive study and mapping of the natural conditions and resources of the Transbaikal, Central Asia, Belorussia and the Yakut ASSR. The first stage of such a study and mapping of the natural resources of Tajikistan and the Kalmytsk ASSR has been completed entirely.

An analysis of the results from these studies makes it possible to conclude that the comprehensive study and mapping of the natural resources and the application of space technology to planning the development of the national economy are significant.

An analysis of space photos of Tajikistan and their cartographic processing have made it possible to discover additional reserves of arable lands and lands suitable for irrigation, as well as natural food sources, and geological formations which are promising for valuable mineral exploration. During these studies the dimensions and features of mountain ice formation are studied in greater detail, and the avalanche and mudslide-prone regions are mapped. Valuable data on water and hydroelectric resources are obtained.

In the comprehensive study and mapping of the natural resources of the Kalmytsk ASSR, space photos have made it possible to discover regions in the republic which are promising for oil and gas exploration. The oil- and gas-bearing nature of the structures identified by the photos is confirmed by geological and geophysical data and drilling operations. The results from processed satellite survey data have been used successfully to identify the regions of arable lands and reclaimed lands, to plan the efficient ultization of lands and food resources, and to take environmental protection and recultivation measures.

Specifically, modern areas of drifting sands and salt marshes are identified, together with regions for the possible procurement of emergency fodder supplies. The application of satellite photos to the mapping of the ancient Volga river valley, which is promising for fresh water exploration, is very promising.

Results from an entire series of other developments based on the application of satellite survey technology have also been used successfully in the national economy. Hence, satellite photo-based maps are used in the planning and surveying operations of Gidroproyekt in the Central Pamir, in the surveying and planning of the tunnels on BAM by the organizations of the USSR Ministry of Transportation Construction, and in the study of the hydrogeological features of Lake Sevan.

The front line of research on the comprehensive mapping of natural resources using satellite survey data is expanding. Their productivity has attracted the attention of several economic and scientific organizations. Analogous efforts are being developed in the Kirghiz SSR, Uzbekistan, the Stavropolskiy Kray, the Kalininskiy and Astrakhanskiy oblasts, the BAM regions, Western Siberia and Kazakhstan. Their importance in concentrating the efforts of different departments in joint studies of the most promising regions of the country is increasing.

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INVESTIGATING SPATIAL DISTRIBUTION OF PHYTOPLANKTON IN LAKE BAYKAL BY OPTICAL METHODS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83 (manuscript received 14 Jan 83) pp 11-14

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[Abstract] The total biomass and productivity of phytoplankton can be judged from the concentration of chlorophyll "a." The authors have investigated the distribution of phytoplankton chlorophyll in Lake Baykal. Hydrooptical and hydrobiological investigations were made in July-August 1976-1977, a total of 110 stations being occupied. At most stations measurements were made with a field differential spectrometer, a differential spectrophotometer for hydrooptical investigations, a submersible fluorometer and a transparency meter for determining the spectral brightness coefficient (SBC) of the surface, the concentration of phytoplankton chlorophyll in water samples, vertical distribution of phytoplankton and water transparency. The SBC was registered both at stations and while the ship was proceeding on course. It was found that water transparency in August 1976 was 4.5-9 m, with the chlorophyll content varying from 0.50 mg/m^3 along the eastern shore in the northern part of the lake to 1.5 mg/m^3 along the western shore; in the open part of the lake the chlorophyll concentration was 0.5-1.0 mg/m^3 (the distribution is mapped in Fig. 1). Lower concentrations were observed in July 1977. The chlorophyll concentration maximum was usually at a depth two or three times greater than the transparency depth. The brightness of water body surfaces is dependent on the content and size distribution function of hydrosol particles. With a decrease in water transparency the reflection maximum is displaced into the long-wave region. In the spectra of the brightness coefficients there is registry of chlorophyll absorption, especially the red absorption band, from which it is possible to evaluate the content of phytoplankton chlorophyll in the surface layers of water bodies. The use of the mentioned set of optical instruments was found to broaden considerably the possibilities of hydrobiological investigations, in a relatively short time making it possible to carry out a large volume of observations and to determine the spatial distribution of phytoplankton chlorophyll and to evaluate its productivity. Figures 2; references: 3 Russian.
[27-5303]

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DEEP CRUSTAL STRUCTURE ON SPACE IMAGES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83
(manuscript received 21 Mar 83) pp 32-39

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[Abstract] A series of major landscape elements was defined in northern Armenia and adjacent areas from space photographs obtained by Soviet and American space vehicles. These landscape elements included: Neogene-Quaternary cover of mountains, plateaus and valleys; narrow linearly elongated ranges; major outcrops of the Mesozoic-Cenozoic folded complex, penetrated by numerous lineaments and forming a complex mosaic-block pattern. Each of these landscape types is discussed in detail relative to their images on space photographs. A full-page map shows the interpreted features. It is shown that on space photographs the structures of the granite-metamorphic substrate, and also the structural stages of the folded complex can be discriminated in the form of structural elements of second and higher orders. These structural elements of second and other orders in most cases are not discriminated on geological maps of different scales. But with an increase in the degree of their generalization their overall expression on space photographs forms lineaments which for the most part coincide with deep faults. These faults delimit major tectonic blocks of the buried structural stage, usually the crystalline basement. A whole series of distinctive formations and lineaments could be detected for the first time in the studied area due to the generalizing properties of space photographs. For example, the interpretation of such photographs made it possible to discriminate narrow interblock, long-developing structures near faults which mark both exposed and buried ophiolitic zones, as well as outcrops of basic volcanites, subvolcanic, dike and intrusive formations of the Jurassic. These and other data make it possible to detect deep faults extending to the mantle. The effective combining of geological and geophysical investigations with the interpretation of space photographs at different scales in deep investigations can increase the efficiency and quality of the work. The study of deep structure of concealed structural elements by the interpretation of space photographs and clarification of the block structure of the granite-metamorphic basement is affording new directions in structural-tectonic regionalization and recognition of the patterns of mineral distribution. Figures 1; references: 16 Russian.
[27-5303]

UDC 550.814:629.78

SENSING OF FACTORS INVOLVED IN DEVELOPMENT OF EXOGENOUS PROCESSES ON SPACE PHOTOGRAPHS OF ARID TERRITORIES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83 (manuscript received 9 Mar 83) pp 40-48

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[Abstract] Analysis of the factors involved in the development of exogenous processes is the basis of investigations of the laws and patterns of their distribution and evolution. This article examines the possibilities of detecting the principal factors involved in the development of exogenous processes from space photographs of different levels of generalization in the example of karst, eolian and landslide processes. These processes differ in character since karst and eolian phenomena have an areal distribution on space photographs, whereas landslide phenomena have a linear image. Four major tables are presented: 1. Use of space photographs of different levels of generalization for study of factors in the development of exogenous processes; 2. Principal types of patterns formed by karst on space photographs with local level of generalization and their importance for interpretation (in arid platform regions); 3. Principal types of patterns formed by eolian forms on space photographs with different levels of generalization and their importance in interpretation (for arid platform regions); 4. Principal types of patterns formed by landslide phenomena on space photographs of local level of generalization and their importance in interpretation. Figures 1-3 illustrate specific examples of interpretation of karst, eolian and landslide phenomena; these are also discussed in the text. Since the study of exogenous processes is of great importance, the further development of work such as described in this article can be deemed one of the important directions in the use of space photographs in geological engineering. In particular, this applies to the clarification of the relationships between manifestations of exogenous and endogenous processes, a problem which still remains unsolved. Figures 3; tables 4; references: 5 Russian.
[27-5303]

UDC 551.25:629.78

STRUCTURAL-GEOMORPHOLOGICAL INTERPRETATION OF LINEAMENTS DETECTED FROM SPACE PHOTOGRAPHS AND PATTERNS OF MINERAL DISTRIBUTION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83 (manuscript received 11 Feb 83) pp 49-59

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[Abstract] Stereoscopic interpretation of space photographs from the "Meteor" artificial satellites at scales of 1:10,000,000 and 1:2,500,000 for the Ural

region were used in defining first order lineaments grouped into a hexagonal lattice, illustrated in a map of interpreted features (Fig. 1). The parameters of the lattice were examined for latitudes 52-58°N; the average distance between the points of intersection of lineaments was 274 km; the average distance between lineaments was 235 km. The mapped lattice was subjected to geological-geomorphological and geophysical analysis for ascertaining its reality and investigating its properties. The specific results of this analysis are presented in detail, taking into account the different plotted features (first order faults of the meridional lattice; second and third order faults of this same lattice; faults in latitudinal hexagonal lattice; main and secondary water-divides, elevations, large and small intrusions and dikes, etc.). The position and strike of these lineaments are examined in relation to the magnetic and gravitational fields. It was confirmed that the lineaments are basement faults forming the present-day relief; the defined hexagonal lattice was found to be real and the first order faults, of considerable extent and width, in essence are zones of increased crustal permeability. In this area with the meridional lattice of first order (and some second order) faults there are major deposits of iron, copper, nickel, chromium, manganese, vanadium, bauxites and coal (Fig. 2 shows the location of these deposits relative to the lattice; Fig. 3 shows the distribution of deposits as a function of distances from the axes and points of intersection of first order faults of the meridional hexagonal lattice; Fig. 4 shows the percentage of deposits occurring within a zone of a particular width). There is a statistical correlation between these deposits and the first order faults in the meridional hexagonal lattice. A situation entirely analogous to that in the Urals is observed in Central Europe and is also analyzed here. These lattices are relief-forming and also exert an influence on the form, location and extent of tectonic structures and geological bodies. Figures 5; references 31: 25 Russian, 5 Western.
[27-5303]

UDC 633.1:629.78

SEASONAL VARIATION OF SPECTRAL BRIGHTNESS COEFFICIENTS FOR BARLEY AND RYE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83 (manuscript received 22 Mar 83) pp 72-80

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[Abstract] One of the most important problems in the remote sensing of agricultural crops in the optical wavelength range is a determination of the phase of plant development. This article gives the results of ground measurements of the seasonal variation of the spectral brightness coefficient (SBC) of barley and rye fields together with an analysis which takes into account the phenological development of plants. The field measurements were made in four seasons in barley and rye fields in the Estonian SSR and in experimental plots at a seed selection station. The principal instrument used was a field four-channel photometer which in each spectral channel made it possible to measure

the spectral brightness of the radiation reflected from the fields in the direction of the nadir with an angle of view of about 13° and the spectral density of the flux of total radiation incident on the field from the hemisphere. The photometer spectral channels were blue, green, red and near-IR. Mounted at a height of 2.5 m, the photometer viewed a sector of the field with a diameter of 40-45 cm. An effort was made to make the measurements at the near-midday hours with a stable illumination regime. After photometric measurements were made in the control areas the crop phenophase was determined using the methods usually employed in agrometeorology. The moistness of the soil surface was also determined visually on a four-unit scale (the soil SBC plays an important role in the initial phenophases of development of grain crops). The authors discuss the spectral brightness coefficient and vegetation index of these two crops during different phenophases (sprouting, tillering, stem extension, heading, milky ripeness). It is shown that the seasonal variation of the SBC and vegetation index or other such combined spectral characteristics correlate fairly well with the phenophases of development of grain crops. Figures 3, tables 1; references 12: 4 Russian, 8 Western.
[27-5303]

UDC 518

ORGANIZING WORK WITH INFORMATION FLOWS IN SYSTEM FOR AUTOMATED PROCESSING OF DATA FROM REMOTE SENSING OF THE EARTH FOR USE IN AGRICULTURE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83
(manuscript received 9 Mar 83) pp 85-92

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[Abstract] The USSR Ministry of Agriculture is creating a system for the remote sensing of the state of agricultural resources which includes automated data processing requiring use of several computers. The complex includes a specialized data bank, one computer being specially allocated for this purpose. This computer has peripherals making possible the input of information supplied in different forms (alphabetical-digital, graphic, half-tone); the display and registry of initial, intermediate and final information on color half-tone displays, on alphabetical-digital displays and with printout devices and an automatic color curve plotter. The capacity for storage on magnetic direct-access carriers will make it possible to store great volumes of information. The users of the specialized data bank will be representatives of administrative and Party organizations, remote sensing data processing subsystems, and subsystems for the collection of auxiliary data needed for processing remote sensing data and preparation of materials for dissemination. Two different classes of information must be dealt with ("point" and "grid-square"), these requiring different processing procedures. Figure 1 is a block diagram of the proposed information system; Fig. 2 illustrates "point" and "grid-square" representation of data; Fig. 3 illustrates the programming support for the data bank; a special diagram clarifies the logical structure of the base

for "point" data (all of which are fully described in the text). Examples of the type of information which can be furnished by the system are given. The programming support is organized on the modular principle and the system can be readily augmented by the addition of other modules. While intended for the handling of agricultural data, the same system can be employed for systems for remote sensing of natural resources, such as forests and minerals. Figures 5; references: 2 Russian.
[27-5303]

UDC 502.3:629.78

AUTOMATED SEARCH FOR CONTROL IMAGES ON PHOTOGRAPHS OF EARTH'S SURFACE USING SPECTRAL ANALYSIS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83 (manuscript received 28 Dec 82) pp 93-99

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[Abstract] It is necessary to seek control images when processing aerospace photographs of the earth's surface for their collation, topographic referencing and discrimination of structural elements. In the automated search the photograph is broken down into fragments. The extent of the fragment is determined by the relative energy of the control image in it. The article describes an algorithm for the fragment-by-fragment spectral analysis of a photograph for automated search. The control images sought on the photographs differ from the standard photographs by so-called "admissible transformations." The admissible transformations are stipulated by a group of movements of the plane (shifts and rotations). In applying the algorithm the photograph is placed in the memory of a display processor (512 x 512 image elements). The coherence values are successively computed for each square fragment of the photograph. The fast Fourier-Bessel transform is used in computing coherence. The coherence is invariant relative to the admissible transformations. A mosaic recognition chart (a table of the coherence values for each fragment) is constructed and fed to a half-tone display. The Laplacian is used in enhancing the relative energy of the control images. The algorithm can be used in collating multizonal photographs of the earth's surface with a high spatial resolution and a satisfactory accuracy in determining the coordinates and angle of rotation of the coordinate system for the control image is attained. Formulas are derived for the dispersion of the correlation functions of images differing in rotation in the presence of noise with a normal distribution; these make it possible to evaluate the "triggering threshold" in the fragment-by-fragment spectral analysis algorithm. Figures 3, tables 1; references: 7 Russian.
[27-5303]

UDC 773.711+528.77

METHOD FOR CREATING SYNTHESIZED IMAGES USING DIAZO COLOR FILMS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83
(manuscript received 30 Mar 83) pp 100-102

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[Abstract] There is a wide range of effective approaches for exploiting the full information content of multizonal photographs, but many of these require elaborate processing facilities. The diazo film method is considerably less complex in this respect. It involves the preparation of color synthesized images by the ultraviolet exposure of the diazo film, no use of additive projectors being required. Its relative simplicity makes possible the production of synthesized images at all centers making use of multizonal aerial and space photographs and an arbitrary combination of images obtained in different spectral channels for the purpose of obtaining the desired synthesized images. Diazo material makes it possible to obtain copies with a greater contrast than on the original material. This effect can be eliminated by preparing second and third diazo copies, for which it is best to use black-and-white diazo material which is then copied on color copies. The superposition of different color copies makes it possible to obtain different variants of synthesized images. The presently employed methods for creating synthesized images using projectors do not reveal all the information contained in multizonal photographs. This can be achieved by using a combination of negatives and positives of different channels and other procedures. The successive steps in the processing of diazo materials are discussed. As a result of forming of different combinations it is possible to obtain from several tens to more than a hundred different variants of sets for interpretation (not all would be suitable for further processing). The specific use of diazo materials at the Polish Institute of Geodesy and Cartography for the processing of multizonal photographs is briefly described. References: 1 Western.
[27-5303]

UDC 551.521.3:519.251.6

CRITERIA FOR EFFICIENCY OF EXPERIMENTS IN REMOTE SENSING

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 5, Sep-Oct 83
(manuscript received 17 Mar 82) pp 103-112

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[Abstract] The article discusses problems involved in solution of inverse problems in remote sensing and analysis of their information content. One of the most important tasks is optimization of remote measurements with selection of the best criteria for optimality of an experiment. Accordingly, the author examines several possible approaches to determination of such criteria. A

formulation of the problem is given and the problem of search for the best measurement plan is examined for solving the inverse problem of retrieval of the function φ on the basis of the results of measurements f containing the random errors ε: $f = L\varphi + \varepsilon$. The informational possibilities of the linear inverse problem, which are pertinent to the subject considered here, were examined in an earlier article by the author ("Solution of Inverse Problems by the Method of Ranking of Components With the Availability of Information on the Position and Extent of a Domain of Possible Solutions," IZV. AN SSSR: FIZIKA ATMOSFERY I OKEANA, Vol 12, No 11, 1976, pp 1221-1224. Using this approach, the author formulates criteria for evaluating the quality of an experiment on the basis of the qualitative and quantitative makeup of the information obtained in an experiment. It is shown that a numerical algorithm for optimization of a remote sensing experiment can be based solely on computation of the characteristics of the matrix of information content of measurements S_f. This problem can be solved using an algorithm already described by the author in VOPROSY KIBERNETIKI, NETRADITSIONNYYE PODKHODY K PLANIROVANIYU EKSPERIMENTA, No 73, Moscow, Sov. Radio, pp 110-118, 1981. Proceeding on this basis, the A_W test, characterizing the value of a solution, is recommended as the principal criterion of the effectiveness of an experiment for problems in remote sensing of the environment. The applicability of this test is illustrated in a specific example. Tables 2; references 30: 20 Russian, 10 Western.
[27-5303]

IZVESTIYA ASSAILS U.S. MILITARY SPACE PLANS

Moscow IZVESTIYA in Russian 5 Oct 83 p 5

[Article by L. Koryavin, IZVESTIYA staff correspondent, in the column "Letter from Washington": "The Coils of the Space Threats"]

[Text] The American military clique is becoming cramped in terrestrial latitudes and longitudes. It is aiming for heights above the clouds, seeking "living space" and "a sphere of influence" in the broad reaches of space. You will find no such constellation as "MILSTAR" on any astronomical chart, but it is marked on the Pentagon's strategic charts.

"'MILSTAR'--This is the name of a constellation of U.S. military satellites," writes the magazine NEWSWEEK, "which will be placed in orbit in order to provide the president with the basic means for controlling nuclear and conventional forces." The significance of satellites for military command is common knowledge. The U.S. Army already uses them extensively for communication when carrying out actions of "military presence abroad". Military satellites are a most important part of American plans for "star wars" in space. The space "battlefield" requires its own arsenals of weapons, and these now are being created at accelerated tempos in the United States.

These days the dangerous "smog" of the military opiate hovers especially thick above the American skyscrapers. The question of militarizing outer space is being debated actively in U.S. military and political circles along with other military programs. In Washington today, they get by without the hypocritical argument about "protection of American children in the 21st century", no longer describe space weapons as "exotic means of defense", and say openly: "The United States is preparing for the day when war may begin in space." The WASHINGTON POST stressed this the other day.

From the theory of the space "shield", which President Reagan advocated, the United States has shifted to a sharpening of the "first strike" sword. In view of this, the military does not take into account the fate of children of the coming century. It makes its dangerous plans in calculation based upon the present century, and remains indifferent to the fate of entire generations. That same WASHINGTON POST cited the words of Deputy Secretary of the U.S. Air Force Edward Aldridge: "Whoever rules space," he declared, "also rules the world."

The generals also are creating a new military space hierarchy. Distinguishing badges for the space command created in the U.S. Air Force have been published in the newspapers. The emblem of the badge is symbolic: some kind of symbiosis of strategic missiles and "shuttle" craft literally has covered the globe of the world. Soon a "Naval Forces Space Group" will be formed. But Congressman Kenneth Kramer of the State of Colorado, who is linked to large corporations making "death weapons", proposes to create a unified "United States Military Aerospace Command".

Mention of the large corporations is quite appropriate here. Their "hierarchy" is marked by entirely different distinguishing badges--billions in profits--and they grow proportionately as military programs push efforts in the peaceful conquest of space farther and farther into the background in the United States. The LOS ANGELES TIMES pointed out "the increasing militarization of American activity in space to the detriment of its use for civil and commercial purposes," and Professor Tsipis, of the Massachusetts Institute of Technology, warns that "the conquest of space for peaceful purposes will come to naught in the United States."

Transatlantic concepts of military "conquest" of space are being transformed into the monetary activity of large military-industrial corporations which, receive billions in profits by manufacturing death-dealing weapons. When President Reagan made the speech calling for militarization of space, a representative of the New York (Cyrus Lawrence) Company immediately printed the motto "Money from the skies" on letterhead stationary of his firm. This was not simply a joke. The profits of large corporations participating in the creation of space weapons shot upward with truly cosmic speed.

Today the Pentagon spends more money on military space systems than is spent by the National Aeronautics and Space Administration (NASA). The term "military space budget" already appears in the American press. Its assets consist of billions of dollars and, as the WASHINGTON POST stressed, these are growing by 10 percent annually, which is higher than the growth indices of any other military expenditures of the United States. Vast, too, is the arsenal of systems with which the Pentagon intends to fill near-earth space in shifting the dangerous coils of the arms race into space: "space interceptors" and "laser cannons", orbital "kamikaze" satellites, "missile-killing missiles" --and this is far from a complete list of the means by which the United States is prepared to achieve its imperial ambitions at altitudes above the clouds.

Let us reiterate. The coils of the space threats are winding around pages of the American press today. They are on the lips of politicians and military men, and they are on the television screens. The most important U.S. newspapers carried articles a few days ago about U.S. military objectives in near-earth space. These reflect the intensity of the military psychosis which has enveloped the political and military agencies of the United States today. Hypocritical assertions about the "defensive conceptions" of the United States in space, and about the creation of a space "security shield", have dissolved in the din of threats.

A single example: Literally on the very same day when the Soviet Union proposed to include in the agenda of the UN General Assembly an item "On concluding a treaty for prohibition of the use of force in outer space, and from outer space with respect to earth," the NEW YORK TIMES which, by the way, failed to mention the new Soviet initiative in a single line, carried extensive material under the heading "Weapons Against Satellites Are Ready for Testing."

The campaign for militarization of space has arisen with new strength on the wave of chauvinism and frantic anticommunism which was built up in the United States after failure of the provocative intrusion into USSR air space of the South Korean "Boeing-747". Incidentally, regarding the "Boeing-747": Its technical quality attracted the attention of strategists for the militarization of space, and they included the aircraft in the arsenal of "star wars" weapons. The generals proposed to lift into the air "a combat spacecraft, which would be installed on the fuselage of a 'Boeing-747' liner and then, by means of its own rockets, would go into space and place its cargo in a low, near-earth orbit." They propose to transfer "command posts" into air space above the earth to which, at the moment of a "critical situation", they intend "to launch" even the leadership of the United States. This "flying White House" which, as the American magazine NEWSWEEK has advised, will be "an airborne command post for the president in an extreme situation," is planned for emplacement aboard that same "Boeing-747".

Drawing arrows of expansion in terrestrial latitudes and longitudes, the American military clique is peering even into space, where the military-industrial complex is beginning a new and dangerous round of the arms race. The planned Pentagon raids into space are part of a broad U.S. strategic program aimed at the attainment of global superiority, a program which Washington is trying to cover up by a demagogic screen of preaching about "peacemaking".

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CSO: 1866/39

U. S. ASAT PROGRAM VIEWED AS ELEMENT OF SPACE MILITARIZATION POLICY

Moscow KRASNAYA ZVEZDA in Russian 28 Feb 84 p 3

[Article by S. Oznobishchev, candidate in history: "A Threat To Mankind: Washington Is Forcing the Militarization of Space"]

[Text] "The starting signal for the arms race in space, "--in just this way, the NEW YORK TIMES in late January assessed the first test of the American ASAT antisatellite system, a special 18-foot missile launched from an F-15 fighter plane. This action was regarded in much the same way by other bureaus of the foreign press, by many specialists in military questions and by scientists. It was underscored that in just this way the United States had responded to the commitment assumed in August last year by the Soviet Union not to be the first to launch into space any kind of antisatellite device whatsoever. Let it not be forgotten that our country declared this unilateral moratorium for as long a time as other countries, in particular the United States, will refrain from launching any kind of antisatellite weapon. Washington's irresponsible step was perceived as fraught with exceptionally dangerous consequences and as an unabashed challenge to the world community. For, not very long ago, at the 38th session of the UN General [illegible], a resolution was passed by an overwhelming majority of votes concerning the need to take effective measures for the prevention of an arms race in space. Of course, even earlier in Washington the idea of using space for military purposes was hatched and specific measures were adopted in this direction. Now, however, its realization is regarded as one of the basic directions of the Reagan program for "rearming America," and one of the most important means of achieving military supremacy over the Soviet Union. In a booklet bearing the title "Space--the American Frontier: Stimulus to Growth, Leadership and Freedom," published by the largest Pentagon subcontractor, the military-industrial corporation Rockwell International, it is expressed outright that space systems will grant the United States "military supremacy over the Soviet Union," but the U.S. presidential science aide, Keyworth, made it more precise that in this case it is not simply a matter of military supremacy but of "nuclear supremacy."

In 1982, the United States announced the establishment of a Space Command. A directive of the Department of Defense and the National Security Council, contained a statement that "in the area of defense in the 1985 through 1989 budget years" there is a need "to develop fully operational space-weapon systems ready for deployment." There is a truly ominous character to the plans for building as early as 1987 more than 100 antisatellite systems. It is said that in practice any F-15 airplane can be converted quickly into an antisatellite weapon. Lately, plans are under discussion to modify carrier-based F-14 planes for use as antisatellite weapons. There is also talk about the project of improving the ASAT. In the opinion of the American Information Center for Military Questions, improvements will convert the ASAT into "an extremely dangerous supplement to a first-strike capability."

The arguments for military use of antisatellite systems are extremely striking. U.S. Undersecretary of Defense Ikle, for instance, thinks that an isolated attack on a satellite will undoubtably be regarded by the other side as an act of war and provoke that side to counteractions whose consequences will be devoid of any particular significance. The use of antisatellite systems as constituent parts of first-strike weapons for the destruction of all or many "key" satellites of an adversary is intended to impede significantly a return strike. This conclusion is also supported by the author of many studies in the field of U.S. military space programs, Karas. For the United States, the creation of antisatellite forces, he notes, "does not make much sense if there is no plan to carry out a first strike and to begin a nuclear war."

In the opinion of American specialists, antimissile systems stationed in space will possess even greater military capabilities. Even in American press reports it is recognized that such systems, particularly those equipped with laser and beam weapons, could be targeted not only on objects in space but on objects in the air, on land and sea as well. As attested by the representatives of the U.S. Air Force command, their use could thus lead to the obliteration of "the difference between war in space and war on earth."

The logic of the Washington strategists is abundantly clear: a space umbrella in the form of an overarching antimissile defense and of antisatellite weapons should protect U.S. territory from a return strike. In other words, this "umbrella," fostering the illusion of impunity, might well encourage the aggressive forces of American imperialism to reckless adventuristic actions. Graphic testimony of how persistently the Pentagon is straining to get into space is offered by the flights of the reusable spaceships of the Shuttle program. With their help, it is suggested, it would be possible to launch spy satellites and battle stations with laser weaponry and other military devices on board into near-earth orbit. Nor should it be forgotten that the Navstar space system is capable of determining coordinates of stationary and moving objects with great accuracy, thus greatly increasing the ability to target ballistic missiles. One could go on listing the American military space systems. But these are enough to make the point that there is an escalated extension of the arms race into space, with all its attendant perilous consequences for peace and international security.

One cannot but notice that Washington's politicians and strategists make little effort to conceal their space ambitions and that they are at times publicized in every possible way. Thus, U.S. Air Force Undersecretary Aldridge stated that "the country that controls space can control the entire globe." Notice carefully: "control the entire globe"--no more and no less. Such control, as is clear from a report in the American journal FOREIGN AFFAIRS, would open the possibility of "unrestrained strategic blackmail." Blackmail to which, it should be added, every country whose policy is not in tune with those in power in Washington could be subject.

One wonders whether such a threat to the world community is recognized--and to what degree--by those who are truly concerned with the fate of peace, including those in the United States. It is indeed realized. This can be seen by the more and more frequently appearing publications in the Western press and by the statements of scientists, politicians and respected commentators. They sharply criticize the present U.S. administration, stressing that its space plans and actions are in clear contradiction with the commitments assumed through the Soviet-American agreement on limitation of ABM systems.

"Diabolically clever" are the words used by the London newspaper OBSERVER to describe the strategy devised by the present U.S. administration aimed at "limiting the areas" where in the past mutual understanding was reached with the Soviet Union and in particular at the repudiation of the ABM treaty. In this connection, the newspaper quoted the following statement of a prominent American expert in arms control questions: "Anyone who closely follows the activities of Reagan officials knows that they have always categorically opposed the ABM treaty. Of course, if we would abide by this agreement, we would not be able to work out the machinery for waging 'Star Wars.' A grave threat was hovering over the ABM agreement." According to OBSERVER, this same expert also claims that "in the process of carrying out the above mentioned policy, the administration is duping the American people."

But it is becoming increasingly more difficult to do this. The militaristic course of the present administration is provoking mounting apprehensions and dissatisfaction among sober-minded Americans. According to press reports, Democratic Party presidential hopefuls "have participated in debates called to demonstrate that our planet has become a more dangerous place for mankind during the Reagan administration than it was before." Other countries, too, realize ever more clearly the reality of the global threat issuing from the "diabolically clever" strategy of Washington. For instance, at the UN Science and Technology Subcommittee session on the use of space for peaceful purposes, representatives of developing countries expressed growing alarm about U.S. steps to prepare for space wars. Warning that Washington's plans were jeopardizing the cause of peace, the Indian delegate U.R. Rao, proposed that a moratorium be declared on the testing or use of weapons of any kind in space. "Having failed to limit the deployment of new missiles in Europe," writes the Egyptian newspaper AL'-AKHALI, "Washington is now extending the arms race into space, an act which constitutes a genuine threat to the entire planet."

The desire to remove such a threat motivated vigorous efforts on the part of the Soviet Union aimed at preventing the militarization of space. The Soviet proposals called essentially for reaching an agreement on the complete prohibition of testing and deployment of any space-based weapon for striking objects on earth, in the air and in space. Moreover, the USSR is willing to agree on the destruction of already existing antisatellite systems and the outlawing of production of new such weapons. We mentioned above the obligations the Soviet Union assumed not to be the first to launch into space any kind of antisatellite weapon.

It was very typical that this same Soviet initiative constituted the core of the resolution concerning the need to take effective measures to prevent an arms race in space, a resolution passed by the overwhelming majority of votes at the 38th session of the UN General Assembly. It is also noteworthy that the U.S. delegate voted against this resolution in defiance of the clearly expressed will of the world community, heedless of the fact that the militarization of space would confront humanity with a threat whose magnitude is even now hard to imagine.

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FURTHER COMMENTARY ON U.S. ASAT PROGRAM

Moscow SOVETSKAYA ROSSIYA in Russian 2 Mar 84 p 5

[Article by A. Mozgovoy: "Space Chimeras"]

[Text] "I heard on the radio and have read in the papers some disturbing news that the American military clique was testing an antisatellite system called ASAT. Would it be possible to have more details as to this complex. What are the Pentagon's plans as to the production and development of antisatellite weapons?"
I. Akimov
Vologda

The desert state of New Mexico is highly esteemed by the Pentagon. There, in the city of Los Alamos, is a laboratory where the newest models of atomic weapons are created. And not only that. In the silent laboratories, theories are maturing which are just as dangerous for the world as atomic bombs. One of these ideas appeared at the beginning of 1980. Its creators were the laboratory director Robert Kerr, Edward Chapin, a co-worker in the same department, and P. Domenici, a Republican senator from the state of New Mexico. The trio came to the conclusion that the Soviet-American treaty on limitations on antimissile defense systems signed in 1972 was unsatisfactory for the United States and declared itself in favor of the development of antimissile and space weapons by the U.S.

Do not suppose that some kind of "America" was being discovered in the Los Alamos laboratories. It was simply that the scientists were laying down the theoretical basis for still another line of action in the arms race which the Pentagon was getting under way. In 1977, an agreement had already been made with the Link-Temco-Vought group for the design of antisatellite weapons. The content of the deal was carefully hidden. According to the official declaration of the Pentagon of 8 September 1977, "contract has been made with the Vought Corporation in Dallas (Texas) for the sum of 58,720,738 dollars for the development and testing of facilities in support of the technological program for space defense." What was hidden behind the clever wording, which looks like gibberish, only initiates could know. Thus Link-Temco-Vought had the ASAT (for Anti-Satellite) program in their briefcase.

Actually, the first models of this weapon were created in the U.S. in the 1950's. As an associate of the Rockefeller Institute for International Affairs, Paul Sterz, noted, in Washington "they had begun to think about antisatellite weapons before there were any satellites in orbit." The program moved forward at a rapid rate. In the "Bold Orion" exercises of 19 October 1959, a rocket was launched from a B-47 bomber and succeeded in intercepting an Explorer-6 satellite. The Pentagon built batteries of Thor and Nike-Zeus missiles on the Kwajalein and Johnston atolls which were intended to destroy orbiting vehicles. Later, the U.S. Department of Defense dismantled the obsolete equipment but simultaneously gave an order to Link-Temco-Vought and several other corporations for the design of a new antisatellite system. The relaxation of international tensions and Soviet-American agreements led to an official halt in the development of the system which is contrary to an ABM treaty. But in deep secrecy, the Pentagon, Link-Temco-Vought and other war business monopolies continued to study the problem of the development of antimissile and antisatellite weapons. According to the WASHINGTON POST, from 1974 to 1979 more than a billion dollars were spent for this purpose.

A new weapon was tested on 21 January of this year. It is true that in this test the missile was not aimed at a specific target; but in the future, it will be directed towards special target satellites. Ten of these practice targets have already been prepared.

What is an ASAT complex? It consists of a modified F-15 fighter, a two-stage rocket and a small "interceptor" which can be launched into circumterrestrial space by means of the booster rocket released from the F-15. The basis of the entire system is the Vought Corporation space "interceptor". It weighs a little less than 36 pounds but is full of very complex equipment. It contains homing infrared systems, a laser gyroscope, an onboard computer and several miniature thrusters.

Brigadier General Ralph Jacobson in the hearings of one of the subcommittees of the House of Representatives of the American Congress defined the objectives of the new weapon as follows: "In the United States there is a legitimate need for the ASAT system so as to deprive the Russians of the sanctuary status which they now enjoy in space." From this insolent declaration, it follows that the U.S. intends to arrogate to itself the supposed right to take charge of circumterrestrial space. By the way, at the present time sactuary status in space is enjoyed not only by the USSR, but by other states as well, including the U.S. of course. The Pentagon's intention to control space is fraught with catastrophic possibilities. "ASAT systems are capable of paralyzing the strategic defense of any country," writes the WASHINGTON POST. "For this reason, if such systems were placed in operation there would be considerable temptation to suspect an attack and to carry out a counterstrike if important satellites went out of order for unknown reasons. This increases the danger of nuclear war by accident."

The American scientist, John Payne, believes that antisatellite weapons are a key element in the possibility of nuclear war, but are not defensive as the present American administration is attempting to show. Lists of targets to be destroyed first have already been drawn up in the Pentagon. These include the Salyut space stations as well as meteorological and other Soviet satellites.

Many American political leaders and scientists are opposing the adoption and development of ASAT. In July of last year, more than one hundred congressmen and more than forty arms control experts made an appeal to the U.S. President to come to an immediate agreement with the Soviet Union on a two-stage moratorium on the testing in space of antisatellite weapons. Reagan paid no attention to this appeal.

But an answer was heard from Moscow. An especially important decision was made by the Soviet leadership: the USSR committed itself not to be the first to introduce into space any types of antisatellite weapons, that is, it established a unilateral moratorium as long as other governments refrain from introducing any types of antisatellite weapons into space.

Our country also proposed to include in the agenda of the 38th Session of the U. N. General Assembly an item: "Concerning the conclusion of a treaty for the prohibition of the use of force in space and from space towards the Earth." Except for the usual phrases that the U.S. Department of State would "study" the Soviet proposal for a treaty and unintelligible mutterings to the effect that the exact meaning of the Soviet proposals was supposedly "unknown" to the U.S., the American administration was unable to find a direct answer. This type of "inability to understand" is explained by the constant allergy of the U.S. ruling circles to peaceful initiatives whether coming from the American society, other governments, or international organizations. This was confirmed at the 38th Session of the U.N. General Assembly. The majority of the delegates adopted a resolution on the prevention of an arms race in space, but the U.S. representative voted against it. But now, as we know, the U.S. has tested an antisatellite complex in space. We note that the tests took place literally several days after the U.S. President's speech in which he attempted to present himself and his cabinet as zealous supporters of disarmament. "How can the Soviet Union and the American people take seriously the U.S. President if tests of new weapons in space take place right after his 'peaceful' assurances," was the reasonable question of Senator A. Cranston.

According to the Pentagon's plan, 56 antisatellite systems will be deployed by 1987 at the Langley Air Base in the state of Virginia and the McChord base in the state of Washington. It is further proposed to bring the number of "space interceptors" to 112 and to locate them largely outside of the U.S.: in the Falkland Islands (Malvinas) conquered by the British empire in 1982 from Argentina with the help of Washington, and in New Zealand.

What is the final result? Perhaps the U.S. will obtain the desired superiority? No. The Pentagon's antisatellite weapons are a stick with two ends. Even the American military experts are arriving at this opinion.

The Soviet Union proposes not to rush after a chimerical superiority which is fraught with ruin for all life, but to sit down at the negotiating table and particpate in an honest dialogue based upon the principles of equality and mutual security. "The USSR will cooperate fully with all governments which are prepared to facilitate, with practical means, a reduction in international tensions, and to create an atmosphere of trust in the world," declared the General Secretary of the CPSU, Comrade K. U. Chernenko. "In other words, to cooperate with those who will really act not to prepare war but to strengthen the foundations of peace."

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LAUNCH TABLE

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
2 Feb 84	Cosmos-1535	1,029 km	974 km	105 min	83°
8 Feb 84	Cosmos-1536	679 km	648 km	97.8 min	82.5°
8 Feb 84	Soyuz T-10	(Cosmonauts Kizim, Solov'yev and At'kov; docked with "Salyut-7" on 9 February)			
15 Feb 84	Raduga	35,950 km	--	24 hrs 00 min	1.3°
		(Near-stationary, circular orbit; communications satellite for relay of telephone, telegraph and TV programs)			
16 Feb 84	Cosmos-1537	317 km	220 km	89.5 min	82.4°
		(For continuation of earth resources studies; data to be processed at State Research and Production Center "Priroda")			
21 Feb 84	Cosmos-1538	820 km	781 km	100.8 min	74°
21 Feb 84	Progress-19	261 km	192 km	88.7 min	51.6°
		(Automatic cargo ship launched to "Salyut-7")			
28 Feb 84	Cosmos-1539	367 km	179 km	89.6 min	67.1°
2 Mar 84	Cosmos-1540	36,000 km	--	24 hrs 5 min	1.4°
		(Circular orbit; carries experimental equipment for relay of telegraph and telephone communication in the centimeter waveband)			

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
6 Mar 84	Cosmos-1541	39,424 km	584 km	11 hrs 50 min	62.9°
7 Mar 84	Cosmos-1542	373 km	236 km	90.3 min	70.4°
10 Mar 84	Cosmos-1543	416 km	224 km	90.6 min	62.8°
15 Mar 84	Cosmos-1544	677 km	649 km	97.8 min	82.5°
16 Mar 84	Ekran	35,530 km	--	23 hrs 43 min	0.1°
		(Near-stationary, circular orbit; TV communications satellite)			
17 Mar 84	Molniya-1	40,579 km	646 km	12 hrs 15 min	62.9°
		(Communications satellite for long-distance telephone, telegraph and radio and for broadcast of USSR Central Television programs to points in the "Orbita" network)			
21 Mar 84	Cosmos-1545	396 km	208 km	90.2 min	72.9°
29 Mar 84	Cosmos-1546	36,029 km	--	24 hrs 8 min	1.19°

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