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AN OVERVIEW OF THE KALININGRAD SPACEFLIGHT CONTROL CENTER

Translation of "Tsentr upravleniya poletom", "Mashinostroyeniye" Press, Moscow, 1985, pp. 1-33.

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16. Abstract

This booklet gives a general description of the Kaliningrad Spaceflight Center near Moscow, where Soviet orbiting and interplanetary spacecraft are monitored and controlled. Brief descriptions of the equipment used and the scope of work done at the center are included.

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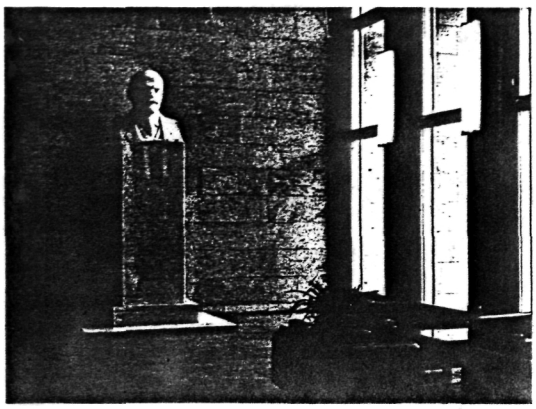
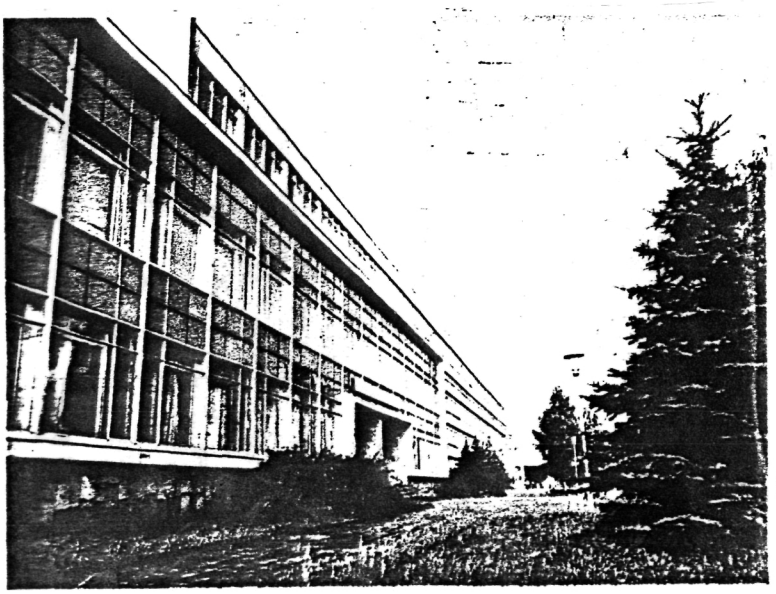
AN OVERWIEW OF THE KALININGRAD SPACEFLIGHT CONTROL CENTER





The flight control center in Kaliningrad near Moscow is well known to those who are associated with astronautics.

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* Numbers in the margin indicate pagination in the foreign text.

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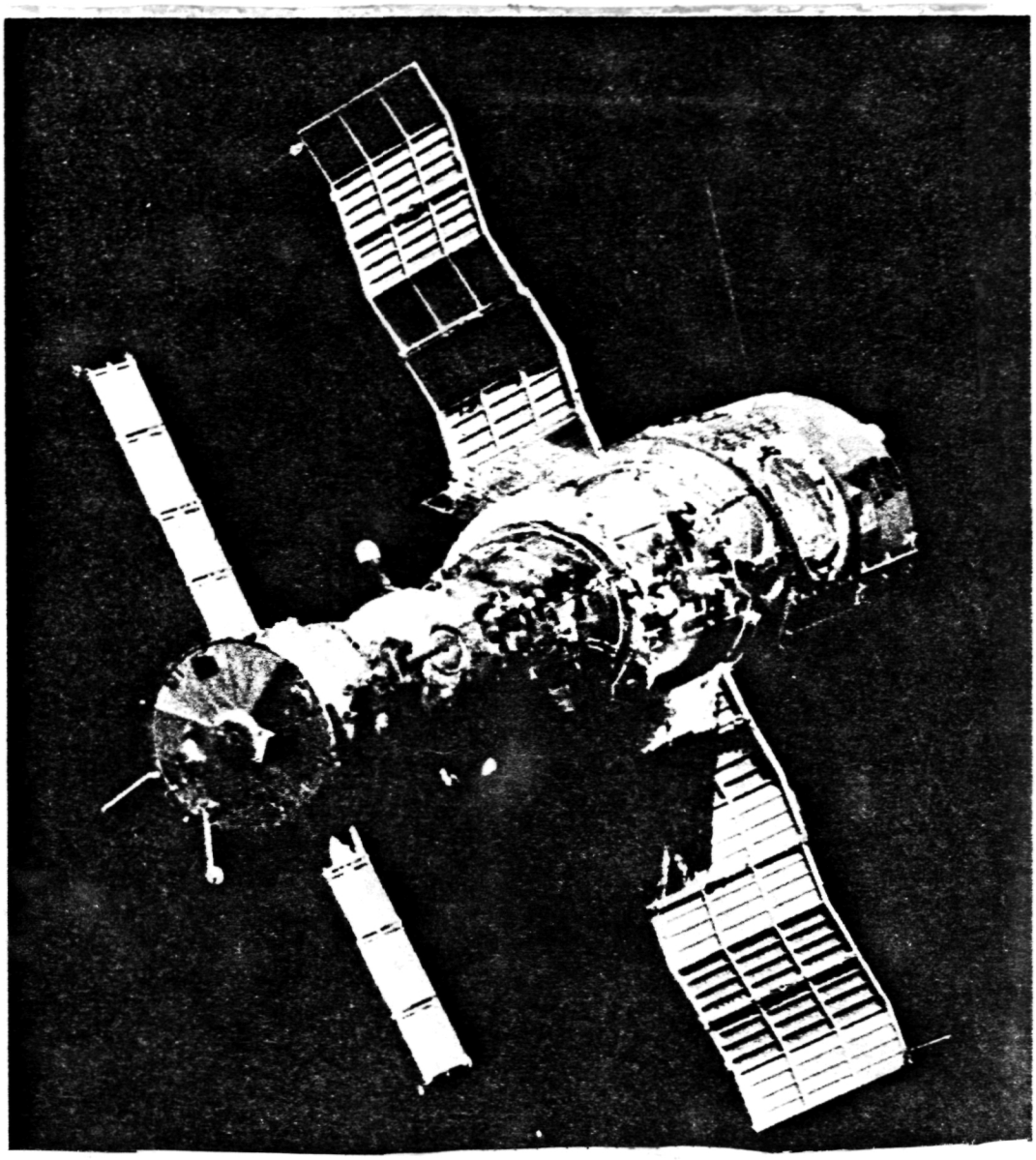

Orbital Complex Salyut-Soyuz

The flight control center is a unique organization engaged in both the actual flight control of spacecrafts for scientific and national economic purposes, as well as scientific investigation and development of methods, algorithms, and means of solving flight control problems.

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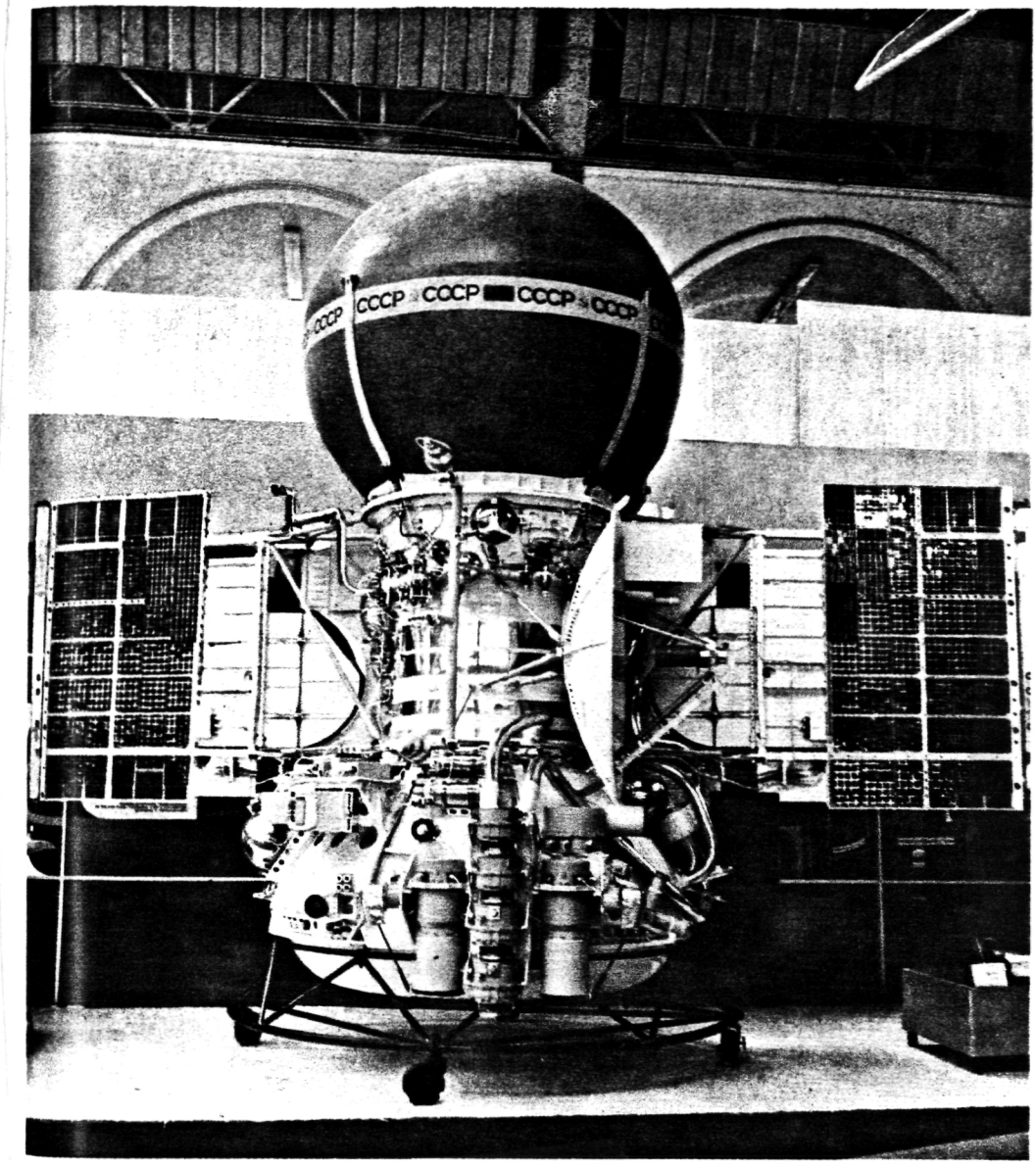

"Venera" interplanetary space probe

This is where spaceships and space stations orbiting the Earth and directed toward the planets of the Solar System are controlled.

The Center monitors the work and condition of the crew via onboard and ground equipment, programming their operation. /4 Programs are developed by gathering, processing, and analyzing information about the condition of all elements of ship and ground equipment. Each hundredth of a second, telemetry transmitters, about a thousand on the ship and more than two thousand at the station convey readings which serve as primary information for control.

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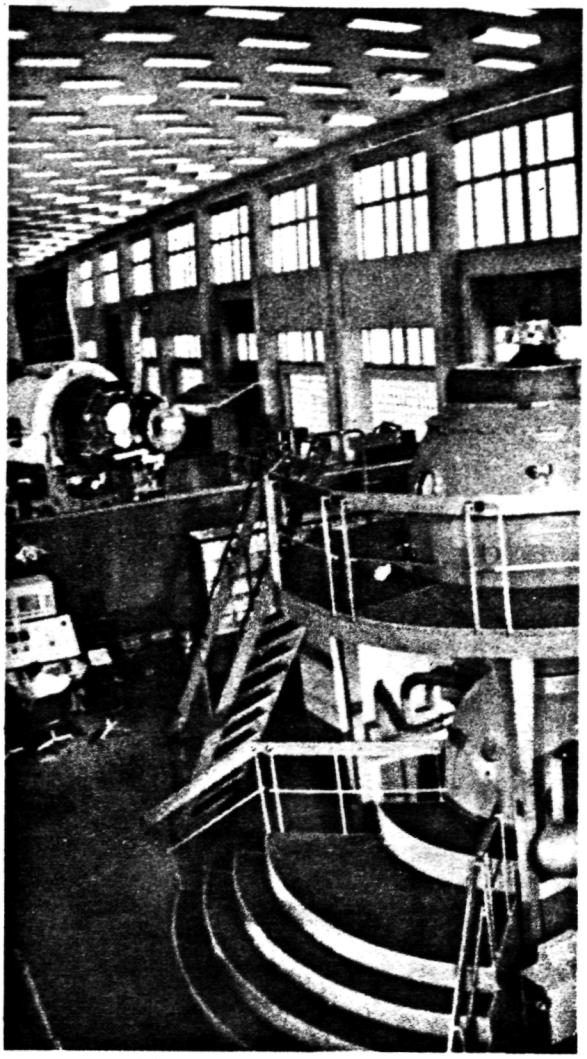
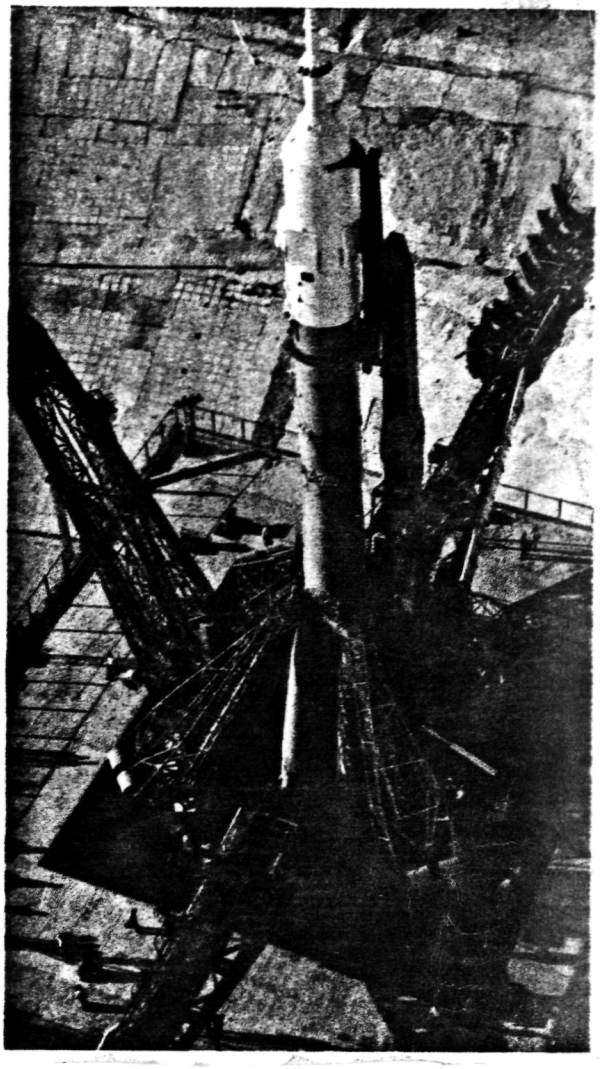
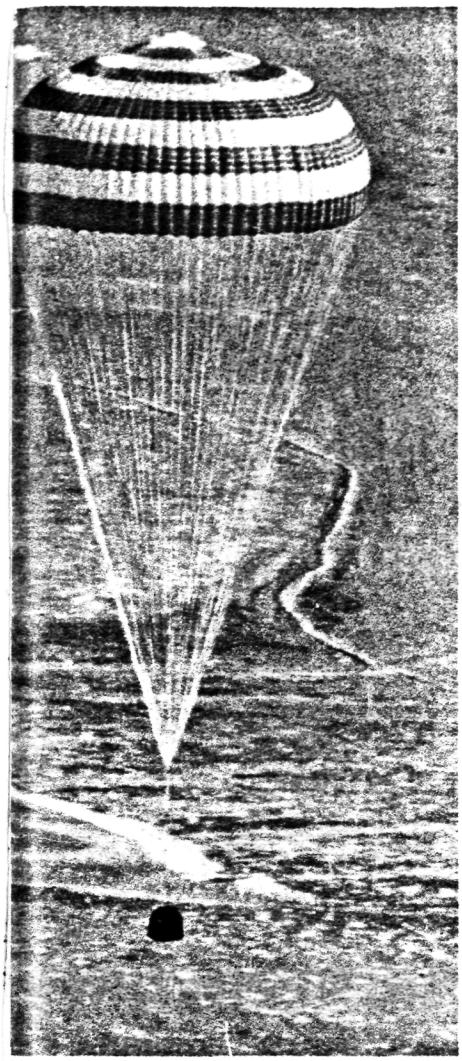




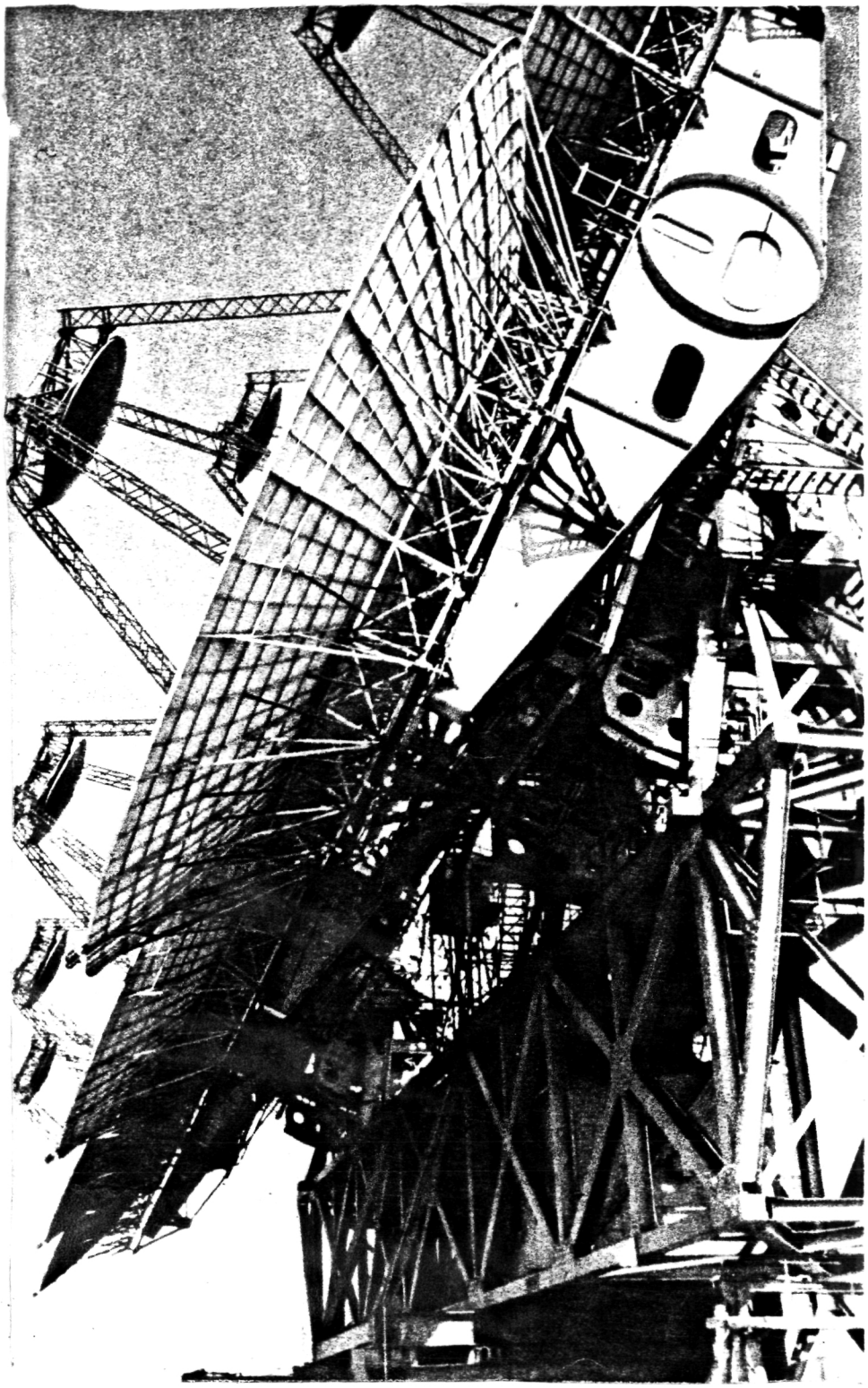
In the control process, the Center carries out operational guidance of flight and coordinates the operation of ground-based tracking stations, floating tracking stations, and ballistic centers. The Center interacts with the launching and recovery complexes, training-simulation facilities, and various organizations participating in flight support.

The Center reports both the date and the exact time of the launch to the cosmodrome, and until the spacecraft enters orbit receives telemetry information from the cosmodrome about the condition of the craft's on-board systems and the state of health of the cosmonauts, television pictures from the launch position and from aboard the ship, information about radio conversations of the cosmonauts with the command post, data on the course of prelaunch preparation and the launch of the craft into orbit.

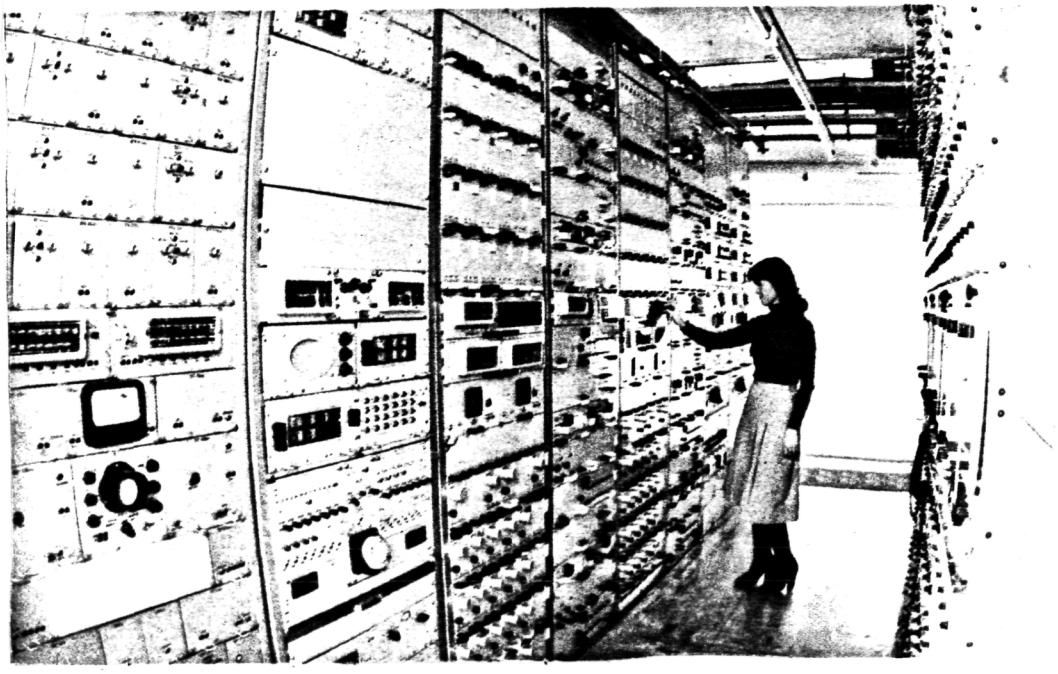


The role of tracking stations is important for ensuring reliable communication with the spacecrafts and continuous flight control. They are used for transmitting radio and television signals and for receiving and processing information from spaceships and orbital stations. With the aid of communication satellites, the control center maintains communication with remote ground and floating tracking stations.

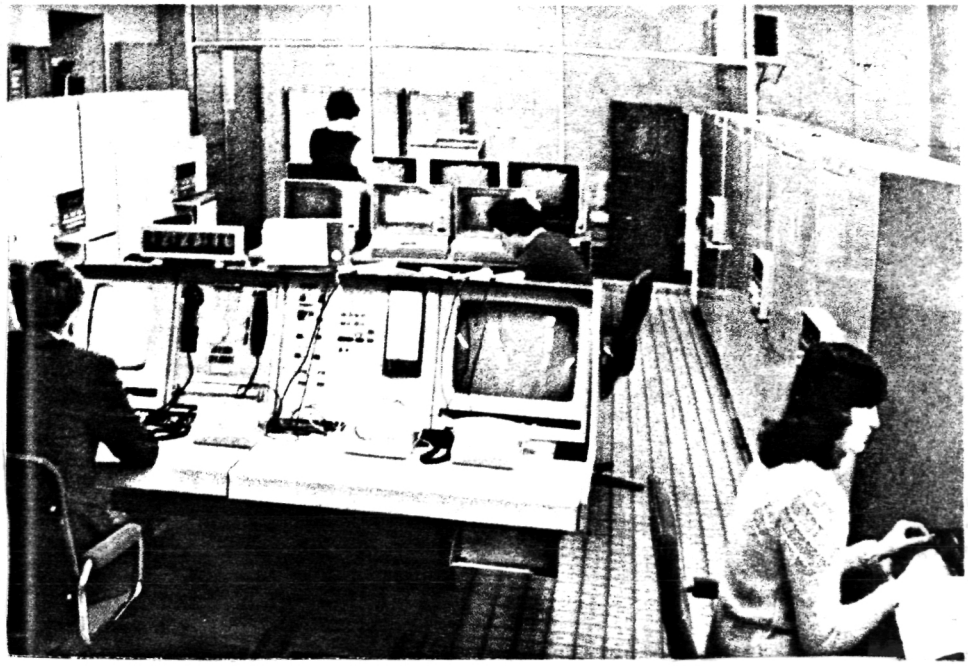
Because of flight trajectory displacement from spiral to spiral due to the Earth's rotation, the orbital complex enters into the station's field of vision at various points. The stations need target designations so that their antennas "meet" the complex at the appropriate locations. The Control Center specifies raw data for calculation. Ballistics determine the orbital parameters of the craft and the complex on the basis of radio measurements taken by tracking stations. /6



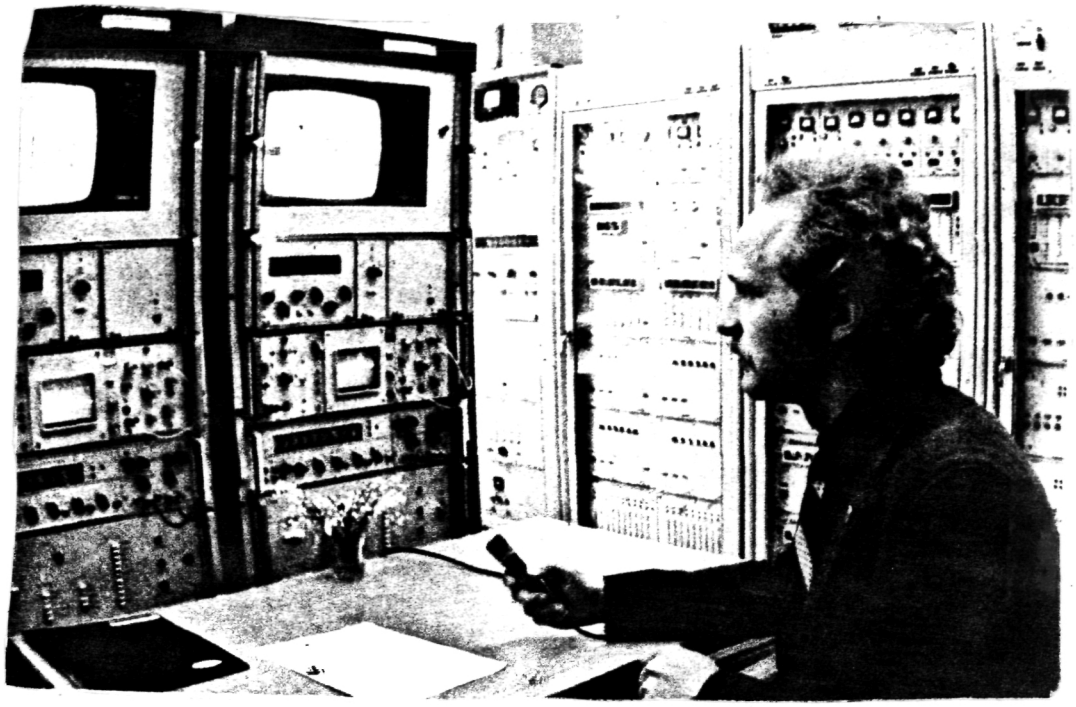
The center's antenna for long-range space communication.



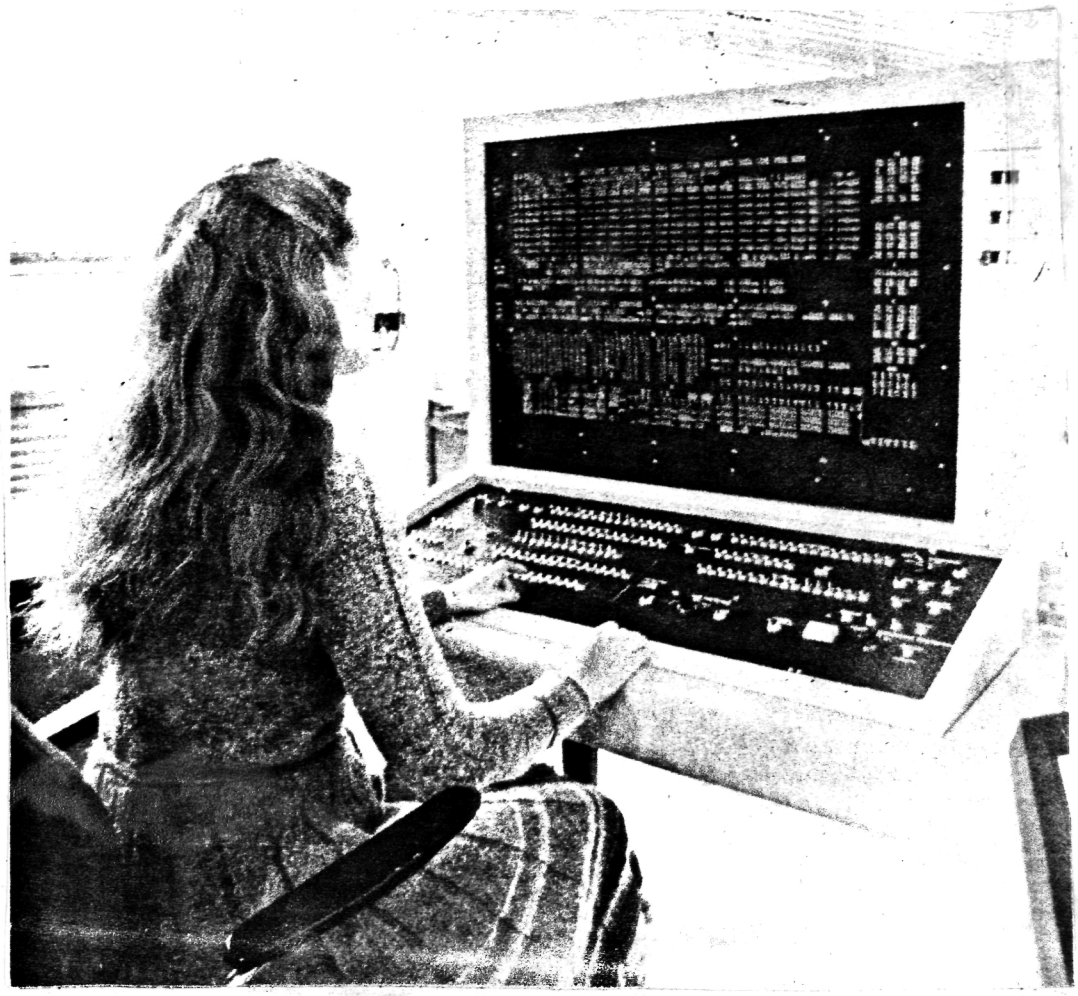
The make up and diversity of the communication complex's /8
equipment makes it possible to conduct an informational exchange with tracking stations and spacecraft through several hundred communication channels and guarantees effective interaction of control groups simultaneously on several subjects.



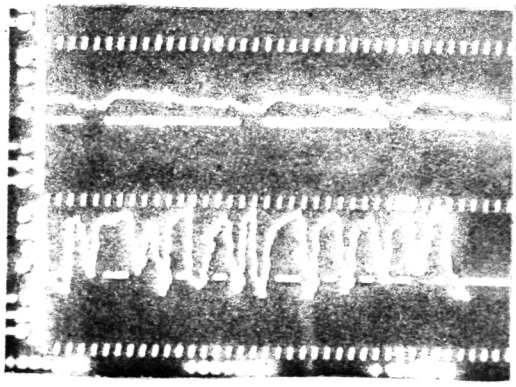
The automated complex: distributes on board the command information needed for flight control in quantities up to 1000 bytes per communication session. /9



The common timing system sychronizes operation of the /10
Center's computers. High accuracy of time calculation (Moscow, flight, Greenwich, and so forth) is guaranteed by constant ties to the State Standard time for radio and television channels. A unique complex of tele-optical projection equipment, an /11
alpha-numeric display controlled by an automatic system with an output of 1.5 million operations per second guarantees the versatility and clarity of the display of generalized information about the flight path on large screens.



The performance of the on-board systems is evaluated /12
according to the results of processing at a real time rate about 3000 telemetry parameters displayed for specialists in various forms. During the communication session, about 0.5 million bytes of information are received each second.

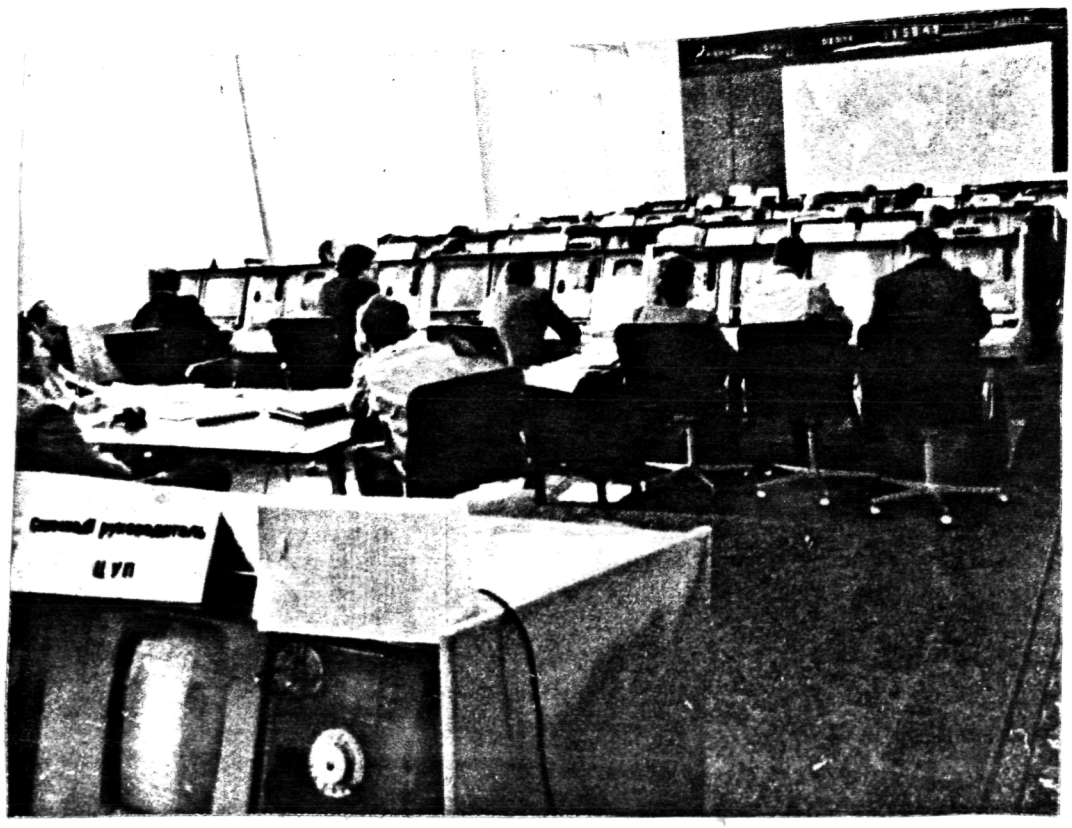


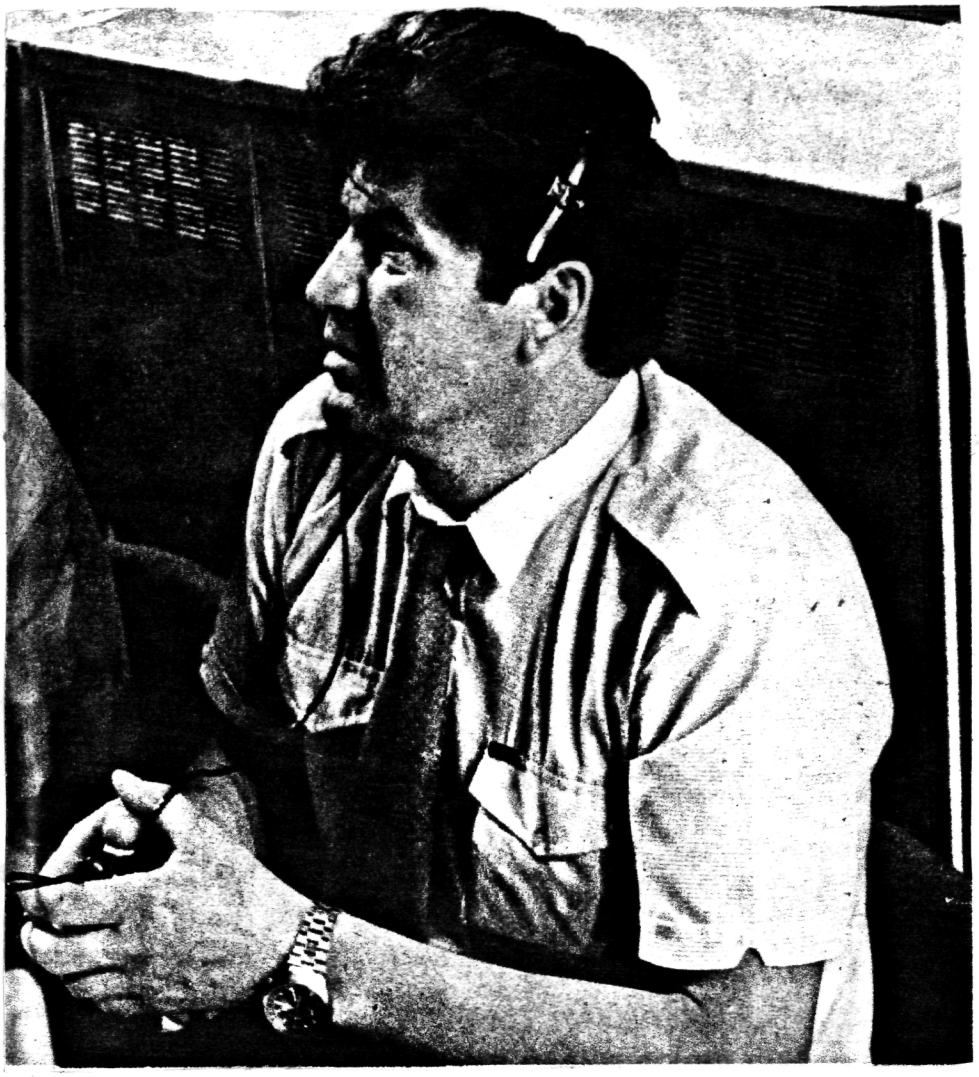
Telemetry data processing, ballistic and command-program calculations are made by using the computer-information system, which has a complex equipment structure guaranteeing a total output of about 40 million operations per second and having a high level of internal and external storage with the total volume over 2 billion bytes. The "El'brus" multiprocessing computer systems and systems with the rebuilt PS-2000 structure are the base of the complex.

Through the tracking stations for periods specified by areas of radio visibility (communication sessions), the Center conducts an exchange of information with the vehicle and on-board equipment. The activities of the Control Center's specialists during the communication session are clearly divided so that each keeps track of the "pulse" of his own system. /14

Individual specialist workstations are provided with equipment for space video communication.

One of the control rooms





Flight instructor and twice Hero of the Soviet Union, cosmonaut of the U.S.S.R. *(illegible name)* /15

On the television monitor screens are data necessary for specialists during operation: results of ballistic-navigation calculations, telemetry data on the operating conditions of on-board systems and scientific equipment, and various types of reference information. The communication system makes it possible to carry on conversations both with the individual specialists and a group of subscribers.

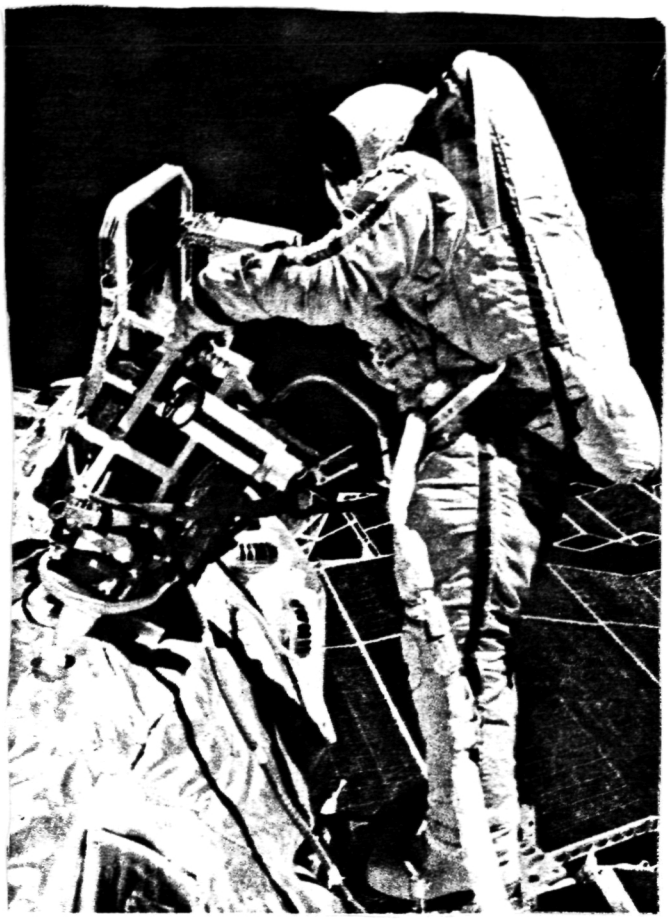
The communication session is over and the orbital complex disappears from the field of vision. However, the Center's specialists are in their places as usual. Results of the session are analyzed and the reports make their way to the flight director on duty. And finally, the conclusion: "Work according to the official program."

Cosmonauts of the U.S.S.R., A.S. Yeliseev, V.F. Bykovsky and /16 astronaut of the German Democratic Republic, Zigmund Jen in the Flight Control Center. A moment at work.

The Flight Control Center's work is particularly impressive when implementing programs of international cooperation, on craft launching, docking, and landing days or carrying out such complex experiments as, for example, entry into outer space. Like a magnet, the control center attracts all those who create space equipment and develop scientific programs for expeditions on orbital stations, and all those who, in the end, carry out these programs.

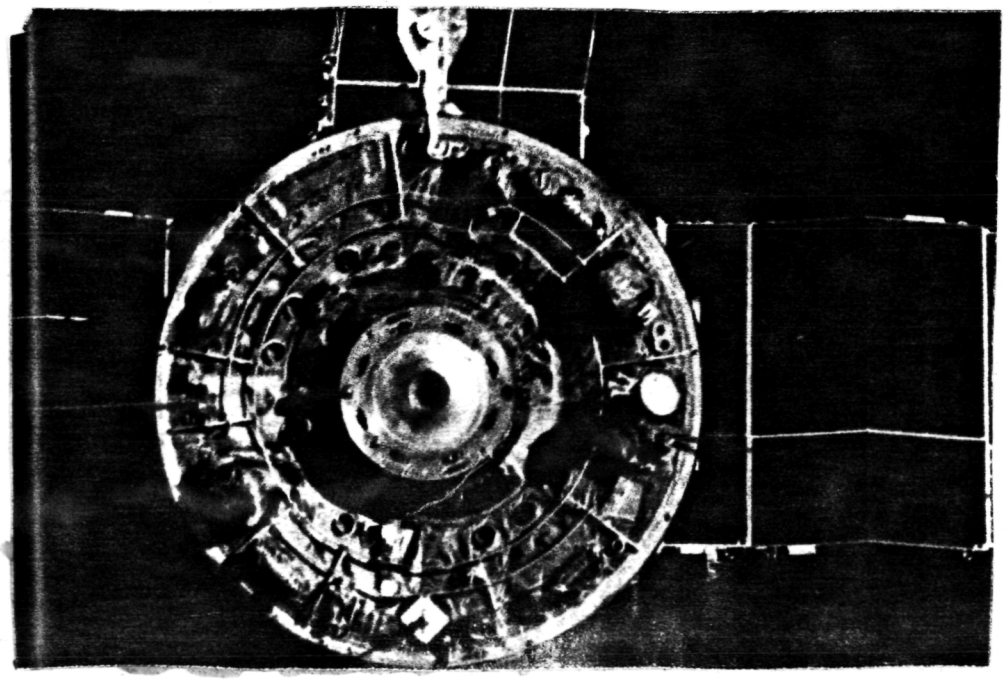
And when two spacecraft "precisely according to the time schedule" locate one another in a starry abyss, the Center's main hall inevitably explodes in applause. This is a tribute of respect not only for the courage of those who are in orbit at this time, but also the for the skill of everyone who works in the Control Center.

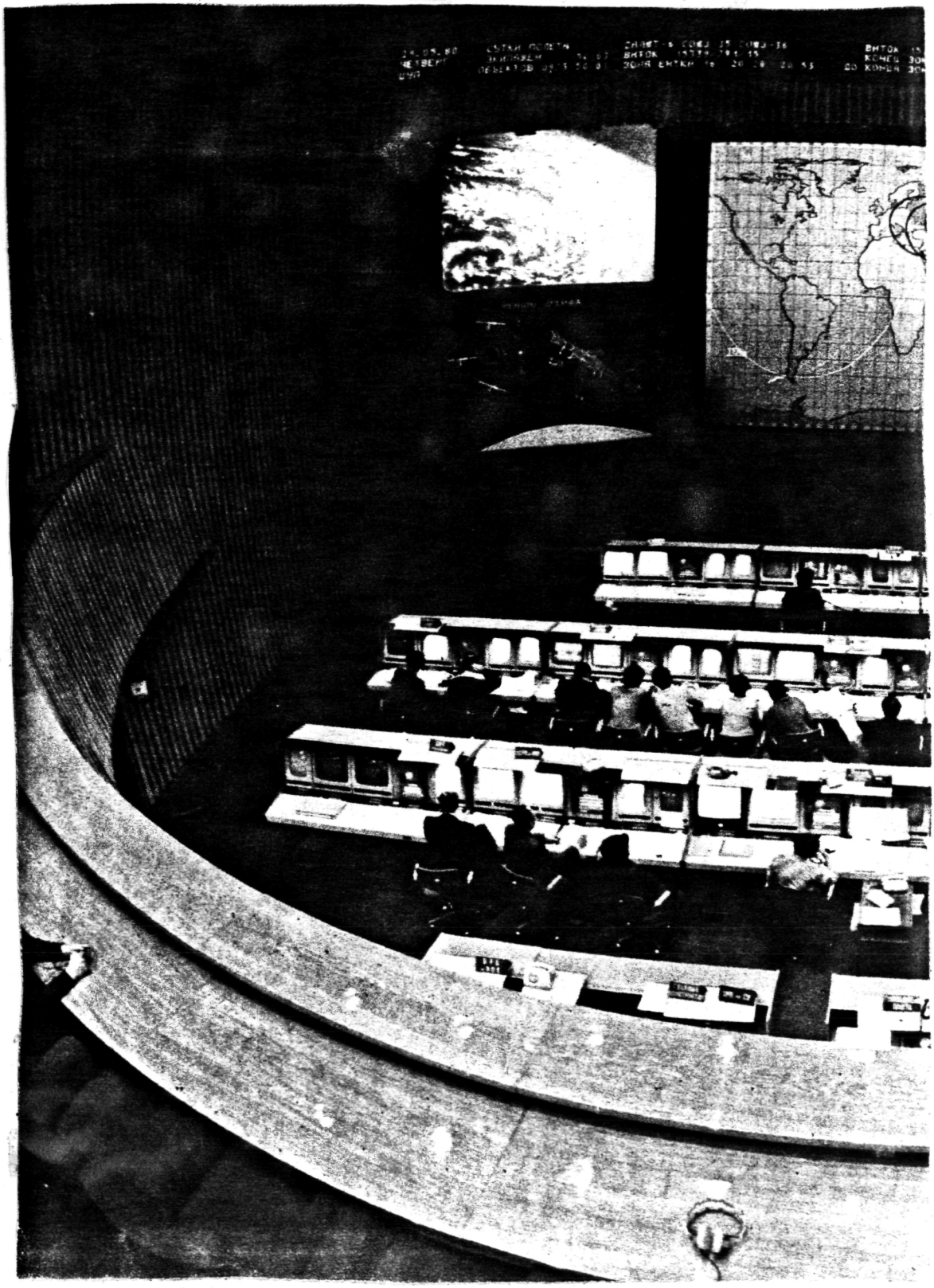
They have enormous experience. They "accompanied" the automatic interplanetary stations "Luna", "Mars", "Venera", and "Vega" which made a voyage billions of kilometers long and which investigated planets a hundred million kilometers from Earth.

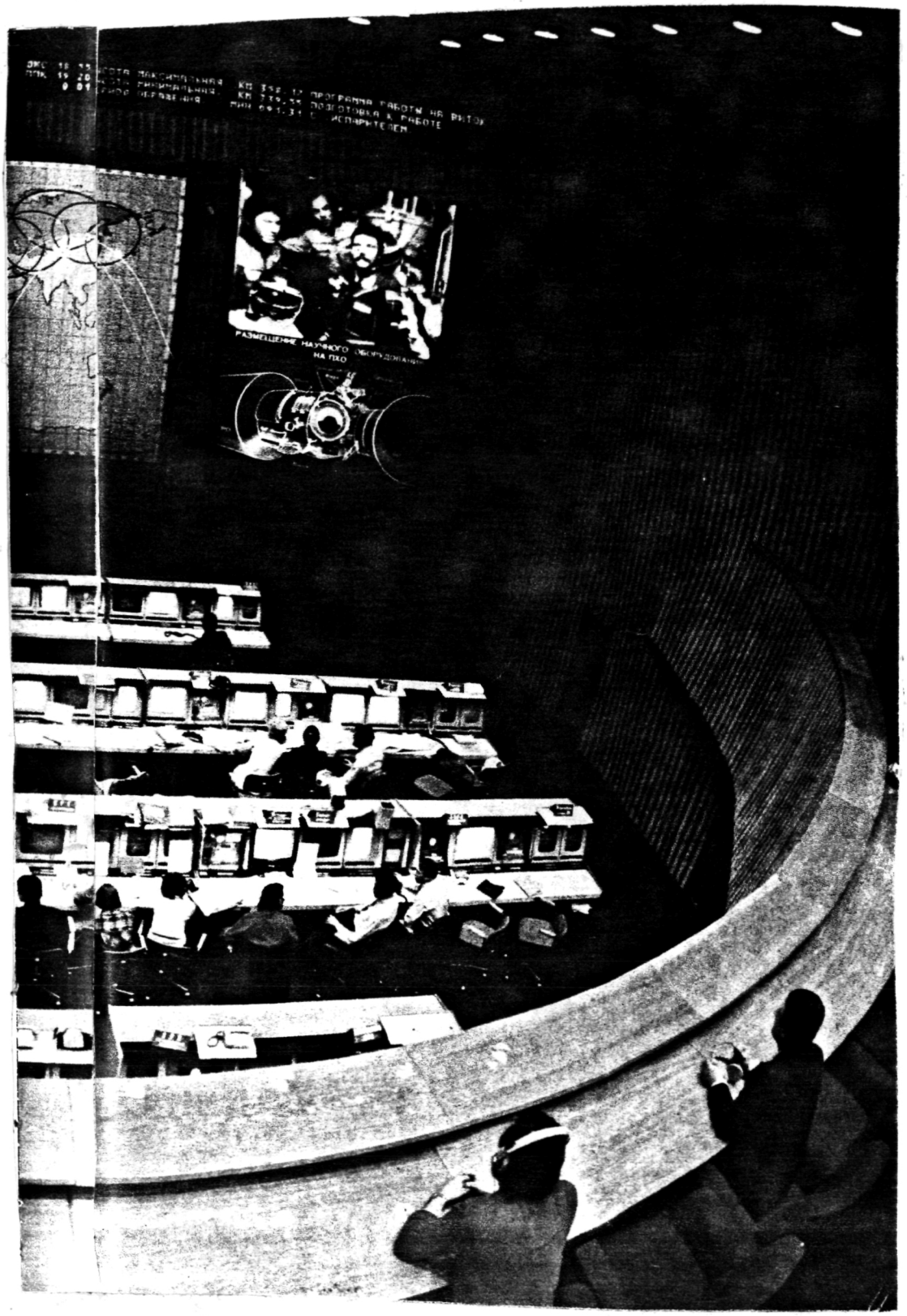


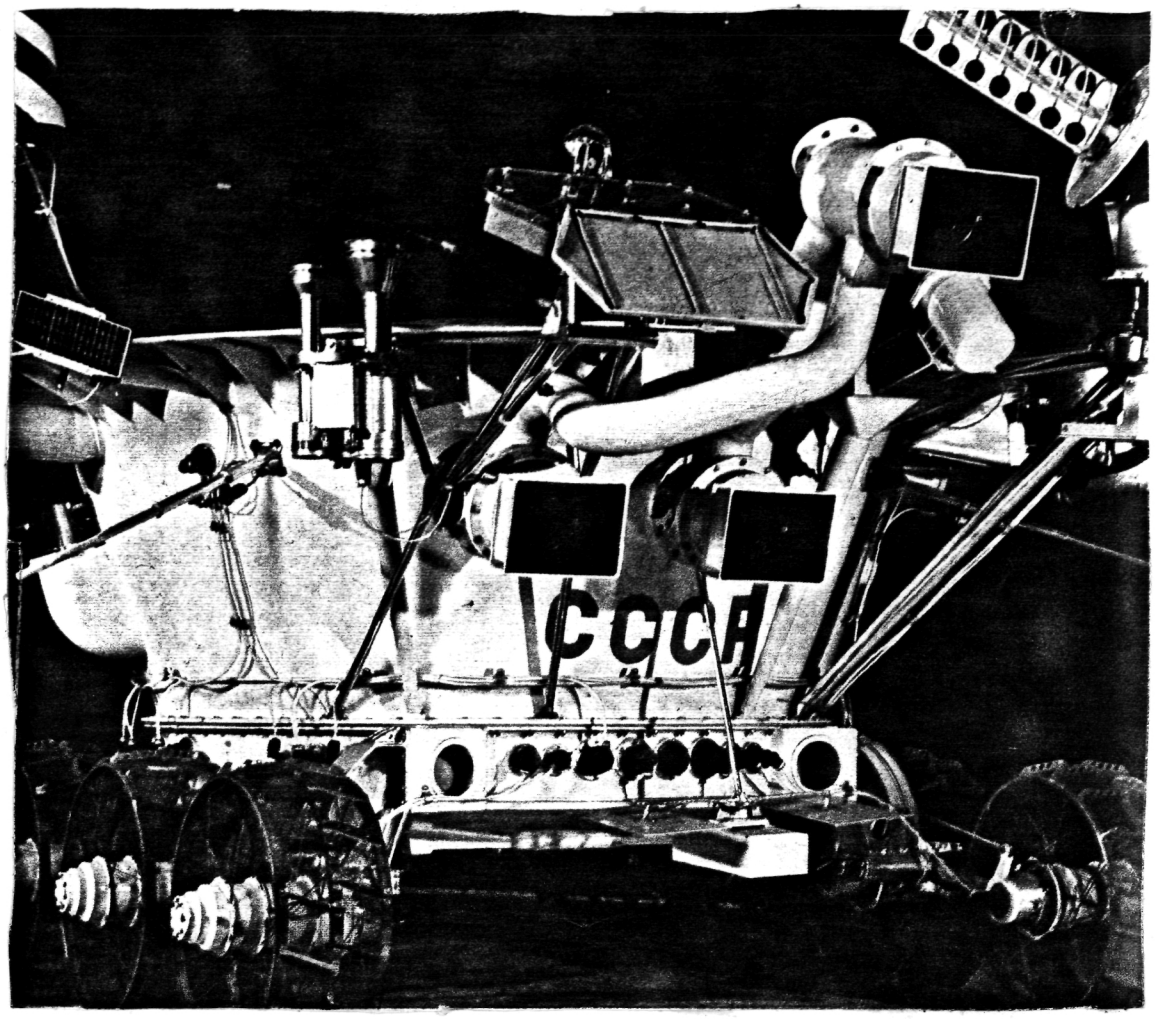
Svetlana Savitskaya /17
is the first woman astronaut in the world to walk in outer space and complete technological operations.

A few minutes until docking
(illegible) station Salyut-7 from the compartment area

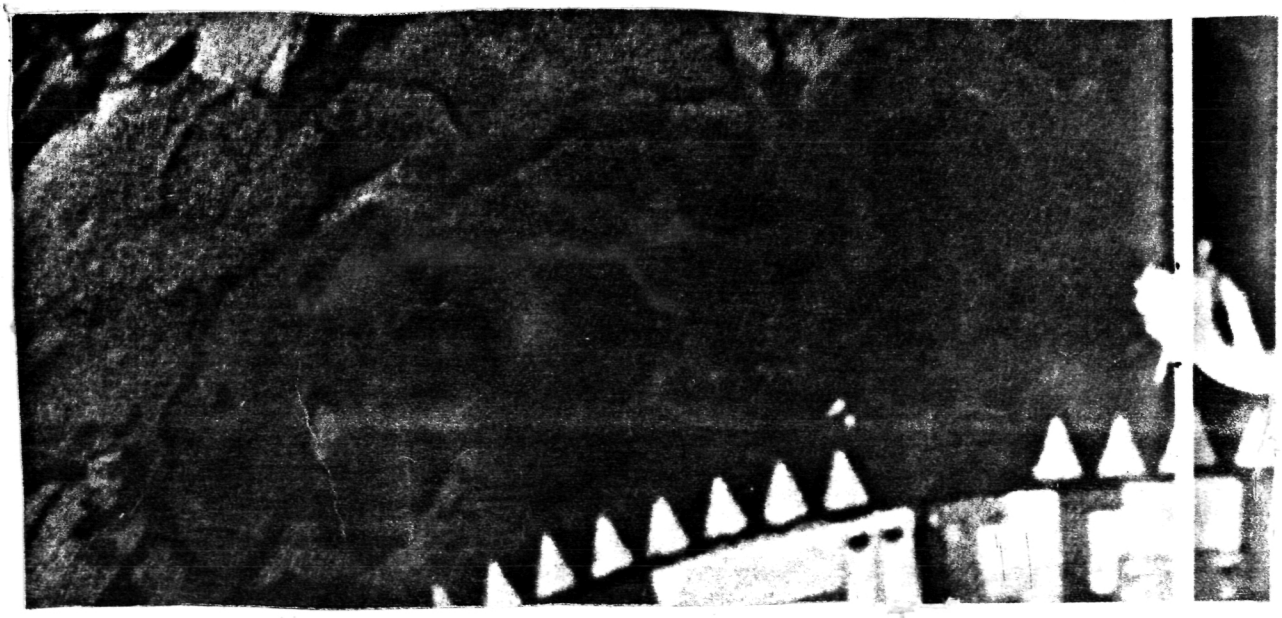


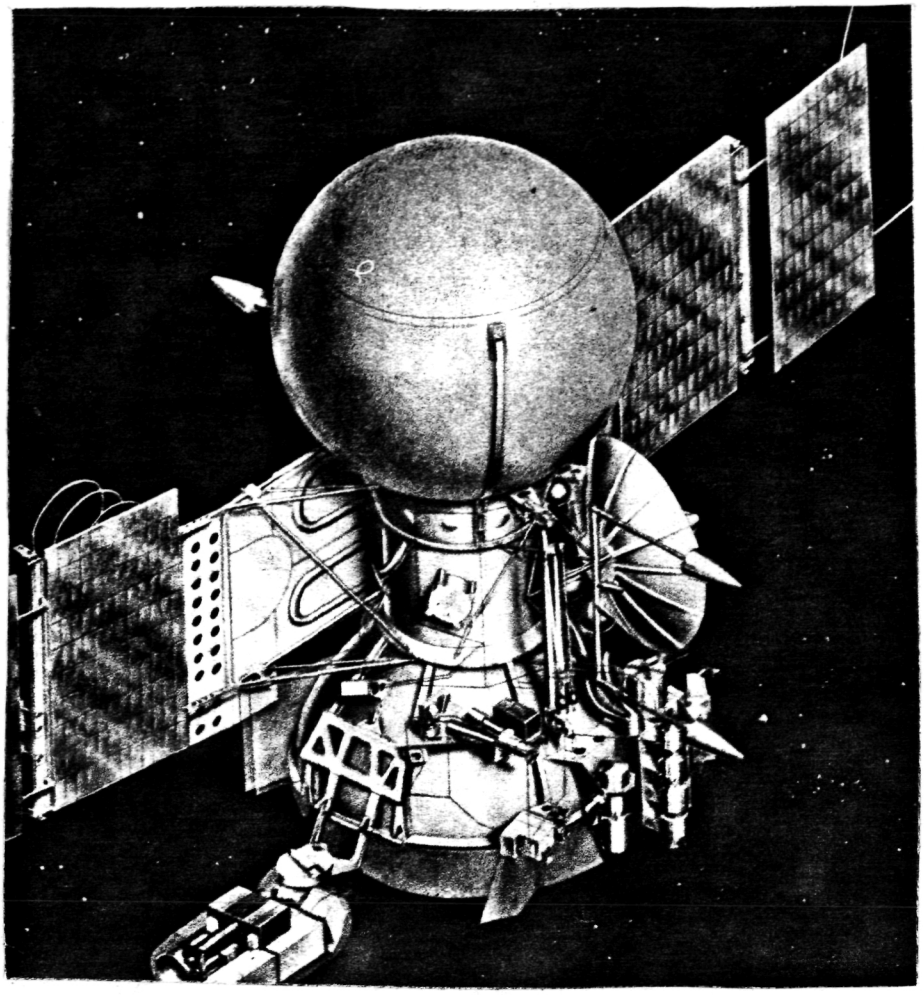






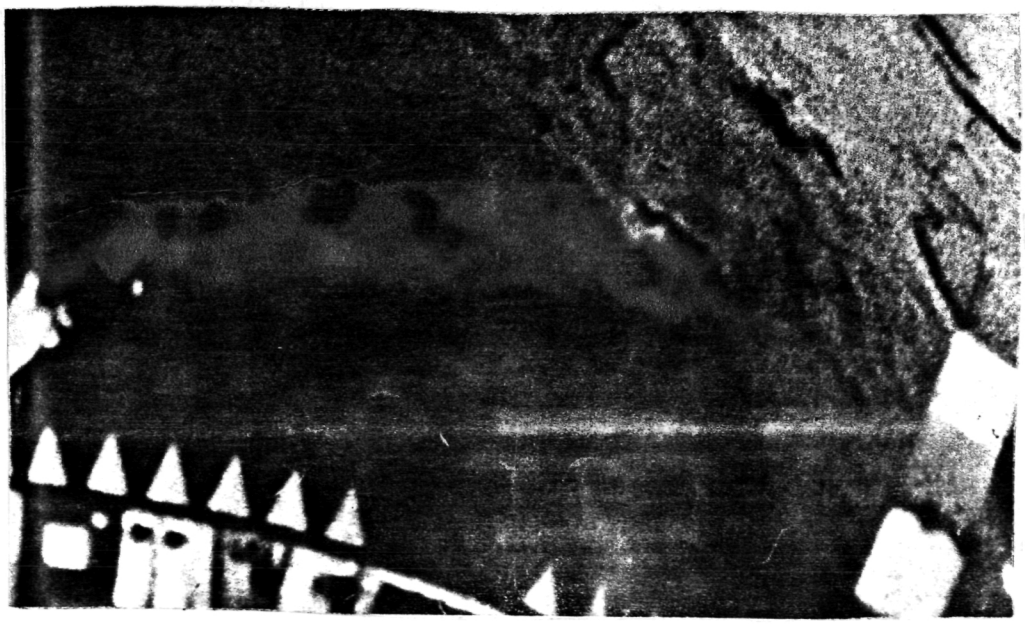
Flights of Soviet spacecraft to the Moon, Mars, and Venus make it is possible to obtain much valuable information about these planets and also to take a new step toward the development of space technology. /20

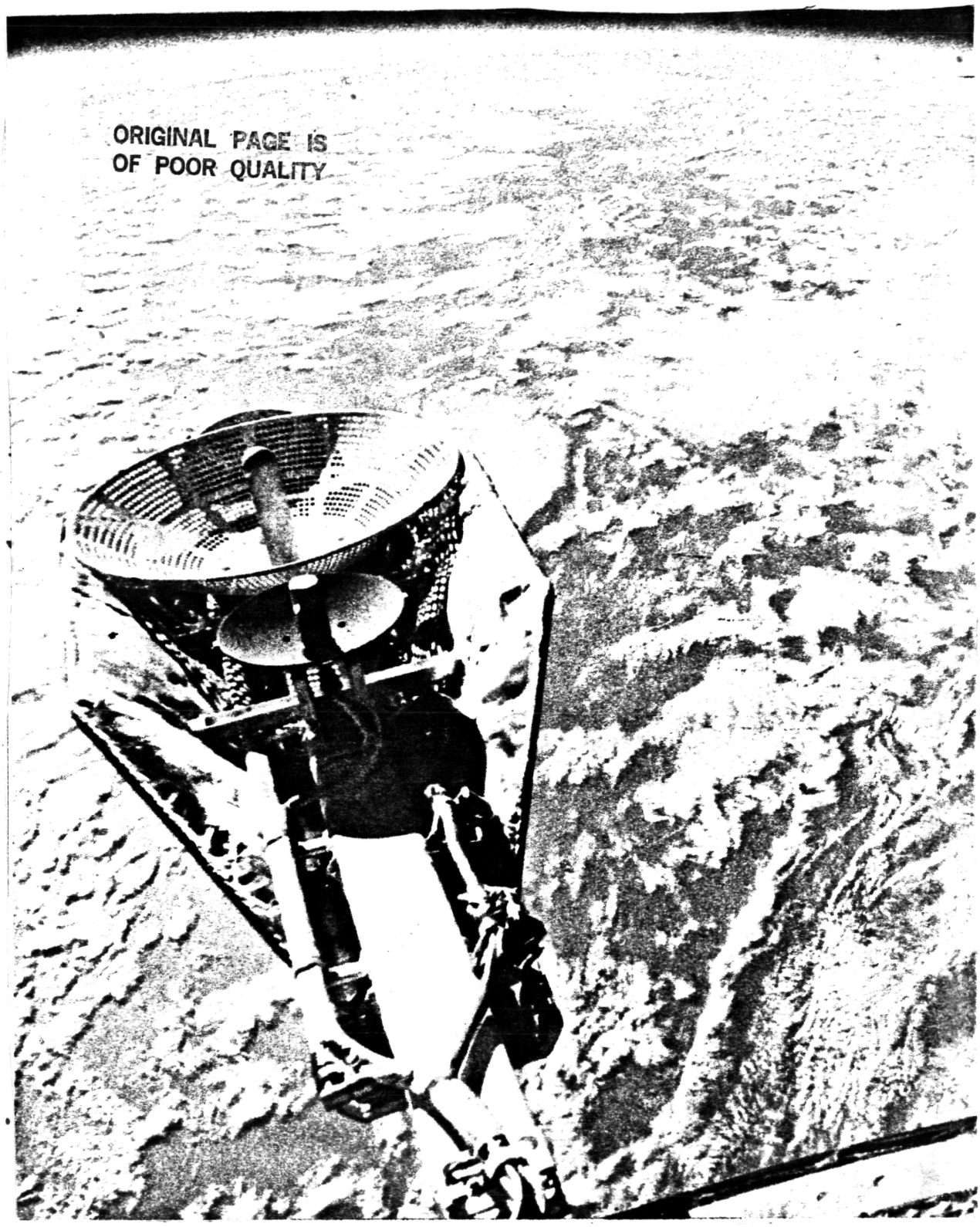




The spacecraft "Vega" for exploring Venus and Halley's comet. /21

The panorama of Venus received from the recovery capsule of the "Venus-13" Station.



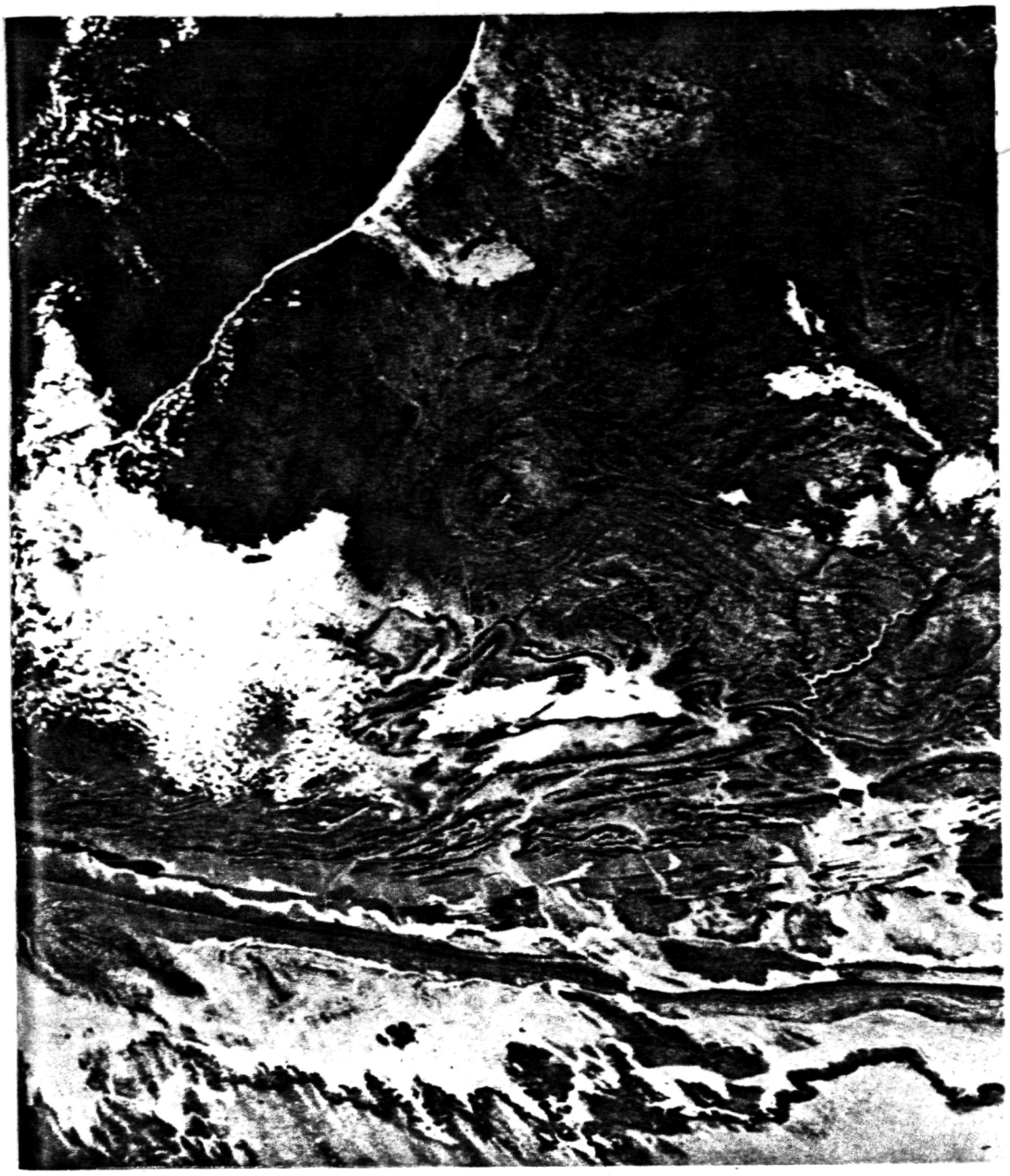


The Salyut-Soyuz space complex, in contrast to other known means of exploring surrounding space known to man, is a unique science-research laboratory.

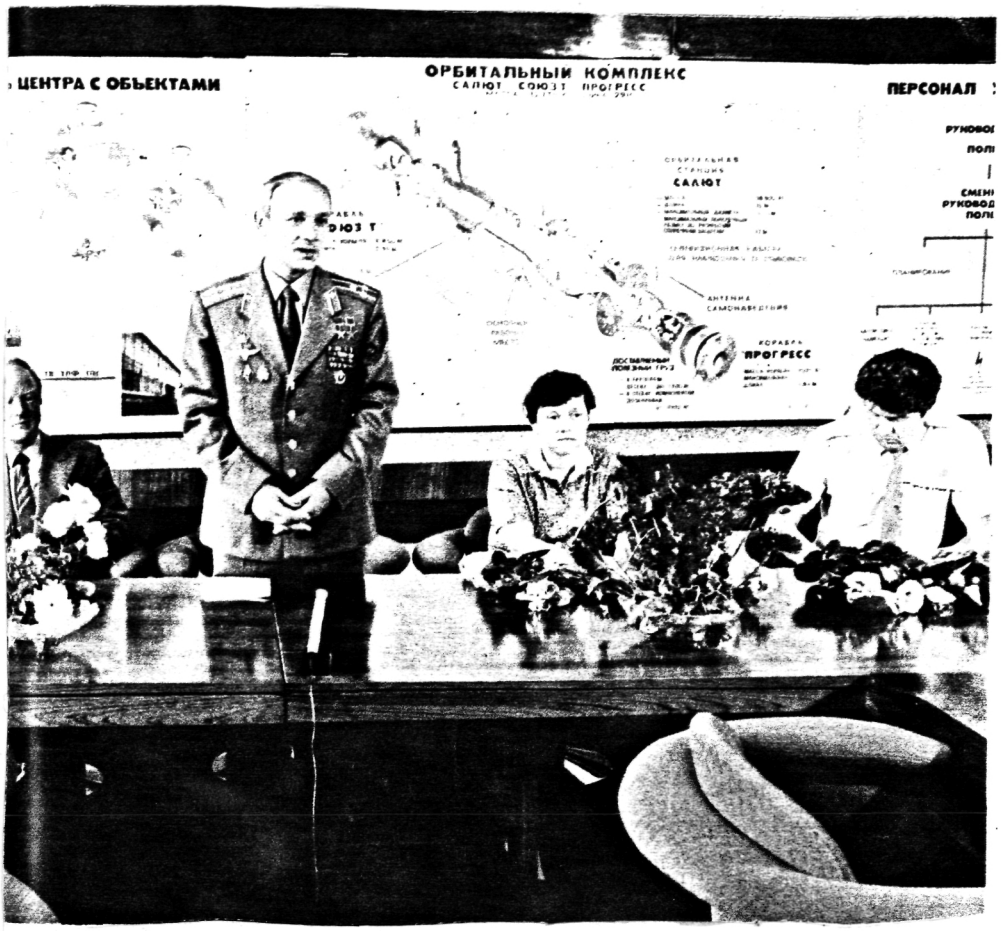
Only from space flight altitude, systematically observing the vast expanses of the earth's surface, is it possible to detect the global phenomena important to science and the national economy.

Space photography at 350 km

Space photography and filming allow us to identify /24 promising areas of mineral deposits. Observations from orbit help us to map out work areas for fish industry expeditions and to correct dates for agricultural technology practices. Only 5 minutes of photographing the Earth's surface from space yields results obtainable in no less than two years of aerial photography.

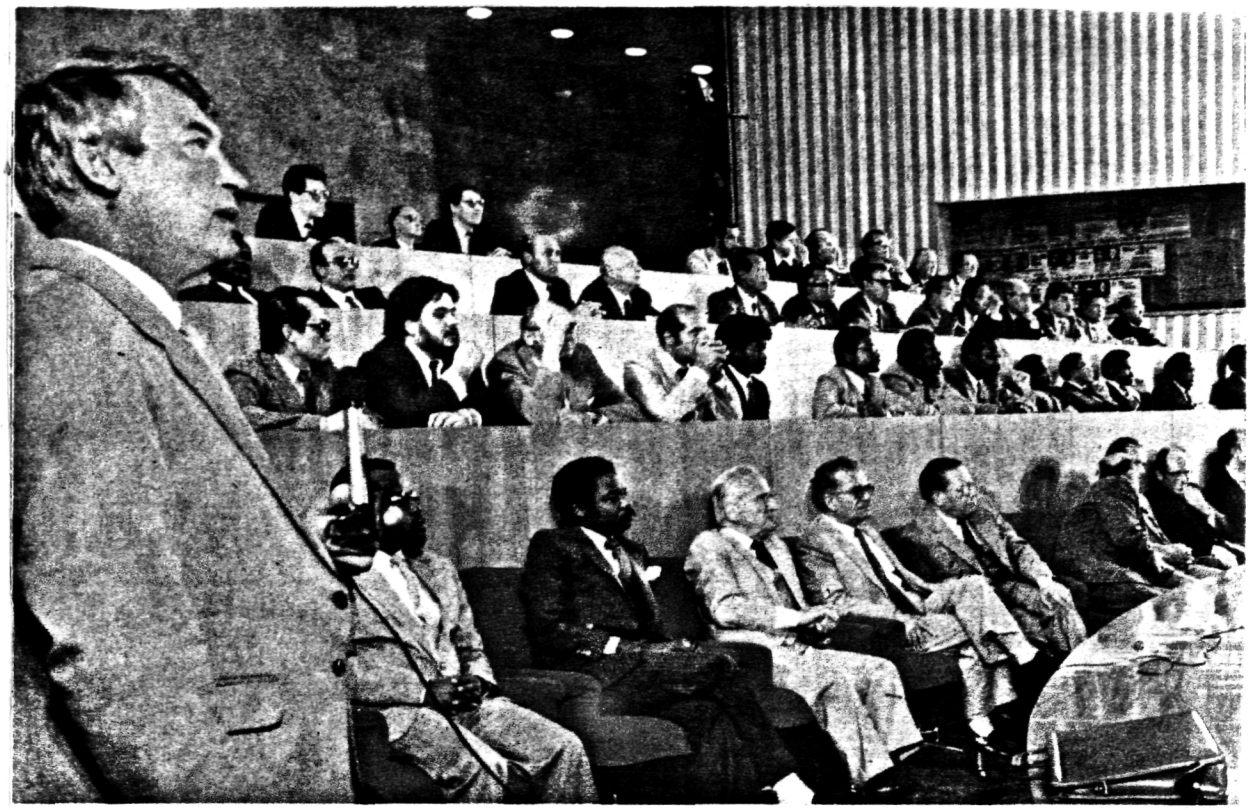


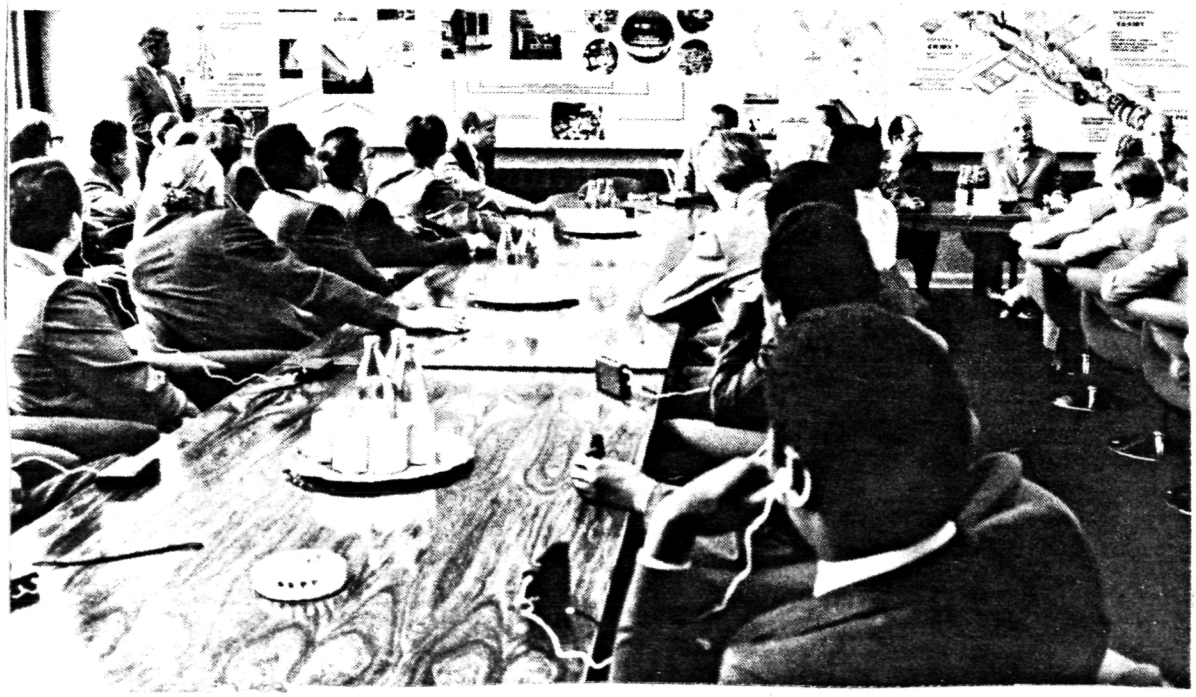
Only aboard the space complex there is it possible to conduct investigations of the Universe beyond the limits of the /25 earth's atmosphere, which significantly distorts results of the observations. Only under conditions of prolonged weightlessness, it is possible to obtain ultra-pure monocrystals, fine and even film coatings, and new substances which can be used for developing unique structures necessary for space technology. Investigations and experiments touching upon various scientific fields are carried out during a piloted flight.



Cosmonauts of the U.S.S.R., *(illegible name)* Dzhanibekov, /27
S.Ye. *(illegible name)* and I.P. Volk shared their impressions of the flight with the Control Center

Gathering information from space -- hour after hour, day after day -- is important and valuable, enriching our experience and knowledge, broadening the horizons of science, and opening new vistas for tomorrow's space navigation. Each stage of the peaceful investigation of outer space is progress for all mankind. The Flight Control Center makes a considerable contribution to these investigations.





Foreign diplomats in the Flight Control Center

Cosmonaut training instructor, twice Hero of the Soviet Union, cosmonaut of the U.S.S.R., V.A. Shatalov, is interviewed by the All-Union radio commentator.

Emblems of international piloted flights on the "Soyuz" ships

1.	U.S.S.R. -- U.S.A.	1975
2.	U.S.S.R. -- Czechoslovakia Socialist Republic	1978
3.	U.S.S.R. -- Polish People's Republic	1978
4.	U.S.S.R. -- German Democratic Republic	1978
5.	U.S.S.R. -- People's Republic of Bulgaria	1979
6.	U.S.S.R. -- Hungarian People's Republic	1980
7.	U.S.S.R. -- Socialist Republic of Vietnam	1980
8.	U.S.S.R. -- Cuba	1980
9.	U.S.S.R. -- Mongolian People's Republic	1981
10.	U.S.S.R. -- Socialist Republic of Rumania	1981
11.	U.S.S.R. -- France	1982
12.	U.S.S.R. -- India	1984