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ASTRONAUTICS INFORMATION

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LUNIK III

SOVIET NEWS COVERAGE OF THE LAUNCHING OF THE THIRD SOVIET COSMIC ROCKET OCTOBER 4-30, 1959

JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY

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Soviet News Coverage of the Launching of the Third Soviet Cosmic Rocket

October 4 - 30, 1959

Translated by Joseph L. Zygielbaum

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JET PROPULSION LABORATORY
California Institute of Technology
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Pravda, October 4, 1959

FROM SPUTNIK I TO LUNIK III

by

Professor S. Poloskov

It has been two years today since the launching of the world's first artificial Earth satellite by the Soviet Union. On October 4, 1957, Soviet scientists, engineers, and workers accomplished a heroic achievement by sending, for the first time in the history of mankind, an artificial body into the cosmos which became for a determined period of time a heavenly body, a satellite of the Earth. Since then, the Russian word "Sputnik" has become a part of the international vocabulary.

It is understood that this outstanding achievement was not a casual success. It represented a new, important step in the scientific program, which was carried on over a period of years in the USSR, for the investigation of the upper atmosphere of the Earth and cosmos by means of rockets. On the technical part, this success was prepared for by the development of a domestic rocket technique. The scientific program was compiled and executed on the basis of experience which was accumulated during investigations of the upper layers of the Earth's atmosphere with the aid of vertical ascents of large and small geophysical rockets.

With the first artificial satellite, important scientific problems have already been successfully solved. Observations of penetration and absorption in the ionosphere of radio waves, which were transmitted by the radio transmitter of the satellite on two frequencies, have made it possible to explain some properties of this layer of the Earth's atmosphere. Observations of the satellite's

movement have permitted some interesting and important conclusions to be drawn regarding the density of the atmosphere at high altitudes.

In addition to Soviet scientists, scientists of foreign countries including England and the United States of America have participated in these investigations. This became possible because of the fact that in the press and at scientific conferences all necessary data for the observation of the satellite were reported. This was also the case during the launching of the succeeding artificial satellites and cosmic rockets.

One of the basic assignments of the first artificial Earth satellite was to study the physical conditions of movement of bodies with cosmic velocities at various altitudes.

Less than a month later, on November 3, 1957, the second artificial Earth satellite was launched. Its main assignment was to investigate the possibility of flight in cosmic space by highly organized animals. That satellite contained the first cosmic traveler, the dog Laika. The medical-biological investigations of the second satellite were successfully combined with a study of cosmic rays.

It should be mentioned that Soviet satellites have exceeded in size and weight the corresponding American satellites.

The gigantic third Soviet artificial Earth satellite (weighing 1327 kg), which was launched on May 15, 1958, represented an entire cosmic laboratory. In order to better understand its scientific value we will point out that Sputnik III carried out successfully a complex of scientific investigations which included all scientific problems which were planned by the Soviet Union for the period of the International Geophysical Year.

The results of scientific investigations which were obtained by the third artificial satellite are very interesting. The most important result was the discovery of a radiation belt which exists around the Earth. Very complete and important investigations were also conducted of the magnetic field of the Earth at great distances from its surface. Particular mention should be made of the direct investigation of the so-called structural parameters of the upper atmosphere. This term defines the study of density distribution and atmospheric content by direct measurements conducted by the instruments. Such instruments were installed on the third satellite: two types of manometers for the measurement of pressure and a radiofrequency mass spectrometer for the determination of the nature of gas molecules and atoms which are in an ionized state in the upper atmosphere. From an experimental point of view these investigations are very complicated; they require large containers, considerable weight, and complex instrumentation which transmits scientific information to Earth. This is why the American satellites, because of their small dimensions and light weight, were not able to conduct this type of investigation.

At the present time the results of the observations have been processed in detail and Soviet scientists have in their possession data about the distribution of density of neutral (nonionized) particles at altitudes of 200—500 km. These data show that even comparatively new (1957) theoretical models of the atmosphere at high altitudes do not give a correct image about its structure and should be disregarded. It was established that the upper atmosphere of the Earth is denser than it was presumed. This represents a discovery of utmost importance.

However, an even more outstanding achievement (so it seems to us) is the investigation of the contents of the ionosphere at high altitudes. During the period from May 15 to May 25, 1958, through the investigations which were conducted by Sputnik III, material was obtained and has been processed which includes about 15,000 mass spectra of positive ions. The measurements pertain to the interval of altitudes from 225 to approximately 1000 km and encompass a huge region of the Earth's atmosphere by latitude and longitude. It is hard to overestimate the value of these investigations. In the regions where, according to previous assumptions, the Earth's atmosphere is practically absent, a quite dense ionosphere was discovered. As far as the chemical content of the atmosphere at these altitudes is concerned, the analysis of mass spectrometers has indicated the presence of ions of atomic oxygen, atomic nitrogen, molecular nitrogen, nitrogen oxide, and molecular oxygen.

On January 2 of this year the Soviet investigations of cosmic space took a new qualitative step. For the first time in the history of the human race an artificial body, created on Earth by the efforts of Soviet people, reached the second cosmic velocity. A cosmic rocket was launched in the direction to the Moon and became an artificial planet.

The entire world has followed the flight of the first artificial planet and scientists of all countries have made attempts to investigate its electromagnetic signals. During the period of this first cosmic flight broad material was obtained on the study of interplanetary matter and cosmic radiation.

The investigations which are being accomplished with the help of satellites and cosmic rockets have removed astronomy from the number of purely

observational sciences. Previously a man could only follow the processes which took place on cosmic bodies or in cosmic space from the Earth's surface, not being able to take part in these processes or to perform direct experiments in interplanetary environment. Now rockets and satellites have made astrophysics an experimental science. Furthermore, a man can begin to interfere in cosmic processes or to create these processes according to his judgment. An outstanding example of this is the creation of the artificial comet, that is, the artificially caused flare-up in interplanetary space.

Between September 12 and 14 of 1959 we became witnesses to a qualitatively new stage in the conquest of the cosmos by man. During these days the first interplanetary flight from the Earth to the Moon was successfully accomplished. A Soviet cosmic rocket delivered to the Moon a banner with the symbol of the Soviet Union. At the same time a series of outstanding experiments was conducted. Simultaneously with the study of cosmic space, Soviet scientists accepted a challenge to study the heavy heavenly body nearest to the Earth--the Moon. The establishment of the fact that the Moon does not have any significant magnetic field is an outstanding achievement.

Of very great significance are the investigations with the help of cosmic rockets of interplanetary gas and solid so-called meteoric matter. The significance of the density of particles in fluxes of gas or corpuscular fluxes which penetrate interplanetary space, and the study of the direction of these fluxes, including those which are discharged by the Sun, are essential for the prediction of processes which take place in the Earth's ionosphere and for the understanding of the reasons for changes in the magnetic field of the Earth. The study of

meteoric matter, its propagation in the planetary system in the direction from the Sun to the periphery, the study of meteoric fluxes including those which were created as a result of disintegration of comets, are also of great importance for the clarification of conditions of movement of interplanetary vehicles. This problem can be accomplished reliably only with the help of investigations conducted by satellites and cosmic rockets. In this regard, with the help of Sputnik III as well as the cosmic rockets, Soviet scientists have obtained new data.

It was established that at very high altitudes such particles accomplish about 10^{-3} impacts/m^2/sec in the surrounding cosmic space, which corresponds on the average with a flux of particles 10^{-12} g/m^2/sec. At first glance it seems that this is a very low magnitude, but in the sum of the entire atmosphere of the Earth it will give more than 1000 tons/day.

All these cosmic investigations, which were conducted in such a short period (only 2 years), represent a huge contribution by Soviet people to world science. These investigations change our idea about a number of sciences. For example, the margin between astrophysics and geophysics was wiped out. It seems as if on one side heavenly objects become nearer and objects of geophysical investigations broaden.

What are the perspectives?

It is very difficult to make a prognosis in our time. In regard to the investigation of the physics of the upper atmosphere, for instance, it is a considerably fantastic scientific assignment to study the Moon directly.

There is no doubt that many of us will become witnesses to new, possibly not less outstanding successes in the study of the cosmos by Soviet people.

However, some events will remain for all time historical, and among them will be the launching of the first artificial Earth satellite, the creation of the first artificial planet, and the first interplanetary flight.

Pravda, October 5, 1959

TASS COMMUNIQUE ABOUT THE LAUNCHING OF THE THIRD COSMIC ROCKET BY THE SOVIET UNION

In correspondence with the program for the investigation of cosmic space in preparation for interplanetary flights, on October 4, 1959, the Soviet Union successfully launched a third cosmic rocket. Installed aboard the rocket was an automatic interplanetary station.

The launching was accomplished with the help of a multistage rocket. After the necessary velocity was reached, the last stage of the rocket injected the automatic interplanetary station into the required orbit.

The orbit of the automatic interplanetary station was chosen in such a manner as to assure the station's passage near the Moon and around the Moon.

The automatic interplanetary station will pass near the Moon at a distance of about 10,000 km, and after rounding the Moon on its course it will return to the region of the Earth. The selected orbit will assure the possibility of observing the station from the northern hemisphere of the Earth.

The last stage of the third Soviet cosmic rocket weighs 1553 kg (without fuel). [A scale model of the nose cone is shown in Fig. 1.]

The automatic interplanetary station was installed on the last stage of the rocket. After the orbit was entered, the station was separated from the rocket. The last stage of the rocket follows in an orbit close to the orbit of the station. The automatic interplanetary station is designated for a broad scientific investigation in cosmic space. Aboard the station are installed scientific and radio-technical instruments and also a system of automatic regulation of the thermal

regime. The electrical power supply for the scientific and radio-technical instruments will be secured by solar batteries and chemical power sources. The over-all weight of the station is 278.5 kg. In addition, the last stage of the rocket carries measuring instruments with power sources weighing 156.5 kg. Thus, the over-all weight of the payload is 435 kg.

The transmission of scientific information and results of measurements of movement parameters of the automatic interplanetary station will be conducted with the help of two radio transmitters which operate on the frequencies 39.986 mc and 183.6 mc. Simultaneously, along the radio line of the frequency of 183.6 mc, control of the orbital elements of the interplanetary station will be conducted.

The signals of the transmitter on a frequency of 39.986 mc will be in the form of impulses of alternate length from 0.2 to 0.8 sec. The frequency of impulse recurrence is 1 ±0.15 cps.

The transmission of information from aboard the automatic interplanetary station will take place daily, lasting from 2 to 4 hours, in correspondence with the program of observation. Instrument operation of the automatic interplanetary station will be regulated from Earth from a coordinating computing center.

Measurement of the rocket parameters will be accomplished by an automized measurement complex at ground stations which are located at various points of the Soviet Union.

News releases about the movement of the third cosmic rocket will be carried by all radio stations of the Soviet Union.

The following operational session by the radio-technical means will begin on October 4 at 1:00 p.m. Moscow time. At this time the rocket will be above a

point over the Indian Ocean with coordinates of 80° E longitude and 5° S latitude at a distance of 108, 000 km above the Earth. The transmission session of the radio-technical instruments will continue for about 2 hours.

Radio observations of the rocket can be conducted from the territories of Europe, Asia, Africa, and Australia.

The launching of the third Soviet cosmic rocket and the creation of an automatic interplanetary station makes it possible to obtain new data about cosmic space and is a further contribution of the Soviet people to international cooperation on the problem of cosmic conquest.

Pravda, October 5, 1959

THE THIRD SOVIET COSMIC ROCKET IN FLIGHT

The third Soviet cosmic rocket, which was launched on the morning of October 4, the day of the second anniversary of the launching of the first Soviet artificial Earth satellite, continues its flight toward the Moon. At 6:00 p. m. Moscow time the rocket departed from the Earth to a distance of 145, 000 km and is located above the region of the Atlantic Ocean with coordinates of 8° 36'S latitude and 5° 48'E longitude.

Processing of scientific measurements of the trajectory parameters of the third Soviet cosmic rocket confirmed the accuracy of its injection into the predesignated orbit.

The automatic interplanetary station, after approaching the Moon strictly at the predesignated time and the determined minimum distance, will round the Moon, flying behind the invisible part of the Lunar disc, and will then turn back toward the direction of the Earth. During the entire period of the several-day-long flight of the automatic interplanetary station, a complex of scientific measurements will be conducted by its instruments, the data of which will be transmitted by radio to ground receiving points over predetermined time intervals. A special ground installation at the coordinating computing center will conduct the turning on and off of data transmission from aboard the interplanetary station ground tracking stations.

During the 2-hour transmission session today, the normal functioning of all scientific instruments of the station, sources of energy, measurement and

transmission apparatus were established. The scientific data which were obtained during the first transmission session are being subjected now to thorough processing.

The next session of data transmission from aboard the automatic interplanetary station will take place October 5.

Pravda, October 6, 1959

THE THIRD SOVIET COSMIC ROCKET IN FLIGHT

At 12:00 noon October 5 the third Soviet cosmic rocket departed from the Earth to a distance of 248,000 km and is now located above a point on the Earth's surface in the eastern part of the Indian Ocean with the coordinates of 14° 20'S latitude and 98° 00'E longitude.

The processing of the measurement results of the actual parameters of movement of the rocket is being conducted continuously with high-speed electronic computers. The processed data confirm the high accuracy of injection of the rocket into the given orbit. The first and second Soviet cosmic rockets, as is known, attained a velocity at the moment of injection into orbit which surpassed the second cosmic velocity. In order to secure the rounding of the Moon and the following return of the automatic interplanetary station toward the Earth, the third Soviet cosmic rocket received an initial orbital velocity somewhat less than the second cosmic velocity. In conjunction with this, the movement of the third Soviet cosmic rocket in the direction toward the Moon is, in comparison with the movement of the first and second Soviet cosmic rockets, somewhat slower.

The automatic interplanetary station, after separating from the last stage of the rocket, will pass at a minimum distance from the Moon at 5:00 p.m. October 6, consuming for the journey from the Earth to the Moon about 2-1/2 days. The distance of the automatic interplanetary station from the Lunar surface will be at that time about 7000 km.

The instrumentation which is installed on the automatic interplanetary station functions in correspondence with a predesignated program of scientific measurements.

The second session of data transmission of measurements from aboard the automatic interplanetary station, as was already reported, took place from 3:00 to 5:00 p.m. on October 5. In the future, reports of the movement of the third Soviet cosmic rocket and the results of scientific observations will be released once a day after the transmission sessions from aboard the automatic interplanetary station and a preliminary analysis of these data.

Continuing its flight towards the Moon, the third Soviet cosmic rocket has on October 5 at 8:00 p.m. Moscow time passed above the Atlantic Ocean at a point with the coordinates of 20° 30'S latitude and 21° 30' W longitude, departing at this moment from the Earth at a distance of 284, 000 km. The movement of the third Soviet cosmic rocket continues strictly along a predesignated orbit.

According to results of preliminary processing of data of telemetering measurements which were obtained on October 4 during the second session of transmission from the station, it was established that the system of thermal regulation, energy supply, and instruments for scientific investigations, which are located aboard the automatic interplanetary station, function normally.

On October 5 from 3:00 to 5:00 p.m. Moscow time, by a command given from Earth, the automatic interplanetary station transmitted consecutive data of telemetering measurements, which were recorded on magnetic tape.

The next transmission session of data to Earth will take place October 6 from 5:00 to 7:00 p.m. Moscow time.

A diagram of the movement of the third Soviet cosmic rocket is shown in Fig. 2, and a sketch of the trajectory is shown in Fig. 3.

Izvestia, October 7, 1959

THE FLIGHT OF THE ROCKET

At 8:00 p.m. October 6 the third Soviet cosmic rocket was located above the Atlantic Ocean to the northeast of the island Martin Vaz at a point with the coordinates of 17° 30'S latitude and 22° 48'W longitude at a distance of 371,700 km from the Earth.

After passing near the Moon at the shortest distance from its surface, which equals 7000 km, at 5:16 p.m. Moscow time October 6, the rocket continued its flight around the Moon. The distance from the surface of the Moon at 8:00 p.m. October 6 was 15,000 km. At this time the rocket was located near the plane of the Lunar equator and had a selenographic longitude of 137° and a latitude of -12°.

The rocket's flight continues strictly along the predetermined orbit.

According to results of preliminary data processing of telemetry measurements during the second and third transmission sessions, the temperature aboard the automatic interplanetary station is maintained to the limits of 25—30° and pressure is about 0.001 mm Hg, which corresponds to the preassigned values.

The instruments of scientific measurements, the Solar batteries, and the chemical power sources function normally.

The next transmission of scientific data to Earth and measurements of coordinates will take place on October 7 from 5:00 to 6:00 p.m. Moscow time.

Pravda, October 8, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

The interplanetary station continues its flight strictly along the predetermined course.

At 8:00 p.m. October 7 the third Soviet cosmic rocket continuing its flight passed through the constellation of Serpens near the star Zeta having a declination of -11° 36' and a right ascension of $16^h31^m37^s$.

The determination of the flight elements which was conducted in the coordinating computing center shows that the automatic interplanetary station continues its flight along a strictly predetermined orbit.

After passing the point of closest distance from the Moon, the automatic interplanetary station, rounding the Moon, continued to depart from the Earth and the Moon. At 8:00 p.m. October 7 the distance of the interplanetary station from the Moon was 126,000 km and from the Earth, 417,000 km.

During its subsequent flight the automatic interplanetary station will continue to depart from the Earth, reaching a maximum on October 10 which will equal 470,000 km. Then the interplanetary station will begin to approach the Earth again, and will pass near it on October 18 in a north-to-south direction. The shortest distance from the surface of the Earth will be about 40,000 km.

Data which were obtained by ground telemetering stations during the consecutive transmission on October 6 confirm that the instruments for scientific measurements, the system for thermal regulation, and the system of power supply continue to function normally.

The next transmission of measurement data and parameter measurements will take place on October 8 from 5:00 to 6:00 p.m. Moscow time.

Pravda, October 9, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

Continuing its flight strictly along the calculated trajectory, the automatic interplanetary station was located on October 8 at 8:00 p.m. Moscow time in the constellation of Serpens, having a right ascension of 16^h36^m and a declination of -6° 48'.

At that moment the distance from the surface of the Earth to the automatic interplanetary station was 448,000 km, and from the surface of the Moon, which rotates along its orbit with an average velocity of 1 km/sec, 235,000 km. At this time the Moon was already passing through the constellation of Sagittarius (right ascension 18^h43^m, declination -17° 48'). The interplanetary station, after rounding the Moon, left the sphere of Lunar gravitation and continued to approach the point of maximum distance from the Earth. The velocity of flight, thereafter, of the interplanetary station decreased continually and at 8:00 p.m. October 8 was 0.5 km/sec.

The subsequent course of the interplanetary station will pass through a plane which is almost perpendicular to the plane of the Lunar orbit; the interplanetary station will rotate around the Earth along an extended elliptic with an apogee of 470,000 km, a perigee of 40,000 km, and a period of about 15 days.

The apparatus for scientific measurements, the system of thermal regulation, and the system of energy supply of the interplanetary station are, according to processed results of data which were obtained by ground stations during the transmission on October 7, operating normally.

The next transmission of scientific data will take place on October 9 from 5:00 to 6:00 p. m. Moscow time.

Pravda, October 9, 1959

COSMIC ROUTES

by

K. Ogorodnikov
Professor Doctor of Physical Mathematical Sciences

The date of October 4 will twice enter the history of the development of Soviet science: in conjunction with the launching of the first artificial Earth satellite in 1957 and with the launching of the third cosmic rocket with an automatic interplanetary station in 1959. Both events represent important steps in the conquest of the cosmos for peaceful purposes by man.

It is known to the entire world that Soviet science occupies first place in this region by the scope of its work as well as by the results achieved. The tremendous successes of the Soviet Union in the investigation of cosmic space and the preparation toward interplanetary travel are recognized by the entire world. This was well demonstrated at the Tenth Annual Congress of the International Federation of Astronautics which took place in London, August 31 to September 5, 1959, in the proceedings of which I participated as a member of the Soviet delegation.

At the Sixth Congress of this Federation, which took place in Copenhagen in 1955, an official statement was made public by the government of the United States of America about their intentions to launch several artificial Earth satellites in conjunction with the International Geophysical Year. It is possible that a modest statement remained unnoticed then, which was made by the head of the Soviet delegation, Academician L. I. Sedov, at a press conference, that from the point of view of Soviet science it is possible to launch much heavier and larger

satellites than the ones which were proposed by American scientists. The further course of events, as is known, has convincingly shown to the entire world how truthful this statement was.

Each consecutive congress of this Federation of Astronautics took place under the sign of rapidly increasing activities of scientists from the entire world in discussing the problems of cosmic conquest. The Tenth Congress of the International Federation of Astronautics, which adjourned in London recently, gathered a record number of participants--more than 700 people. More than 100 papers were delivered on various problems of astronautics. The Soviet delegation delivered eight papers which aroused great interest among all participants.

For the first time this congress elected as president of the International Astronautical Federation for the consecutive term the Soviet scientist Academician L. I. Sedov. Sedov was elected unanimously. Two or three years ago a representative of Soviet science would stand no chance of being elected to such a post. Obviously a great change took place in the opinions of scientists of all countries in order for them to vote unanimously for the representative of a socialist state.

There is no doubt that two factors influenced these people: one is connected with the increase of informational authority of Soviet science, which was especially strongly demonstrated in the preceding two years in conjunction with the successful investigations in the field of cosmic conquest. But the main reason is the fact that during the work days of the congress the population of the entire world, including scientists, was under the deep influence of the forthcoming visit of the head of the Soviet government, N. S. Khrushchev, to the United States of America.

Finally warm winds began to blow in the labyrinth of the "cold war," and the accumulated exaggerations and prejudice in regard to the Soviet Union and its scientists began to collapse.

The participants of the congress admitted that we may now consider the problem of satellite launching as practically solved. Nobody has any doubt that the USSR, as well as the USA, is capable of launching as many satellites as it wishes. The obvious superiority of Soviet satellites by dimension and weight (which is admitted by everybody, including American scientists) is quite considerable. This among other things makes Soviet satellites more effective for the investigation of the upper layers of the Earth's atmosphere, since their much larger size and mass results in a much longer life span in atmospheric conditions.

As far as the launching of rockets toward the Moon is concerned, especially after the launching of the second and third Soviet cosmic rockets, the high level of Soviet science became even clearer, as foreign scientists are forced to admit.

This fact considerably disturbed many famous American investigators. So, the known leader of the Explorer group, Wernher von Braun, made a bitter statement that it will take the Americans not less than three years to reach the present level of Soviet rocket technique even with the efforts which are now undertaken in the USA.

"But where will the Russians be then?" asked von Braun.

The remaining countries are not preparing any satellite launchings as yet, except England, which has declared its intentions to utilize for this purpose its ballistic rocket. However, this year England is negotiating with the United States of America about the launching of an English satellite with the help of an American rocket from an American launching site.

Izvestia, October 9, 1959

THE BOLD INTERPLANETARY FLIGHT

by

V. Siforov
Member Correspondent of Academy of Sciences of USSR

The first year of our seven-year plan--1959--was marked by extremely important events. As a result of the persistent, purposeful effort of an outstanding pool of Soviet scientists and other specialists, three cosmic rockets were launched.

The recently launched third Soviet cosmic rocket has injected into an orbit an automatic interplanetary station. There is no doubt that this station will considerably broaden our knowledge about cosmic space and particularly about the environment surrounding the Moon. With the help of this station, scientists will be able to obtain scientific information about the other side of our natural satellite, which has been up to now inaccessible for observations.

The successful launching of three cosmic rockets with more and more variable and complex scientific instrumentation and with constantly more complicated flight assignments, during a period of only 9 months, testifies to the considerable achievements and rapid tempo of development of Soviet science and technique, particularly in the field of rocket construction, automation, and radio electronics.

In correspondence with the problem of investigation, the third Soviet cosmic rocket will accomplish a flight around the Moon and will then return to the vicinity of the Earth.

In comparison with the preceding cosmic rockets, the third rocket has a number of important properties. Its instrumentation is designed for a longer operational period, since it took approximately 2-1/2 days for that rocket to travel from the Earth to the Moon, and only 2 weeks after the launching the rocket will return to the vicinity of the Earth. For that purpose the power supplies include a set of Solar batteries, which make it possible to transform thermal energy of the Sun directly into electrical energy. Furthermore, steps were taken for a more economical regime of operation of the instruments and data transmission, for the purpose of a more economical energy consumption from the power supplies. This is being accomplished through a determined program of transmission which lasts from 2 to 4 hours daily. The instrumentation aboard Lunik III is being controlled from Earth. This makes it possible to switch on the instrumentation only when valuable scientific information is anticipated. By the same token, the electrical energy of the power supplies is being preserved in this manner.

During the construction of the rocket's instrumentation, as well as the ground instruments for the third Soviet cosmic rocket, scientists and designers had to overcome tremendous difficulties. Very high accuracy of original data on the movement of the automatic interplanetary station at the moment of separation from the last rocket stage had to be maintained. Indeed, the magnitude of the initial velocity and flight direction had to be maintained with a jeweler's precision.

The launching of the second Soviet cosmic rocket has already proved that we have achieved very good results in this regard. It should be mentioned that a deviation of the initial velocity of the container of Lunik II on the order of only several hundredths of a per cent from that calculated would lead to a miss. The

required accuracy of the initial data on the flight of the third cosmic rocket is even higher. In this case it was necessary to predict its movement over a much longer period of time, to calculate the position which it will take in space after traveling a distance of about a million kilometers from the Earth to the Moon and back to the Earth's vicinity.

This problem, as well as a number of others no less difficult, was successfully solved. Just as during the launching of the second cosmic rocket, Soviet scientists were already fully convinced at the beginning of the flight of the automatic interplanetary station that the assigned objectives would be achieved. A comparison of actual and calculated trajectories has shown that they coincide with a high degree of accuracy.

A large crew of Soviet scientists, designers, engineers, technicians, and workers participated in the preparation of this tremendous cosmic experiment. Very much was also accomplished by specialists in the field of radio electronics. The role of this branch of science in the conquest of cosmic space with the help of satellites and rockets is extremely great. It may even be said that it would have been impossible to perform these outstanding experiments without electronics. What precisely is the role of electronics in this experiment?

With the help of electronic-mathematical instruments preliminary calculations were conducted of different versions of a variety of trajectories of movement of the cosmic rocket, the calculation of assumed discrepancies in the magnitude of initial velocities, flight direction, moment of container separation, etc. Numerous scientific information about various properties of cosmic space were transmitted through radios from artificial heavenly bodies. By means of

radio-electronic constructions, the verification of the accuracy of the selected flight trajectories of satellites and rockets during their initial flight stages was accomplished. By means of radio signals from Earth the instrumentation of the automatic interplanetary station is being controlled, and much more became possible only with the help of radio-electronic means.

The range of radio communication has sharply increased during the past two years. The transmission of information to Earth from the first artificial Earth satellite was conducted from an altitude of several hundred kilometers; on the other hand, radio signals from the first and second cosmic rockets were received by us from distances of about half a million kilometers. In the case of the third cosmic rocket, for the first time in the history of radio technique and electronics, the application was introduced of automatic control from Earth of the instruments aboard.

Science and technique are being developed rapidly during our time. Ahead of us are many difficult assignments and problems for the further conquest of cosmic space. Among them is the launching of scientific instruments to the surface of the Moon, flights to Mars and Venus, utilization of Earth satellites for high-quality television broadcasting throughout large territories of the Earth's surface, and the realization of regular cosmic journeys. No matter how fantastic these problems seem to be, it may be convincingly confirmed that they will be successfully solved in the not too distant future.

No matter how great the successes will be in the further conquest of cosmic space, man will never forget the Soviet investigators who with their dedicated work have accomplished great scientific achievements by launching the first

artificial Earth satellite, creating the first artificial planet of the Solar system, conducting outstanding investigations of cosmic space near the Moon, and sending into the cosmos the first automatic interplanetary station.

There is no doubt that in the future Soviet scientists will continue to contribute tremendously to the development of space science. The problem of interplanetary flights definitely will be solved. The high level of Soviet science and technique, the rapid tempo of its development, the fundamental superiority of the socialist system which creates all necessary conditions for successful and quick execution of scientific investigations on a large scale, the tendency of Soviet scientists to cooperate with scientists of all other countries for the achievement of noble goals in the development of science, and the improvement of living conditions for people--all this will very strongly speed up the solution of the most difficult problems.

Izvestia, October 10, 1959

THE FLIGHT OF THE THIRD COSMIC ROCKET

At 8:00 p.m. Moscow time, October 9, the automatic interplanetary station was located in the constellation of Serpens, having a right ascension of 16^h40^m and a declination of -2° 36'. At this time the station passed over a point on the Earth's surface with the coordinates of 3° S latitude and 22° W longitude. Its distance from the surface of the Earth was 466,000 km.

The station will reach its orbital apogee on October 10 and will begin to approach the Earth, passing at a distance of about 40,000 km from the Earth's surface on October 18 at 8:00 p.m. with a velocity of 4 km/sec.

Having a rotation period around the Earth of about 15 days, the station will cover during one orbital turn more than a million kilometers.

The scientific instruments, the equipment, and the automatic interplanetary station continued normally, according to processed data from the acquisition of October 8.

The next acquisitions will take place on October 12 and 15 from 5:00 to 6:00 p.m. Moscow time.

Pravda, October 10, 1959

THE TRIUMPH OF SCIENTIFIC CALCULATIONS

by

Y. Tobedonostsev
Doctor of Technical Sciences

The automatic interplanetary station, which was injected into an orbit by the third Soviet cosmic rocket and which will circle the Moon, continues its flight successfully. Soviet scientists are particularly happy with the fact that the station continues its flight strictly along a calculated trajectory.

Great difficulties had to be overcome by Soviet specialists during the solution of this complicated technical problem. The most difficult seemed to be the first step when the assault on the cosmos began; that is, the achieving of a velocity for flying instruments which would permit them to defy the influence of the Earth's gravitation. It was necessary to develop a speed of 8 km/sec with the help of a rocket in order to place an artificial Earth satellite in orbit. In the case of Lunar flights, more than an additional 3 km/sec had to be added to this velocity.

During the calculation of a trajectory for cosmic rockets it is necessary to take into consideration not only the rotation of the Earth around its axis, the gravitation of the Sun and the Moon, but, in addition, the respective movements of the Earth and the Moon in space, the reciprocal position of these heavenly bodies, and much more. It was necessary to consider also the inclination of the Earth's gravitational field from the central field due to the compression of its poles.

Extremely high requirements are presented by the guidance system for flights of cosmic rockets. For instance, an error in the flight velocity of the last stage of the rocket at the moment of the motor cutoff on the order of only 1 m/sec, that is, 0.01% of its full velocity, will lead to a flight-trajectory deviation around the Moon of a distance up to 250 km. A change in the flight direction even on the order of 1' will displace this trajectory a distance of 200 km. Thanks to the extremely high perfection of the guidance instruments, the necessary, literally sniper-like accuracy in rocket guidance was observed.

It should also be kept in mind that during the process of preparation of the launching of the cosmic rocket and during the rocket's movement along the assigned trajectory, the Earth continues to rotate constantly around its axis and the Moon travels around the Earth and circles the Sun together with the Earth. Therefore, each moment of time in the launching of a cosmic rocket has its corresponding value in flight guidance and the velocity magnitude of its last stage. The precalculated moment of ascent should be maintained with very high accuracy, literally within a few seconds.

All these difficulties were successfully overcome by Soviet scientists and designers, securing a very highly organized preparation and rocket launching and also a perfect starting system and a highly reliable launching automation.

The interplanetary station, after circling the Moon, has now left the sphere of the Lunar gravitation. In its further movement the station will pass around the Earth along an extended ellipse with a maximum distance of 470,000 km, nearing the Earth at a distance of 40,000 km in the period of rotation of about 15 days. So, one more cosmic body created by human hands has appeared in our Solar

system. This is an instrument designed to penetrate the mysteries of the universe, an investigator for forthcoming interplanetary flights. The interplanetary station will enter the annals of history as a triumph of scientific calculations, a miracle of our time.

Pravda, October 11, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

On October 10 the third Soviet cosmic rocket reached its maximum distance from the Earth.

The accurate injection of the automatic interplanetary station with the help of a multistage cosmic rocket into the assigned trajectory has assured the station's journey along a strictly determined position in relation to the Moon during the maximum approach. This had made possible the utilization of the necessary influence of the gravitational force of the Moon for such a curvature in the further flight trajectory of the station, which would secure its return to Earth from the direction of the northern hemisphere.

In its further flight, returning to Earth from the northern part of the firmament, the automatic interplanetary station will continuously increase its declination. The interplanetary station will not disappear beyond the horizon at any time of the day for points located north of 60°N latitude during the period from October 15 to 18.

At 8:00 p.m. Moscow time, October 10, the automatic interplanetary station was located in the constellation of Serpens at a point with the following equatorial coordinates: right ascension 16^h44^m; declination 1° 23'.

At this moment of time the interplanetary station was passing over a point on the Earth's surface with the coordinates of 1.4°N latitude and 22.6° W longitude, at a distance of 470,000 km from the Earth.

The scientific instruments, the power supply, and thermal regulation of the interplanetary station continue to function normally. As was already mentioned, the next transmissions of scientific measurement data will take place on October 12 and 15 from 5:00 to 6:00 p.m. Moscow time.

Pravda, October 11, 1959

THE AUTOMATIC INTERPLANETARY STATION

by

V. Fedynsky
Doctor of Physical Mathematical Sciences

On October 4, the day of the second anniversary of the space era which was opened with the launching of the first Soviet artificial Earth satellite, the world was informed of a new, outstanding success of our scientists, engineers, and workers in the field of cosmic investigation. The third Soviet cosmic rocket, with an automatic interplanetary station, was launched toward the Moon.

The operation of the instruments of the cosmic interplanetary station is controlled from the Earth by a coordinating computing center. The rocket has rounded the Moon, making a dream come true which was expressed by Jules Verne in one of his most courageous and fascinating novels. However, reality has already far surpassed the winged fantasy of the writer which previously seemed to be impossible. A Soviet scientist controls the instruments of the third Lunar rocket from a distance of hundreds of thousands of kilometers, a fact about which even the courageous Jules Verne could not have dreamed.

Soviet science, which has already made a great contribution to the cause of of international cooperation on the conquest of the cosmos, is marching forward with huge steps. The first artificial Earth satellite, which was launched October 4, 1957, has marked the assault of men on cosmic space. The third artificial satellite, which is still continuing its flight around the Earth and which has, since May 15, 1958, accomplished almost 7300 revolutions, has made it possible to

conduct an important scientific observation of the density and the molecular and atomic contents of thin gases of the upper layers of the Earth's atmosphere.

The flight of the first cosmic rocket, which was launched on January 2, 1959, became a planet of the Solar system and was created by the hands of Soviet people, has marked the attainment of a complete victory over the ties of the Earth's gravitation. The second cosmic rocket, which was launched September 12, 1959, has delivered to the Moon with extreme accuracy a pennant with the symbol of the Soviet Union. With the help of this rocket an important scientific discovery was made about the absence of a noticeable magnetic field around the Moon. This discovery puts some light on the nature of the magnetic field of the Earth and other cosmic bodies.

There is no doubt that the launching of the third cosmic rocket, which is directed to fly around the Moon and then return to the vicinity of the Earth, will bring more important information about cosmic space, including information about the structure of the other side of the Moon which is invisible to the Earth.

The very launching of the third cosmic rocket in a flight around the Moon represents a brilliant solution to one of the most difficult problems of cosmic ballistics.

The calculation of the flight trajectory of the rocket around the Moon was very complicated because of the rotation of the Moon around the Earth and the Lunar gravitation which would affect the rocket. Consequently, the assignment of initial conditions for the rocket during its launching around the Moon required extreme accuracy. According to flight results, it is obvious that such

extreme accuracy of the rocket launching was successfully achieved. This in its turn testifies to the new achievements of our specialists in the field of rocket technique.

Another achievement on a large scale is the realization of telemetric contact with the rocket at a distance of above 400,000 km. The telemetric contact with the rocket permits the obtaining of concentrated information which is continuously being accumulated by the automatic interplanetary station during its flight. The realization of a telemetric communication is also an important step toward the creation of guided cosmic missiles, a step which paves the road toward interplanetary flights.

With the probing of cosmic space in the vicinity of the Moon, there arise entirely new extremes in perspectives in geophysical and astronomical discoveries. Even the very movement of our Lunik III around the Moon--only one of its trajectories--might yield valuable information about the shape of the Moon.

The compression of heavenly bodies, that is, the variation in the polar and equatorial diameters which is a result of rotation around an axis, causes a perturbation in the movement of bodies traveling around them which can be easily observed. It is known that by observing in the movement of artificial satellites perturbations which are caused by the compression of the Earth, scientists have very accurately determined the value of these compressions.

The accuracy of determining the compression according to the movement of satellites is not less than the accuracy of the best ground geodesic measurements. It is true, the compression of the Moon is not great. The Moon, however, while always facing the Earth with one side, might have the form of a triaxial

ellipsoid; that is, that it might be elongated in its equatorial plane in the direction of the Earth. A flight around the Moon and an accurate study of the rocket's trajectory might help to clarify the shape of the Moon.

A flight around the Moon might also explain whether the ionospheric traces which are observed near the Moon are connected with the Moon itself, or whether they happen to be related to the general gas structure of interplanetary space.

Telemetric communication with the automatic interplanetary station at such a considerable distance points out the possibility of sending automatic instruments, which would be controlled from the Earth, to the Moon. Then the Moon would become an object of investigation by geophysical means, which in the present time predominately penetrate the cosmic regions which previously used to be the subject of study by astronomical science only.

Numerous Soviet observation stations, as well as stations of other countries in the world, continuously track the flight of the Soviet Lunik. Its signals carry throughout our entire planet, proclaiming the beginning of the third anniversary of the cosmic era. This era which was uncovered by the Soviet Union, the first socialist state, should become an epoch of unheard-of flourishing of science and technique.

Izvestia, October 11, 1959

"MINE" AND "OURS" IN SCIENCE

by

E. Fedorov
Member Correspondent of Academy of Sciences, USSR

Answering a question of an American Journalist--if the planting of a pennant with the emblem of the Soviet Union on the surface of the Moon indicates the taking of possession of the Moon by the Soviet Union--N. S. Khrushchev has said that as far as Soviet people are concerned the expression "mine" is obsolete and the new conception "ours" is taking over. "Therefore," Khrushchev continued, "the sending into the cosmos of a rocket and the planting of our pennant on the Moon we consider as our conquest. And by the word 'our' we understand to mean the countries of the entire world; that is, that we think that this is also your achievement and the achievement of all people which live on the Earth."

The practical activity of Soviet scientists in the field of investigating cosmic space fully corresponds with the position which was expressed by the head of the Soviet government.

A mutual exchange of information, the application of similar methods for investigation, a bold analysis of the obtained results at international conferences, are undoubtedly useful in any field of science. This, however, will be of special value during geophysical investigations and in the investigation of interplanetary space.

Geophysical phenomena take place in the space surrounding the entire Earth's sphere. For the study of these phenomena it is necessary to organize a

systematic observation at many points on the Earth's surface. These observations should be conducted through an agreed-upon program by means of uniform instruments at determined moments of time. Only by this method could the results be comparable and the derived conclusions have a sufficient basis.

Of an analogous character are the investigations of cosmic space.

The utilization of artificial Earth satellites for scientific purposes is more effective if the observations of these satellites are conducted in a synchronized manner at various points on the Earth's sphere. So, the first artificial Earth satellite, which was launched by the Soviet Union, has already permitted scientists in many countries to determine the density of the atmosphere, by observing the gradual drag of the satellite and by investigating the structure of the ionosphere and studying propagation of radio signals from the satellite.

The launching of high-altitude geophysical rockets and, particularly, artificial Earth satellites and cosmic rockets, is a very complex and expensive project. Such experiments can be conducted only by the most developed, as far as science and technique are concerned, countries. It seems that it is the duty of these countries to report to the scientific world the new data about the nature of our planet and other heavenly bodies, information about properties of cosmic space which is obtained as a result of these unique experiments.

Soviet scientists have taken upon themselves a considerable share of investigations which were conducted during the International Geophysical Year. An especially large contribution was made by the Soviet Union in the study of the upper layers of the atmosphere and cosmic space with the help of rockets and artificial Earth satellites.

From the territory of the Franz Josef Land in the mean latitudes of the European part of the Soviet Union and in the Antarctic were launched 125 rockets in accordance with the IGY program. Many of these launchings represented serious scientific achievements. Some of these experiments required rocket systems of exceptional technical construction. I'm referring to, for instance, the known flights to altitudes of 200 and 500 km by heavy rockets which were equipped with a variety of measurement instrumentation. These flights were reported in detail by the Soviet press.

The summary of investigations conducted by the second and third Soviet Earth satellites exceeds everything that was designed for the study in the upper layers of the Earth's atmosphere by the IGY program.

The results of these investigations were not kept secret.

The Soviet scientific institutions have systematically publicized and widely distributed all information, which has made it possible to organize the tracking of the flight of our satellites in all countries. The large dimensions of the Soviet satellites and the considerable force of their radio transmission extraordinarily simplified the problem, and such observations have been actually carried out in various countries with the aid of comparatively simple devices.

The Academy of Sciences of the USSR has speedily published the basic results of scientific investigations which were conducted with the help of artificial Earth satellites and rockets. The first data, as is known, were published in the central newspapers, which voluntarily gave their pages for purely scientific information. More detailed papers on the contents and density of the atmosphere, new data on the ionosphere, on the propagation of radio waves, about the unique data

of biological experiments, radiation belts, and many other data were published in scientific publications.

Soviet scientists have followed this established rule according to the IGY order of information and have also relayed knowledge to their foreign colleagues pertaining to cosmic rockets launched outside of the IGY program. More important results were discussed at several international conferences, at the assembly of the IGY in August 1958 in Moscow, at the conference for the study of cosmic rays which took place in Moscow in 1959, and at many symposiums abroad.

The joint study of information which was obtained during the flights of Soviet and American satellites and cosmic rockets has demonstrated the concept of international cooperation in science which prevailed during the entire IGY program. In conjunction with this, it is very difficult not to be surprised when from time to time in the American press appear statements about the fact that Soviet scientists do not release information obtained as a result of cosmic investigations, and particularly the type of statement which was made at one of the press conferences for Comrade Khrushchev. Such a reproach should sooner be directed to the scientific institutions of the United States of America.

In 1959 it became known that some American artificial Earth satellites which were launched in 1958 in correspondence with the program of the IGY actually were designed for the determination of results of nuclear explosions, which were conducted by the Americans at high altitudes in the Fall of 1958.

In 1959 the USA succeeded for the first time in launching satellites in a polar orbit so that they passed over the entire surface of the Earth's sphere. These satellites, of the Discoverer type, judging from news releases are

considerably larger and more perfected than the satellites which were launched by the USA earlier. These satellites flew over the territory of the USSR, and tracking observations of these satellites could have been quite useful. However, American scientific institutions have refused to disclose the necessary information (ephemerides, radio transmission frequencies), stating that the launching of these satellites had nothing to do with the IGY program.

Attention should be drawn also to the problem of organization of international cooperation in the investigation of the upper layers of the atmosphere and cosmic space in the period after the IGY.

The Soviet government in 1958 proposed discussions about the utilization of cosmic space for peaceful purposes and about the coordination of investigations of cosmic space. In the session of General Assembly of the UN a year ago, as is known, the problem of coordination of investigations of cosmic space was discussed. It seemed as if all countries, and particularly the USA, should be interested in a broad and equal cooperation of various governments in this important project.

However, during the discussion of a staff for a committee which was proposed for such a coordination, the USA attempted to make up such a staff which would permit them to dictate their will to the Soviet Union and other socialist countries. Naturally the Soviet Union could not agree to this and did not participate in this committee.

At the same time, through the initiative of the National Academy of Sciences of the USA, the International Council of Scientific Unions adopted a solution to the organization of a scientific nongovernmental international committee for the coordination of investigations of cosmic space.

However, this committee (COSPAR), created by the initiative of the USA, was constructed in such a manner that among the nineteen members the Soviet Union was the only socialist country represented and had at its disposition only one vote at the time when the USA possessed three such votes, England--four, France--two, and Belgium--two.

During the discussion of the project for a COSPAR in the Spring of this year in the Hague, the Netherlands, the committee unanimously admitted that such a structure cannot secure a broad international cooperation in the investigation of the cosmos and has decided to change its structure.

Thus, the persistent wish of some influential circles in the USA to secure for themselves, at any price, a predominating influence in all problems which have to do with cosmic space, interferes with an international coordination of investigations.

Many scientists and a number of political leaders in the USA, Great Britain, and other western countries clearly think that international scientific cooperation in the investigation of cosmic space should be constructed on a broad basis and an equal participation of various governments and an honest intent for its achievement. It is then necessary to prove that the contribution of the Soviet Union in the investigation of cosmic space is sufficiently real. Therefore the attempt to limit artificially the participation of the Soviet Union and socialist countries in questions of organization of cosmic-space investigations and to put them in an unequal, subordinated position had to be turned into a failure.

This situation is beginning to receive some acknowledgement. As is known, the American representatives in the organization of the United Nations have

supported the proposition of V. V. Kuznetsov to organize an international conference for the problems of scientific investigations of cosmic space. The International Federation of Astronautics has elected the Soviet scientist, Academician L. I. Fedov, as its chairman, and COSPAR intends to investigate the new project.

Comrade Khrushchev has answered the American political leader V. Anfuzo that the Soviet Union always was and still is for international cooperation for peaceful utilization of cosmic space, but for such a cooperation by which the USSR and other socialist countries, which conduct great investigations in the field of the cosmos, would be present with an equal position.

The launching of the second Soviet cosmic rocket, which has accomplished a broad program of scientific investigations and has reached the Moon, and the extreme accuracy of operation of the Soviet automatic interplanetary station, which has completed a flight around the Moon and which is returning now to Earth, testify to the huge successes and great possibilities of Soviet science and technique.

The entire world can see that these possibilities are directed by the Soviet people for peaceful scientific purposes. Each new achievement of the Soviet Union brings the time nearer when men will be able to leave the limits of the Earth and step on the surface of the Moon and the planets.

Izvestia, October 13, 1959

THE FLIGHT OF THE THIRD COSMIC ROCKET

The automatic interplanetary station continues its flight along the assigned orbit. After passing its orbital apogee (point of maximum distance from Earth), the interplanetary station began to approach the Earth and at 8:00 p.m. Moscow time, October 12, the station was located at a distance of 456,000 km from the Earth's surface.

During its passage through the orbital apogee the automatic interplanetary station moved with a minimum velocity which equaled approximately 0.4 km/sec. After passing the apogee, the velocity of the interplanetary station began to increase and on October 12 it reached about 0.5 km/sec. In its further flight, as the interplanetary station will near the Earth, its velocity of movement will increase constantly.

At 8:00 p.m. Moscow time on October 12 the automatic interplanetary station continued its flight through the constellation of Serpens, having the following equatorial coordinates: right ascension $16^h51^m19^s$, declination 9°26'24". At this time the interplanetary station was located above a point on the Earth's surface with the coordinates 22°42'W longitude and 9.4°N latitude.

According to data which were obtained from aboard the automatic interplanetary station during the communication session of October 12, the instruments which are installed on this station continued to operate normally. The next transmission session of measurement data will take place on October 15 from 5:00 to 6:00 p.m. Moscow time.

Pravda, October 14, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

On October 13 the automatic interplanetary station has, continuing its flight through cosmic space, approached the Earth at a distance of 430,500 km. The data processing of trajectory measurements which were obtained during the transmission session on October 12, confirms that the interplanetary station is traveling in correspondence with the calculated orbit.

The processing of telemetry records shows that the scientific instruments which are installed aboard the interplanetary station and also the system of thermal regulation and energy supply function normally.

At 8:00 p. m. Moscow time October 13 the automatic interplanetary station shifted from the constellation Serpens to the constellation Hercules, to a point with equatorial coordinates as follows: right ascension $16^h55^m13.8^s$, declination 13° 54'.

At the indicated time the interplanetary station was located above the Atlantic Ocean south of the Cape Verde Islands over a point on the Earth's surface with the coordinates of 22.7° W longitude and 13.9° N latitude.

As was already reported, the next session of communication with the automatic interplanetary station will take place on October 15 from 5:00 to 6:00 p. m. Moscow time.

At the time of the communication session of October 15, the distance between the Earth and the interplanetary station will be 349,000 km.

Izvestia, October 14, 1959

ALONG THE VIRGIN PATHS OF THE UNIVERSE

by

A. Shternfeld
Laureate of the International Prize for the Furthering of Astronautics

The data from the interplanetary station's passage near the Moon and also the value of apogee and perigee (largest and smallest distance from the Earth), as reported by the TASS communique, permit the following conclusions to be made about the character of flight of the new artificial heavenly body.

Its trajectory along the sector between the Earth and the Moon underwent great changes mainly as a result of interaction of the gravitational fields of our planet and its natural satellite. However, from the moment when the automatic interplanetary station and the Moon parted, the Moon had practically no influence on Lunik's orbit, which took on an elliptical shape. [See the diagram in Fig. 4.]

The center of the elliptical orbit of the automatic interplanetary station is displaced by 215,000 km in relation to the center of the Earth. At the moment when the large axis of the orbit is about 523,000 km, its small axis extends only to about 300,000 km.

The extent of the orbit along which the automatic interplanetary station travels is approximately 1,300,000 km. Along this course the station travels with a velocity which is close to the orbital velocity of the Moon (1.02 km/sec).

At the moment of closest approach to the Earth the velocity of flight of the automatic interplanetary station will reach its maximum, about 4 km/sec. This

is only 5% less than the second cosmic velocity, which at such a distance from our planet equals 4.2 km/sec.

The second cosmic velocity, as is known, is not a constant value. This velocity decreases with altitude, as the gravitational force of the Earth weakens. If this velocity is 11.2 km/sec near the Earth's surface, then at a distance of 40,000 km it becomes equal to 4.2 km/sec. This means that if a rocket which carried the interplanetary station had been launched from an altitude equal to its orbital perigee, it would have had to achieve a velocity of 0.2 km/sec in order to escape the Earth's gravitational pull.

The velocity of the station will gradually drop as the probe approaches the most distant point from the Earth along its orbit, the apogee (470,000 km). At the apogee the speed of the station will be approximately 1,400 km/hr.

Since the orbit of the automatic interplanetary station extends to great distances from the Earth, the life span of this station is unlimited (not considering incidents such as a collision with a large or small meteorite or other unexpected cosmic phenomena).

Based on the orbital dimensions of the automatic interplanetary station, it is possible to calculate that the orbital period of the station will equal approximately 15.3 days. The orbital period of the Moon around the Earth in relation to the stars is 27.32 days. Consequently, the automatic interplanetary station, which travels in a plane which is almost perpendicular to the plane of the Lunar orbit, will from time to time pass through the vicinity of the Moon.

When, after the first approach to the Moon (October 6), the interplanetary station will again near the Lunar orbit on October 22 at midnight, the Moon will

not be there. In relation to the interplanetary station the Moon will then be located on the other side of the Earth. Gradually this distance will undergo a change.

In principle, for the investigation of the Lunar surface, it is possible to create automatic interplanetary stations which will complete periodical flights around the Moon and the Earth such that the Lunar face will be different at each meeting. Such "periodical" stations, while traveling along extended elliptical orbits, can accomplish 13 to 14 flights around the Moon over a period of 1 year. However, in this case the station will depart from the Moon on the order of tens of thousands of kilometers and will pass near the Moon at very high velocities.

The orbits of such artificial heavenly bodies which will pass at close distances to the Moon will be considerably distorted. The flight of these stations will also be influenced by the compression of the Earth and other factors. In principle it is possible in the future to correct constantly the orbit of such "periodical automatic stations" by means of miniature rockets.

Pravda, October 16, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

Continuing its flight towards the Earth, the automatic interplanetary station was located on October 15 at 8:00 p. m. Moscow time in the constellation of Hercules, having a right ascension of $17^h5^m41^s$ and a declination of 25° 33'.

At this time the interplanetary station was located over the Atlantic Ocean at a point to the southwest of the Canary Islands with the following coordinates: 22.1°W longitude and 25.6°N latitude. At 8:00 p. m. October 15 the distance between the interplanetary station and the Earth was 339,200 km and the flight velocity was about 0.9 km/sec.

Data processing of trajectory measurements which were received during preceding transmissions confirm that the interplanetary station continues its flight along a trajectory which is very close to that calculated. During the transmission of measurements on October 15 from 6:00 to 7:00 p. m. Moscow time, it was established that the scientific and measurement instrumentation of the station continues its operation normally.

The trajectory data and scientific measurements which were obtained during the transmission of October 15 are being processed.

The next transmission of data from aboard the automatic interplanetary station will take place on October 16 from 1:00 to 2:00 p. m. Moscow time.

Pravda, October 17, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

On October 16 at 8:00 p.m. Moscow time the automatic interplanetary station was located at a distance of 267,000 km from the Earth. The flight velocity of the interplanetary station at this moment was about 1.2 km/sec.

Data processing of measurements which were transmitted to Earth during the communication sessions with the station on October 15 and 16 have indicated that the instrumentation of the interplanetary station operates in correspondence with the assigned program. The pressure and temperature aboard the station remain within the limits of the calculated magnitudes.

The Solar batteries, the chemical power sources, scientific and measurement instrumentation function normally.

At 8:00 p.m. Moscow time the interplanetary station was located in the constellation of Hercules at a point with the following coordinates: right ascension $17^h15^m15^s$ and declination 34° 53'.

Next transmission will take place on October 17 from 12:00 to 1:00 p.m. Moscow time.

Pravda, October 18, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

At 8:00 p.m. Moscow time October 17, the automatic interplanetary station was approaching the Earth at a distance of 166,500 km.

The flight velocity of the interplanetary station continues to increase and at this moment it reached a speed of 1.7 km/sec. According to reduced data the automatic interplanetary station will reach its minimum distance from the center of the Earth, which equals 47,500 km, on October 18 at 7:50 p.m. Moscow time. At this time the interplanetary station will be located above a point on the Earth's surface in the region of the Solomon Islands, traveling from northwest to southeast. During its travel at a minimum distance from the Earth, the velocity of the interplanetary station will reach its extreme of 3.91 km/sec.

Data of telemetric measurements have confirmed that the scientific and measurement instrumentation of the station continues to operate normally.

The next transmission of data from aboard the automatic interplanetary station will take place on October 18 from 11:00 to 12:00 a.m. Moscow time.

Pravda, October 18, 1959

THE SOVIET COSMIC ROCKET IS APPROACHING ITS PERIGEE

by

A. Mikhailov

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Director of the Pulkovo Observatory

The third Soviet cosmic rocket is approaching the Earth, and after rounding our planet at a distance of 47,500 km (from the center of the Earth) it will then again speed away into cosmic space. The launching of this rocket was accomplished on the day of the second anniversary of the creation by Soviet specialists of the first artificial Earth satellite. Since October 4, 1959 the rocket has traveled more than 1 million km and has passed behind the Moon, observing the other side of this satellite, which was never seen by a human eye; then, following calculations, it traveled with amazing accuracy along an assigned, strongly expanding elliptical orbit, completing its first orbit around the Earth over a time period of about 15 days.

The problem of investigating the movement of heavenly bodies, natural as well as artificial, pertains to the field of celestial mechanics. The basis of this science is the law of gravitation, which was discovered by Newton almost 300 years ago. Dealing with the universal property of all material bodies to attract each other with a force proportional to their mass and inversely proportional to the square of the distance between them, this law, which is so simple in its mathematical formulation, requires the solution of extraordinarily complicated problems

during its practical application. The point is that particles of each body are separately subjected to universal gravitation, so that each particle is, according to Newton's law, attracted by other particles of the given body as well as of all other bodies of nature.

It is understood that bodies which are very distant in a cosmic sense have such a low gravitational pull because of their great distances that their influence, in most cases, might be neglected. But even if we would limit our investigation to only two bodies which travel in relation to each other, then also in this case the problem is very complicated, since the total attraction of one body to another consists of a huge number of elementary gravitations of each particle of one body to each particle of the other body.

Only when these two bodies have a simple external spherical form with an accurate distribution of their internal mass or if the dimensions of the bodies are very small in comparison to the distances between them, is their gravitation determined by the distance between their centers of gravitation, and their respective movements adopt a correct and comparatively simple character which was empirically discovered in the beginning of the seventeenth century by Kepler by the example of movement of planets of the solar system.

Such a discovery was possible because of the fact that the planets, together with a central body of the planetary system--the Sun, satisfy very closely both simplified conditions: they are all almost spherical in form and they are located far away from the Sun as well as from the other planets. But along with this simplifying circumstance there exists in the planetary system a great complication: we have to deal not with two mutually attracting bodies but with many.

With only two bodies present--for instance the Sun and one planet or the Earth or the Moon--their relative movement is determined by the laws of Kepler and generalized by Newton, and follows along one of the conical courses, that is, along an ellipse, parabola, or hyperbola, and the presence of a third body with a gravitational pull extremely complicates the problem. This considerable problem in celestial mechanics of three bodies has no general solution and can be solved only in each concrete case with the help of complicated mathematical instrumentation and, more often, by plotting endless lines of figures, all by the method of consecutive approaches. Only the contemporary electronic machines speed up these difficult calculations.

Luckily, as far as the movement of bodies of the Solar system is concerned, this complicated problem is simplified by two circumstances. On one side, during the investigation of the movement of planets, the gravitational pull of the Sun is predominating as a result of its huge mass. Because of this, the movement of each planet around the Sun is executed very closely according to the law of Kepler, and the gravitational pull of other planets in regard to the given planet changes the planet very little from its straight movement, causing the so-called motion disturbances. If it were not for the predominating influence of the Sun, the movement of the planets would be much more complicated and their orbits would scarcely resemble a Kepler ellipse.

But in many cases there are also other circumstances which simplify the problem of three bodies.

On the first night of the nineteenth century, in Palermo, the first small planet was discovered which, because of its small dimensions (its diameter was 16 times less than the diameter of the Earth) and small mass (approximately 8000 times less than the mass of the Earth) could not noticeably influence by itself the movement of other planets. But at the same time its movement was disturbed by the gravitational pull of large planets. Since then, almost 2000 small planets have been discovered of which the smallest has a diameter on the order of 1 km. In conjuction with this, the so-called limited problem of three bodies was created. This problem is reduced to the investigation of the movement of a body with such a small mass that its gravitation has no noticeable influence on two other massive bodies which, being attracted to each other through their gravitational pulls, travel around each other along a Kepler ellipse and, in a more simplified form of the problem, along a circular orbit. At the same time, the small body experiences a gravitational pull from both larger bodies by which its movement is determined.

As was proven by very broad and detailed investigations, the movement of such a small body can vary considerably, depending on the initial conditions, that is, on the magnitude and direction of its velocity at a certain given moment which is assumed to be the initial moment. From all possible orbital forms, the most interesting are the periodical orbits, those orbits by which the small body that completes one or several rotations around a larger body returns again to its initial position with the previous velocity and therefore repeats the same motion for an unlimited number of times.

The flight of the third cosmic rocket represents exactly the case of a limited problem of three bodies. The rocket travels under the influence of the gravitation of the Earth and the Moon, but the rocket itself does not show any influence on these bodies. Completing its first orbit around these bodies, the rocket again departs from the Earth, but during the second orbit the rocket will not circle the Moon because the Moon will at this time be on the opposite side of its orbit. Actually the rocket will reach its apogee--the farthest point on its orbit from the Earth, which is located beyond the orbit of the Moon--during the second revolution 15 days after the first passage through that apogee. But the rotational period of the Moon around the Earth equals 27-1/3 days; therefore the Moon at this time will have traveled not much more than a half of its orbit and obviously will be located on the opposite side of the Earth.

An interesting question arises: will the previous positions of the Earth, the Moon, and the rocket ever be repeated?

There will undoubtedly be approaches of the rocket to the Moon and its passage through the sphere of Lunar influence, which might change the orbit of the rocket in one or the other direction. It is possible that such a change will occur by which the perigee distance will decrease enough to cause the rocket to enter denser layers of the Earth's atmosphere, and then the rocket would burn up on re-entry. But there is also a possibility of a direct collision between the rocket and the Moon, as was the case with the second Soviet cosmic rocket which was purposely launched in such a manner as to impact on the Moon.

It will be possible to predict and calculate in more detail all these interesting phenomena after optical observations are completed during the rocket's approach to the Earth. Near its perigee the rocket will be visible as a slowly moving, sparkling point of approximately the 12th astral magnitude, invisible to the naked eye, but available for photographic recording by powerful light astrographs. If men will succeed in obtaining photographs of the rocket, then its orbit will be so pinpointed that the further movement of the rocket will become known for a considerable period of time. Soviet observatories are getting ready to "trap" the approaching rocket, and we may hope that in the forthcoming days we succeed in predicting its further fate.

During the two weeks of its existence the cosmic rocket has already transmitted to Earth, by means of radio signals, a great amount of valuable and unique information about the physical properties of the environment which surrounds the Earth and the Moon and about the Moon itself. In addition, further investigations of the rocket's movement are of great scientific interest. The movement of the rocket can yield information regarding problems such as, for instance, the determination of the center of gravity of the Moon, which does not coincide with the center of its shape as it was derived from astrometric observations of our natural satellite. Observation of the rocket's movement might facilitate the study of the disproportion of the Earth's rotation around its axis and the resulting variation in the length of days on the Earth. The observations might help to define more accurately the magnitude of compression of the Earth and to explain a number of other actual questions of celestial mechanics, astronomy, and geodesy.

If over a period of two years Soviet scientists, engineers, and workers were able to create such a great number of various artificial heavenly bodies which have yielded and which will continue to yield so much new information about cosmic space and the Moon, then in the near future, by further completion of the rocket technique which is being applied by us for many scientific purposes, much more new data about other bodies of the Solar system will undoubtedly be obtained. These data considerably broaden our knowledge about the universe and increase our possibilities of utilizing the forces of nature for the welfare of the human race.

Izvestia, October 18, 1959

THE COSMIC LIFE OF THE MOON

by

Professor N. Kozyrev

Up to now, men have been chained to the Earth's surface, as far as space investigation is concerned. Now it is possible, with the help of cosmic rockets, to study the world from other positions. This is especially valuable for the investigation of the Moon. From the Earth we can only see one side of the Moon. Now a flight around the Moon will make it possible to investigate its other hemisphere.

It is not likely that the other side of the Moon will prove to be different in principle. But, for the understanding of the origin and the history of the Moon, it is very important to know its entire surface.

What conclusions can be drawn about the physical properties of the Moon on the basis of astronomical data? Measurements of Lunar luminosity have shown that its surface is very dark. It consists of rocks which reflect light as little as a newly plowed field. This shouldn't be strange. If we would be able to see in the middle of the night a sector of a field lit up by the Sun, then it would seem to us as bright as a full Moon. Such a surface gets strongly heated by the Sun during the Lunar day, which lasts about 14 Terrestrial days; its temperature reaches 130° C. During a similarly long night the surface of the Moon cools to -100° C and even lower. The quick cooling of the Lunar surface can be observed during the Lunar eclipse. From this it follows that the Solar rays heat only the very upper

layer of the Lunar surface. That means that the rocks which form the Lunar surface have a very low temperature conductivity, a thousand times less than the conductivity of the Earth's crust. Such properties are characteristic of porous rocks in vacuum conditions, when heat is transferred only along the junctions of thin partitions.

There is actually no atmosphere on the Moon, no steam from water, and consequently no water. The most precise investigations have not discovered any signs of an atmospheric light dispersion on the Moon. However, judging from the data of the second cosmic rocket, it is possible that negligible traces of a Lunar atmosphere do exist.

The surface of the Moon is most probably composed of porous volcanic rocks which resemble pumice. If the current of internal heat on the Moon were similar to the heat on the Earth, then the temperature of the rocks would have increased by depth approximately 30° C/meter. Therefore the Lunar crust should be very thin, and it is possible that the formation of mountains and volcanic processes on the Moon take place more intensely than on the Earth. It is very interesting that the Lunar mountains in relation to the dimensions of the Moon are very high (their height is measured by the length of their shadow). For instance, in the Leibnitz Mountains near the sourthern rim of the Moon, a mountain peak was discovered with a height of 9 km. The huge Lunar craters,or circuses, which sometimes measure more than 100 km in diameter, are obviously gaps which appeared in place of pockets of melted matter which were drained by volcanic activity. If this is so, then they exceed by several times the dimensions of gaps in the places of Earth volcanoes.

Topographic study of the Lunar surface indicates that, just as on the Earth, the surface was gradually composed as a result of the lowering and raising of its crust. Lava, racing through the crevices, could have created the comparatively level surface of the Lunar seas. The high range of the Lunar Alps is cut through completely by a valley with steep edges measuring in width more than 10 km. Obviously the raising of the Lunar crust, with a considerable expansion, took place here. From these examples it can be seen that the Moon had a long history. That history can be read by studying the layers of various formations in the topography of the Moon. The point is that there is no ventilation on the Moon, no washout or erosion, and the old topography is well preserved and can be observed satisfactorily. Only superficial deformations can take place, caused by sharp temperature changes, impacts of meteorites and cosmic dust.

The most preserved and therefore youngest Lunar formations are the craters with light beams, which can be seen even with small telescopes during a full Moon. Some beams of the crater Tycho extend for more than three-fourths of the Lunar circumference. The origin of these beams is still a mystery. It is probably a system of small invisible crevices which are filled with luminous matter. A spectral analysis has shown that this matter illuminates under the influence of a stable, probably corpuscular radiation from the Sun.

If the Moon had a magnetic field, then the charged particles which come from the Sun could have dropped on the dark side of the Moon near its poles, as is the case with the magnetic field of the Earth. As a result, flareups of radiation should have been noticed there, that is, polar luminosities or aurorae which would have taken place directly on the hard surface of the Moon. But such

phenomena were not observed by anybody. Therefore, a conclusion about the absence of a magnetic field on the Moon could have been made even before the direct proof was obtained by the second cosmic rocket.

The system of beams should dissipate in time under a layer of cosmic dust and superficial distortions. A calculation shows that it will take several tens of millions of years to accomplish this. Therefore, more ancient craters did not have any beam systems. This type of an analysis of the topography permits us to establish in the history of the Moon several periods of strong mountain-forming activities which were succeeded by a state of comparative inactivity. This coincides to quite an extent with the geological history of the Earth.

All mentioned observations testify about the Lunar life in the far past. It is therefore very interesting to clarify whether the life of the Moon continues in our time. Direct proof about the existence of specific processes inside the Moon was successfully obtained only last year during spectral observations of the crater Alphonsus. The spectra have shown that on November 3, 1958, a discharge of gases undoubtedly took place from the central peak of this crater. These gases consisted of composite molecules and were discharged in the amount of about 100,000 cubic meters, if one should reduce them to the pressure of the Earth's atmosphere. This has shown that internal energy and the possibility of gas-forming processes are preserved on the Moon to the present time.

Thus, the cosmic life of the Moon still continues. As far as organic life is concerned, it is hardly possible in the conditions of the rough Lunar surface. Otherwise the adaptability of life to the physical conditions is so great that the possibility of simple life forms on the Moon should not be discounted prematurely.

All these astronomical conclusions about the nature of the Moon will soon be checked. The time is not far away when the Moon will be as well studied as the Earth's sphere.

Pravda, October 19, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

At 7:50 p.m. Moscow time on October 18, the automatic interplanetary station completed its first orbit around the Earth. The interplanetary station has conducted scientific investigations of cosmic space in the vicinities of the Earth and the Moon. During the rounding of the Moon, photographic pictures were taken of the other side of the Moon which is invisible from the Earth.

Data of scientific measurements and photography are being processed. The results of processing will be published. Completing its first orbit and departing from the Earth again, the automatic interplanetary station will not be observed from the territory of the Soviet Union for about 2 days.

The next communication session with the interplanetary station will take place on October 21 from 3:00 to 4:00 p.m. Moscow time. At this time the automatic interplanetary station will be at a distance from the Earth's surface of about 327,000 km and will pass over a point on the Earth's surface with the coordinates of 38° E longitude and 23° S latitude.

Pravda, October 19, 1959

THE UNMATCHED SCIENTIFIC EXPERIMENT

Photographs of the Invisible Side of the Moon

by

N. Barabashov

Chairman of Commission for the Investigation of Physical Conditions on the Moon and the Planets of the Astronomical Council of the Academy of Sciences USSR, Director of the Kharkov Astronomical Observatory, Academician of the Ukrainian Academy of Sciences.

The Soviet automatic interplanetary station has completed its first orbit around the Earth and the Moon. During the rounding of the Moon the station has taken photographic pictures of the invisible side of our natural satellite. Information about that side of the Moon and other data about cosmic, near-Lunar space were transmitted to the Earth and are now being processed.

The announcement about this unmatched experiment which was designed by Soviet scientists and engineers filled the hearts of all Soviet people with pride and great joy.

It is known that the Moon always faces the Earth with the same side. Because of the Lunar librations (oscillations) we are able to observe three-fifths of the Lunar surface; two-fifths of the Moon is always hidden from us. This part of the Moon can be seen only from an interplanetary vehicle.

Since the time when Galileo designed the telescope, a multitude of work has been dedicated to the observation of the Lunar surface. With contemporary

astronomical instruments the Lunar surface is visible extraordinarily clearly. The Lunar surface is known to us in detail as much as the surface of the Earth.

On the visible side of the Moon large and small dark spots can be observed and also bright points, mountains, and craters. The dark spots are actually huge hollows or depressions. We call them seas even though they do not possess a single drop of moisture. Small dark spots are called lagoons, lakes, marshes, etc. A large part of the Lunar surface is covered with mountains and is very coarse. Huge circular mountains on the Moon are called circuses, smaller circular mountains–craters. There are more than 30,000 small craters. The entire Lunar surface is covered with them. These craters are spread out through the valleys of the Lunar seas and even on the slopes of large craters and circuses.

In addition to circuses and craters, long mountain ranges and separate mountains are visible on the surface of the Moon. Some of these mountains reach a height comparable to the highest mountains of our planet. The highest Lunar mountain reaches a height of 9 km. Lunar seas, the surface of which seems to be grayish and sprinkled with green, have depths down to 1 or 2 km.

Spectrophotometrical investigations and colored photography of the Moon, which were made by the author of this paper, show graphically the distribution of mountain rocks and varied coloring throughout the Lunar surface. However, the coloring of various radiants of the Moon's surface is much less expressed than on the Earth.

In addition to the above indicated formations, there exist on the Moon also "crevices" or "trenches" and "luminous beams." The crevices are deep

and comparatively narrow. They have the shape of dark lines sometimes slightly bent. Up to 500 trenches and crevices are known at the present time. Large Lunar crevices are visible even by a magnification of only 50 to 60 times.

Of great interest are the so-called luminous beams. These are formations of some kind of luminous matter. In many cases they extend over the Lunar surface in the form of radially distributed beams. This is also where they got their name.

Observations which were conducted by the Kharkov Astronomical Observatory of the luminous beams and the powder-like level and rough surfaces have shown that the luminous beams cannot consist of powder-like substances with sufficiently small grains. The latest investigations have indicated that the luminous beams are the same as the coarse regions of the Moon which are covered with lighter matter. This conclusion was made on the basis of the fact that the structure of the surface of the luminous rays is similar to the structure of the remaining Lunar surface.

Many scientists have dedicated their life to the study of the Moon and have compiled detailed Lunar charts. Since the end of the nineteenth century, photographic atlases of the Lunar surface have been compiled which are distinguished by great accuracy and an abundance of details. But all our knowledge about the surface of the Moon pertains only to the side which is visible from the Earth. There was no knowledge at all of what the other side of the Moon looked like.

Various assumptions exist on this account. Some astronomers consider that on the other side of the Moon there are few seas and their dimensions are

small. A presumption was also made that on the other side of the Moon there is water and even atmosphere. But this is unlikely.

Now we don't have to guess anymore. There will be accurate scientific data in the hands of Soviet scientists about this problem. Astronomers of the entire world are awaiting impatiently the publication of results of the photographic recordings of the hidden side of the Moon.

The announcement about photographing the hidden side of the Moon has agitated the entire world; because of the efforts of scientists, engineers, and workers, the human race will for the first time in history be able to take a look at the regions which seemed to be forever hidden from its observation. On the basis of obtained data it will be possible to study in detail the history and order in the creation of the Lunar topography and we will come nearer to the solution of the problem of the origin of the Moon itself and of the geological processes which have caused the formation of the Lunar surface.

Pravda, October 22, 1959

TASS COMMUNIQUE ABOUT THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

Continuing its flight, the automatic interplanetary station was located on October 21 at 8:00 p. m. Moscow time over a point on the Earth's surface with the following coordinates: 37° W longitude and 21° S latitude in the region of Rio de Janeiro. The distance of the interplanetary station from the Earth was 342, 000 km and the flight velocity was 0. 89 km/sec.

On October 24 the next transmission session from the interplanetary station will take place. The following transmission session of scientific data from aboard the automatic interplanetary station will take place on October 26 from 3:00 to 4:00 p. m. Moscow time. At this time the automatic interplanetary station will be at its maximum distance from the Earth, which equals 483, 000 km. The equatorial coordinates of the station in the beginning of the forthcoming transmission session will be as follows: declination 2°, right ascension 16^h45^m.

Izvestia, October 27, 1959

THE FLIGHT OF THE THIRD SOVIET COSMIC ROCKET

In correspondence with our assigned program of scientific investigations, at 6:30 a.m. Moscow time on October 7 special instrumentation aboard the interplanetary automatic station was activated for the purpose of obtaining pictures from the other side of the Moon and following transmission of the images back to Earth.

For the purpose of photographing the Moon, the automatic interplanetary station was supplied with an orientation system and phototelevision instrumentation with a special construction for automatic processing of films.

The period for photographing the Moon was selected in such a manner that the station traveling along its orbit was in a position between the Moon and the Sun, which illuminated at this time 70% of the invisible side of the Moon. At that moment the station was located at a distance of 60,000 — 70,000 km from the surface of the Moon.

Activated by a special command, the orientation or directional system found the station so that the lenses of the photocamera faced the other side of the Moon, and gave the command to turn on the pnoto apparatus.

Photographing of the Moon continued for about 40 minutes and a considerable number of pictures of the Moon in two different scales were obtained.

Film processing (development and fixation) was conducted automatically aboard the interplanetary station. Transmission of signals of the photo image of the Moon to Earth was made with the help of a special radio-technical system. This system at the same time secured the transmission of data of scientific

measurements, determination of orbital elements, and also the transmission from Earth to the interplanetary station of commands which directed its operation. The television apparatus secured the transmission of a half-tone image with highly resolvable capabilities.

The first pictures of the invisible side of the Moon which were obtained as a result of preliminary processing will be published in the newspapers on October 27 with the necessary descriptions.

The Academy of Sciences of the USSR has appointed a commission for the purpose of naming the craters, mountain ranges, and other natural features of the invisible part of the Moon.

Aboard the automatic interplanetary station are also located instruments for the purpose of scientific investigation in interplanetary space. The obtained results of scientific investigations are recorded on tape by ground stations and are presently being processed.

The operation of the automatic interplanetary station along its first orbit has shown that:

1. The flight of the cosmic rocket along a complicated predetermined orbit was successfully secured;
2. The problem of guiding an object in space was solved;
3. Radio telecommunication and transmission of television images at cosmic distances was accomplished;
4. An image of the other side of the Moon, previously inaccessible for investigation, was obtained along with a number of other scientific results.

At 8:00 p. m. October 27 the interplanetary station will be over a point on the Earth's surface with the coordinates of 38° 6' W longitude and 6° 30'N latitude at a distance of 484, 000 km from the center of the Earth.

Specification of the orbital characteristics of the automatic interplanetary station indicates that the life span of the station from the moment of launching will be approximately 6 months during which time the station will accomplish from 11 to 12 revolutions around the Earth. After the expiration of this period the interplanetary station will enter the dense layers of the Earth's atmosphere and will disintegrate.

Pravda, October 27, 1959

COMMUNIQUE OF THE SPECIAL COMMISSION FOR THE NAMING OF FORMATIONS ON THE OTHER SIDE OF THE MOON BY THE ACADEMY OF SCIENCES OF THE USSR

The Commission of the Academy of Sciences of the USSR, under the chairmanship of the member correspondent of the Academy of Sciences of the USSR, A. A. Mikhailov, has, after examining the materials on the investigation of photographic pictures obtained from aboard the automatic interplanetary station, confirmed the names of established formations on the other side of the Moon which is invisible from the Earth.

These names describing newly established formations are published in the paper "The Third Soviet Cosmic Rocket." In the course of disclosing the new formations on the other side of the Moon, their naming and descriptions will be published.

Pravda, October 28, 1959

THE NATURE OF THE INVISIBLE SIDE OF THE MOON

by

A. Markov
Doctor of Physical-Mathematical Sciences

The unmatched scientific victory of Soviet scientists, engineers, and workers is today in the center of the world's attention. With the hands of Soviet people an automatic interplanetary station was prepared and launched which has made it possible to take a look at the previously inaccessible side of the Moon. The grateful world has already evaluated this achievement as a tremendous scientific advance. This event will be written into the history of civilization forever.

The telegraphic agency of the Soviet Union announced on October 26 that the photographic pictures of the invisible side of the Moon were taken from a distance of 60,000 to 70,000 km from the Moon at the moment when our automatic interplanetary station was in cosmic space between the Sun and the Moon. A thoroughly designed system with an apparatus has secured the corresponding position of the photo lens at this moment. Photographing continued for 40 minutes; then the images were transmitted to Earth, covering a distance of tens of thousands of kilometers.

The pictures of the other side of the Moon which were published on October 27 have disclosed a considerable difference in the actual topography on the Moon in comparison with that which was imagined by authors of hypothetical charts of the invisible side of the Moon, such as the German astronomer Franz and the English astronomer Wilkins. An examination of the first Soviet pictures of the

invisible side of the Moon has shown that it has a prevailing mountainous surface and, contrary to anticipations, it possesses only two "seas," the Moscow Sea and the Sea of Dreams. The names were selected by special commission of the Soviet Academy of Sciences. Thus, approximately only 10% of the surface of the invisible hemisphere of the Moon is covered by "seas," when 30 to 35% of the hemisphere visible from Earth is covered by seas.

The reasons for this, and more accurate conclusions about the history of the Lunar mountain formations, will now be studied mutually by astronomers and geologists. Of course, we will take into account the fact the the influence of tidal forces which are caused by the Earth's gravitation is more strongly noticeable on the visible hemisphere of the Moon. We must further consider that on the visible side of the Moon during Lunar eclipses, which occur up to two times a year, a temperature change takes place very sharply; over a period of a half hour the temperature will change by 250°C. It is possible that these two reasons are sufficient to cause the flow of lava on the surface of the Moon from the crevices in its crust which were caused by sharp temperature changes. Because of this fact, as it seems to us, more seas are created on the visible side of the Moon than on the invisible. Temperature changes on the invisible side of the Moon take place less sharply because of the absence of Lunar eclipses on that side.

Some astronomers who consider that the mountain formations on the Lunar surface depend on collisions with meteorites notice also that as far as frequency of meteorite impacts on the Lunar surface is concerned, the conditions are not the same on both sides of the Moon. A detailed investigation of Soviet pictures of the other side of the Moon should give new data about our satellite as well as the course of evolution of its surface.

Izvestia, October 30, 1959

THE ASTRAL WORLDS BECOME CLOSER

by

T. Fetisov
Special Correspondent of Izvestia

Several travel hours from Moscow, in a picturesque setting, is located the radio-astronomy station of the P. N. Lebedyev Physics Institute of the Academy of Sciences, USSR. Its site was selected so as to be far away from industrial plants. This was not accidental, because it is necessary to avoid any disturbances during the operation of these very sensitive instruments.

The further development of radio astronomy requires the construction of larger and larger radio telescopes, including portable radio telescopes with antennae in the form of parabolic reflectors.

The construction of large radio telescopes with massive reflectors represents a considerably difficult task. At the present time there are several large reflector radio telescopes. But all of these telescopes are able to receive emissions of a wavelength not shorter than several centimeters; the largest of these radio telescopes is located in England at the site of the radio-astronomy station Jodrell Bank, with a wavelength of only 20 cm.

Now, at the site of the radio-astronomy station of the Physics Institute, the USSR's first large, portable radio telescope has been constructed and is already undergoing experimental exploitations.

The telescope was designed and constructed at the Physics Institute over a period of several years under the supervision of the senior scientific associate,

candidate of physical-mathematical sciences, A. E. Salomonovitch, and the chief designer of the telescope, P. D. Kalachev. Groups of a number of research and industrial organizations also participated in the calculations and preparations of the telescope, according to a statement by the chief of the station, D. V. Kovalevsky.

The diameter of the parabolic reflector is 22 meters, and its focal range is 9.5 meters. The weight of the reflector is 65 tons, and the weight of the entire telescope is 380 tons.

The portable radio telescope is a very complicated and precise instrument. It required almost 2 years of construction and assembly.

A narrow, winding steel staircase leads to the control room. In the center the main panel is located. Next to it are the racks with receiving instruments and automatic recorders. A. E. Salomonovitch explained:

"Our telescope has the largest resolving capability of all portable radio telescopes in the world. It can be directed at any point in the sky. It is supplied with a special tracking installation. This installation permits lengthy observations of cosmic radio-emission sources. At present we are investigating Solar and Lunar radiations. We have already succeeded in obtaining several radio images."

Nearby the telescope we noticed a row of high steel supports. As we were told, this is the beginning of another interesting instrument -- a cross-shaped radio telescope. It is being constructed under the leadership of the candidate of physical-mathematical sciences, V. V. Vitkevitch. The new telescope will be the largest in the world. The span of each arm of the telescope will be about 1 km;

its height will be 40 meters. The antenna of the arm, which will be oriented in the direction from west to east, will be capable of rotating around a horizontal axis.

[A photograph of the radio telescope at the Lebedyev Institute of Physics is shown in Fig. 5. The telescope at the Leningrad Observatory is shown in Fig. 6.]

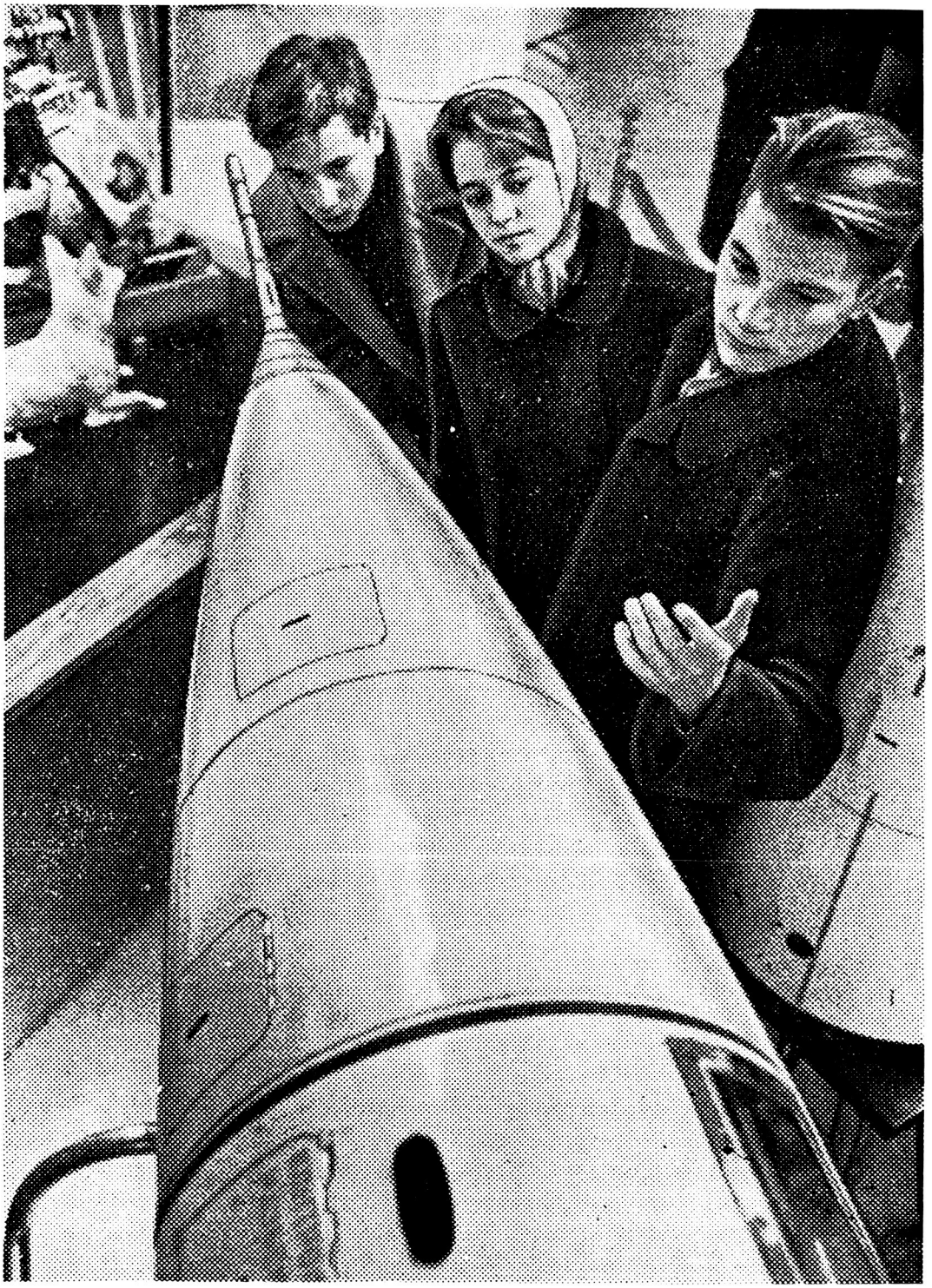

Fig. 1. Scale Model of the Nose Cone of the Soviet Cosmic Rocket at an Exhibition in Moscow

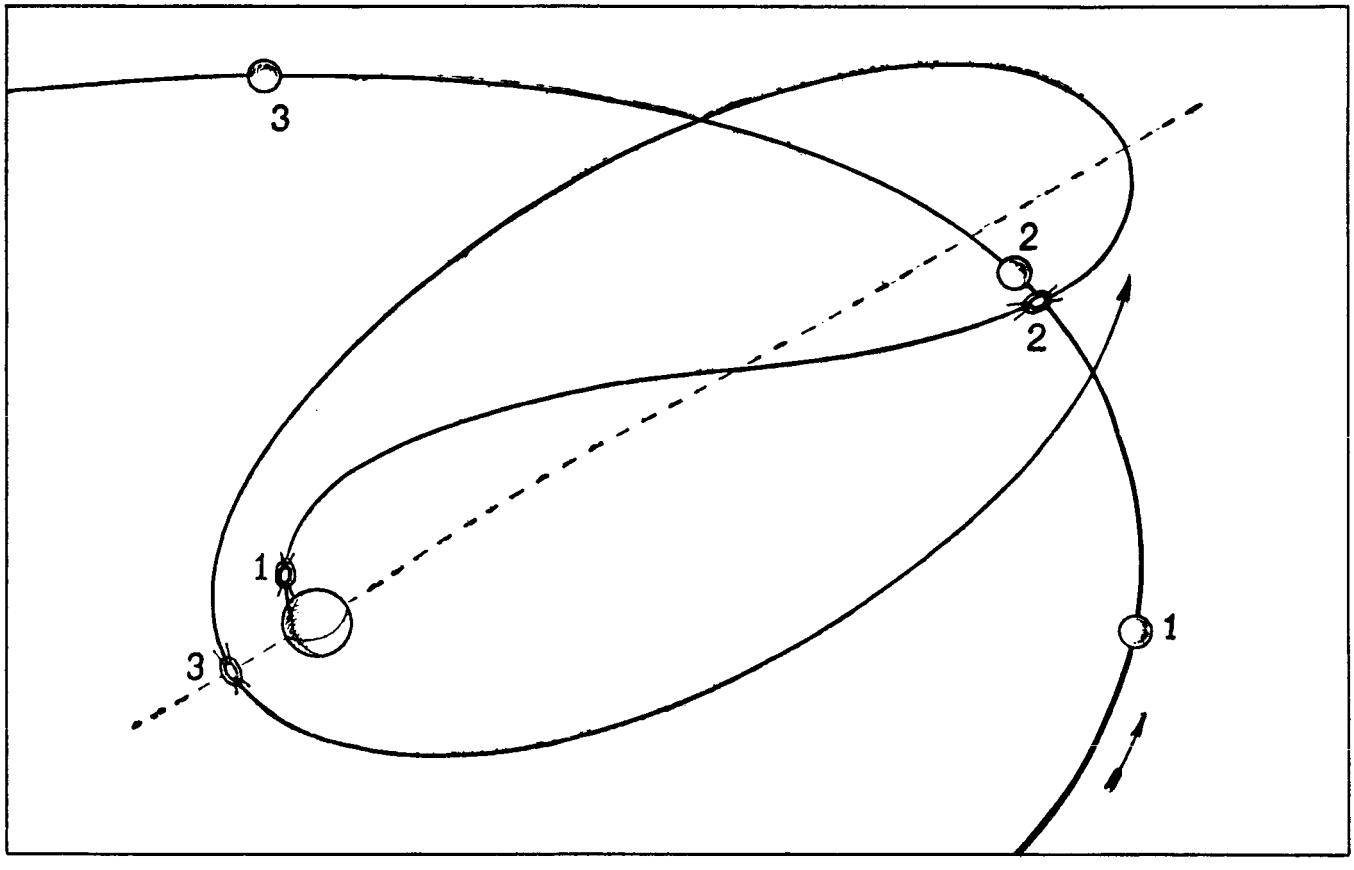

Fig. 2. Relative Positions of the Moon and the Soviet Cosmic Rocket

(1) Position of Moon and rocket at moment of injection into orbit
(2) Position of Moon and rocket at moment of closest approach
(3) Position of Moon and rocket at rocket's closest approach to Earth

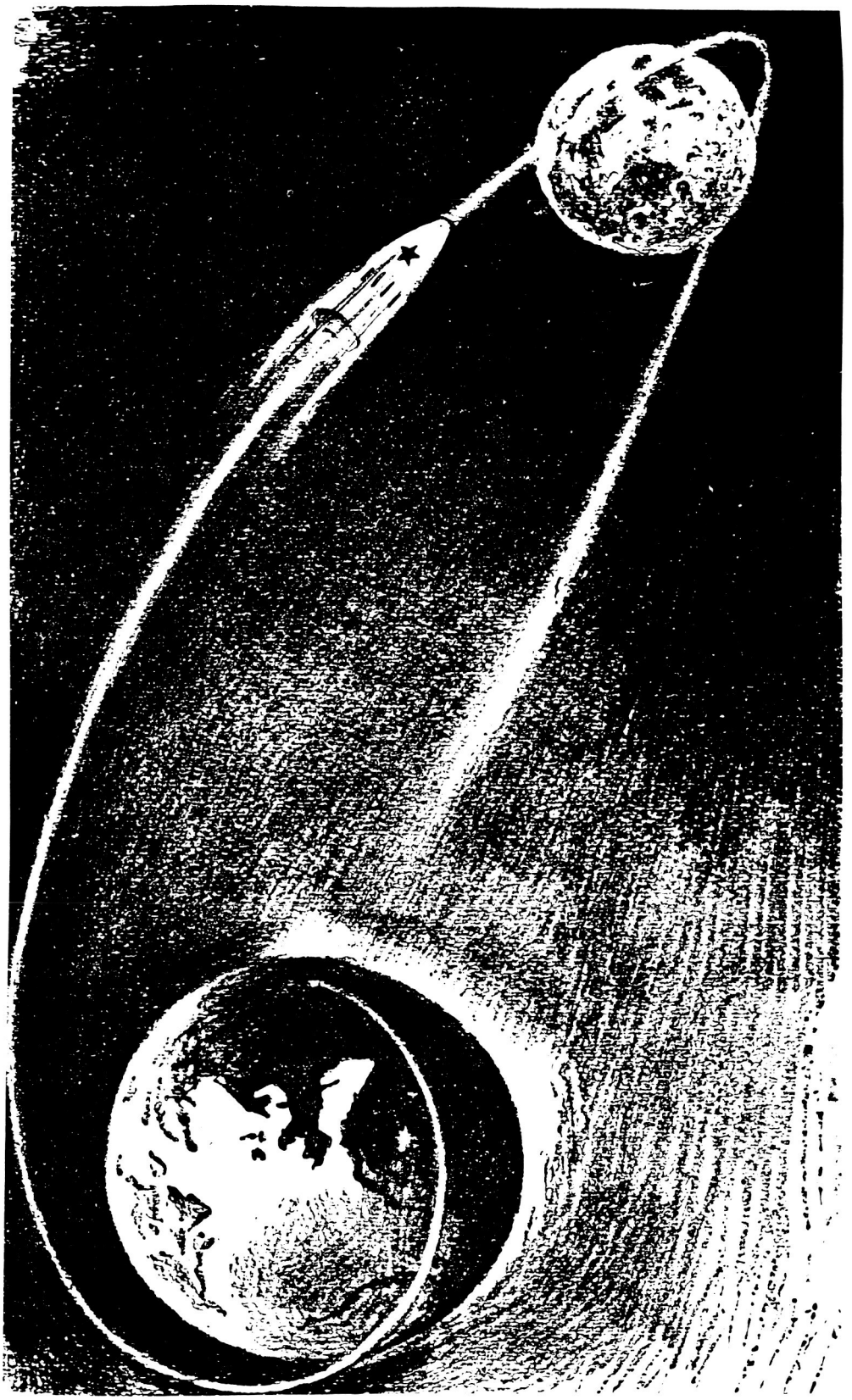

Fig. 3. Path of Lunik III (from Izvestia)

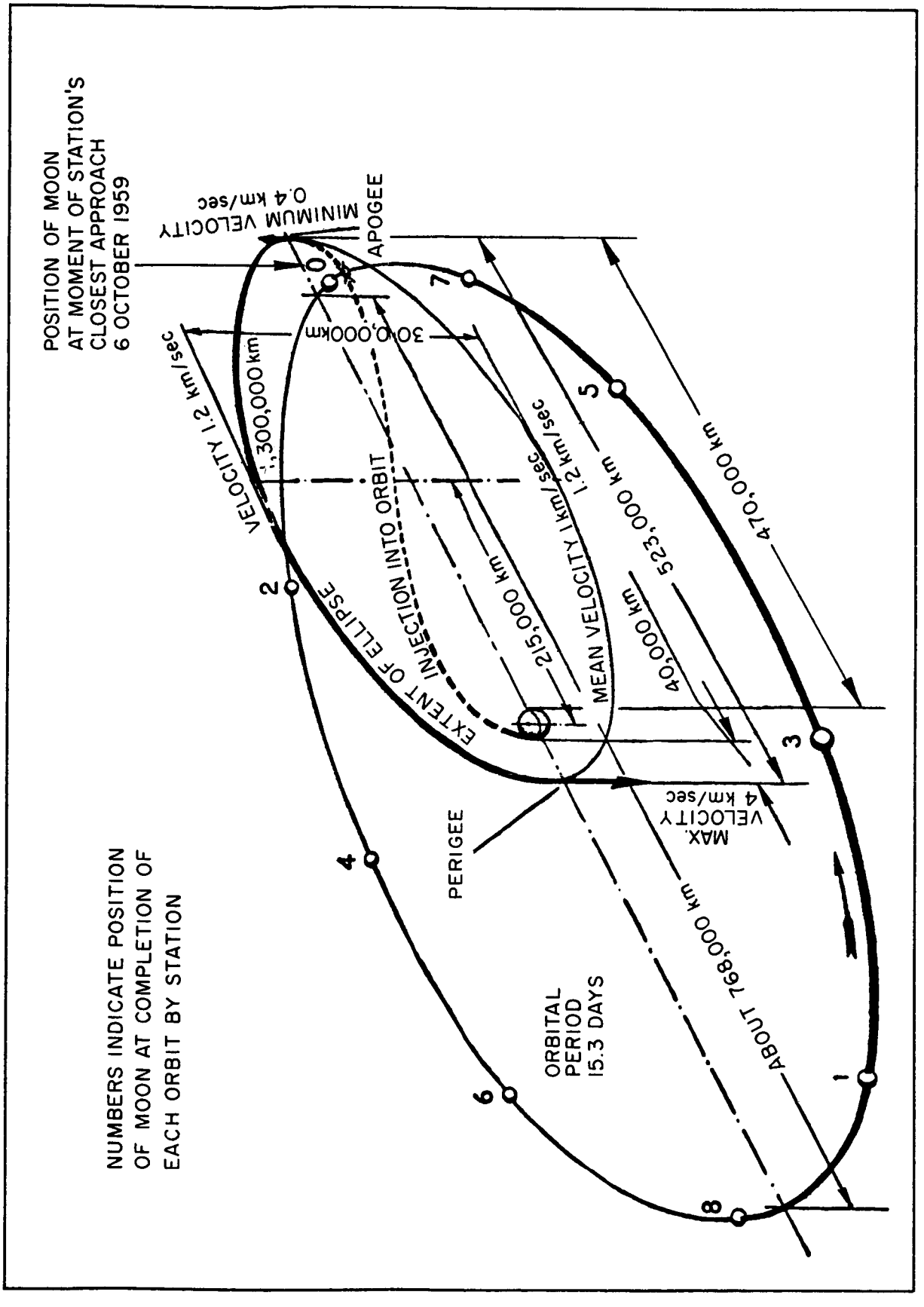

Fig. 4. Flight Characteristics of Lunik III

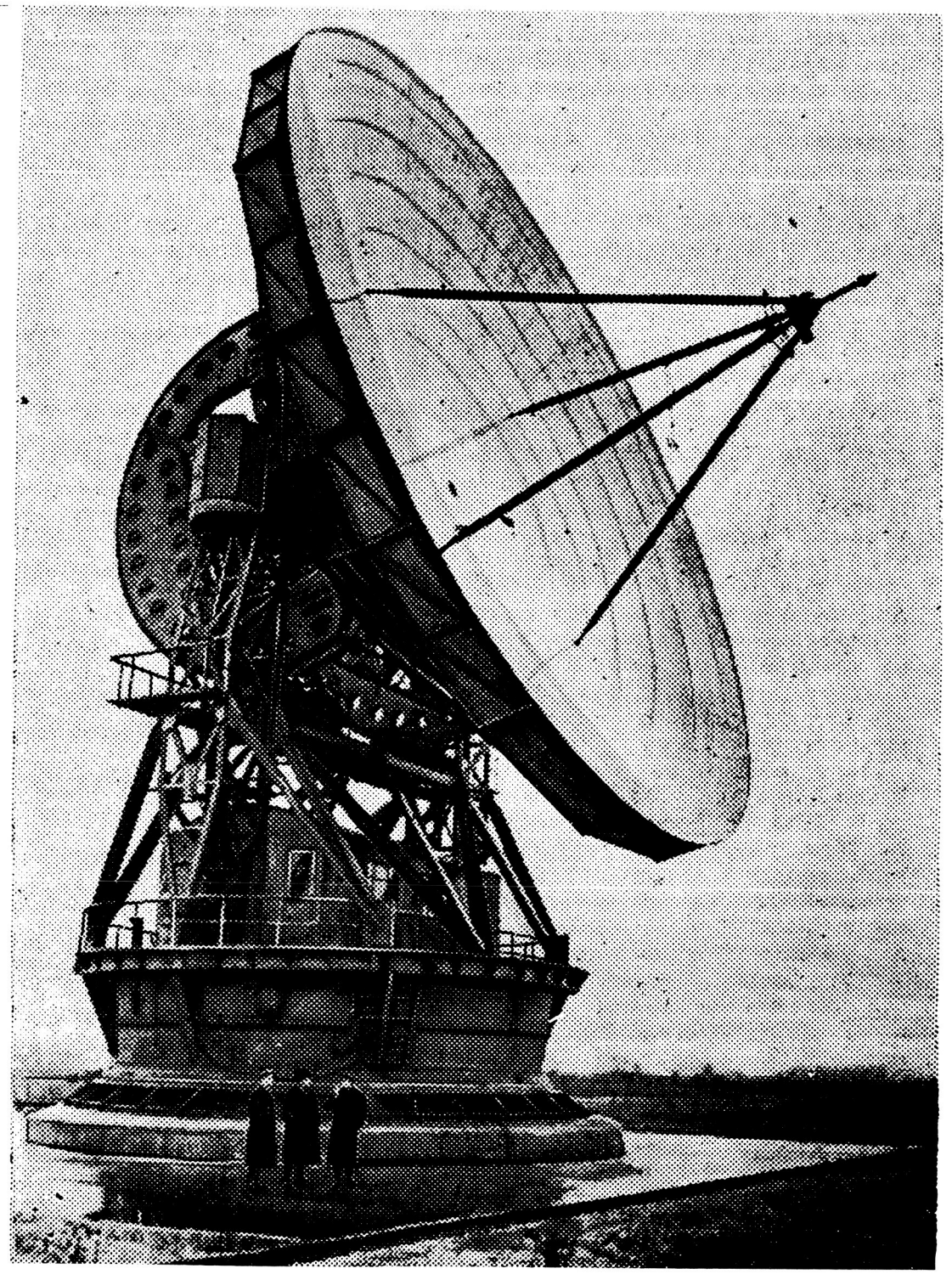

Fig. 5. Radio Telescope at Lebedyev Institute of Physics

Diameter of mirror reflector	22 meters
Focal range	9.5 meters
Weight of mirror	75 tons
Over-all weight of telescope	380 tons

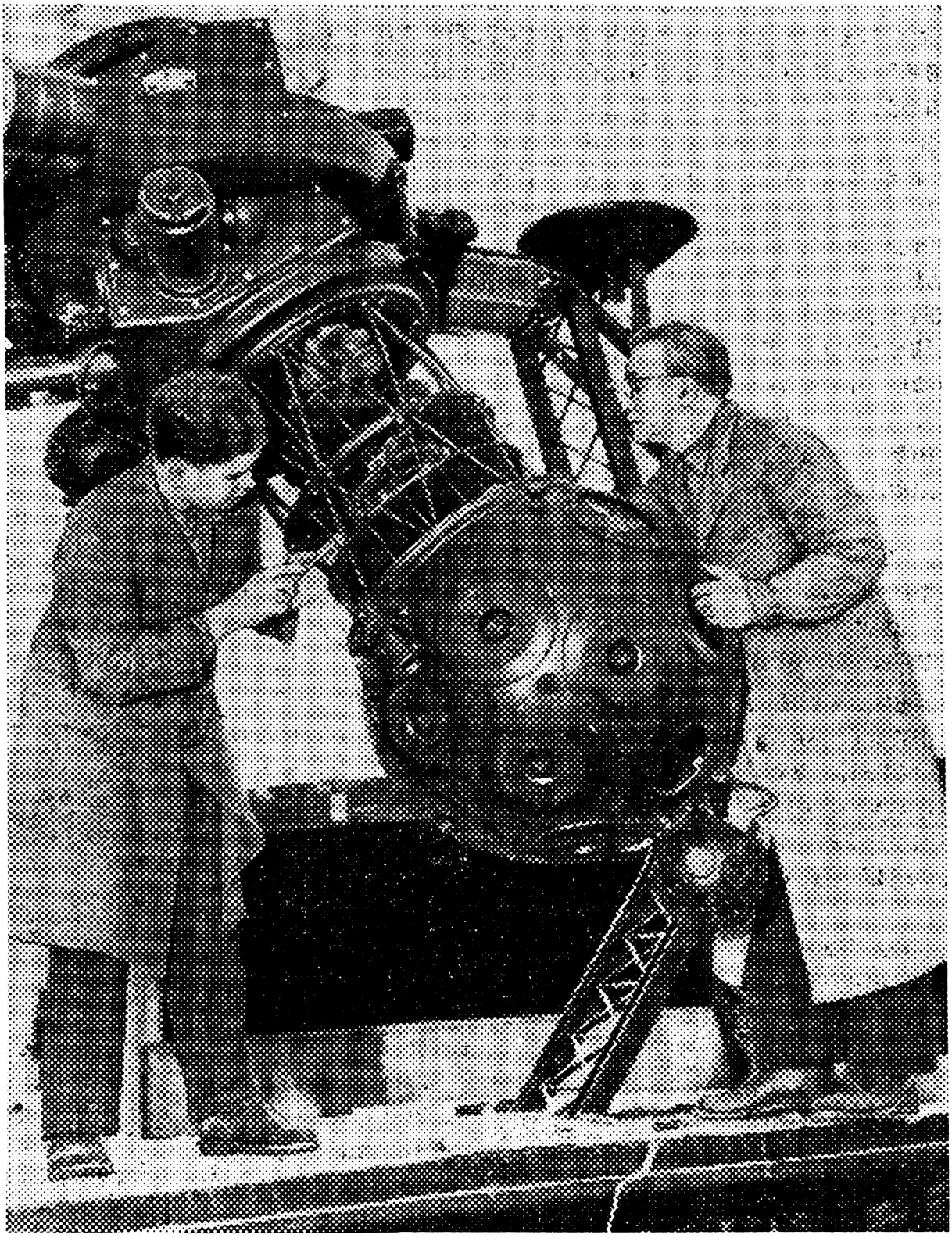

Fig. 6. Telescope at Leningrad Observatory
(built by the Carl Zeiss Optical Co.
of East Germany)