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THE SOVIET INTERPLANETARY STATION "VENUS-4"

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by

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The eve of the glorious anniversary of the Great October socialist revolution and the tenth anniversary of the era of space research were marked by a new brilliant victory of Soviet science and technology. The automatic interplanetary station "Venus-4" has smoothly descended to the surface of the nearest to Earth planet in the solar system -- Venus, and has conducted a broad complex of scientific investigations in the course of its flight, in the near planetary space and in the atmosphere of the planet.

By its dimension, distance from the Sun and depth of its atmosphere, Venus resembles the Earth more than any other planet. Venus rotates around the Sun at a distance of 108 million kilometers and completes a full turn along its orbit, which is nearly circular, during a period of 225 terrestrial days. In course of the motion of Venus and Earth around the Sun the distance between these two planets varies from 40 to 260 million kilometers. With the help of optical telescopes it is possible to observe at such distances details measuring several hundred kilometers in size. However, these proven methods are not effective in the observation of Venus due to that planet's dense cloud cover. This is the reason why science did not have available until now reliable information about the physical conditions on Venus, including its atmosphere.

Indirect data about the chemical composition, pressure and temperature of the Venusian atmosphere, based on the results of observations from Earth, are contradictory and gave birth to a large number of hypotheses. So, for instance, estimates of the surface temperature varied from -40 to +400°C and the magnitude of the atmospheric pressure near the surface varied from 1 to 50-100 atm. Only recently it became possible to estimate the speed of rotation of the planet around its axis by means of radar observations. Beginning with 1961 Soviet and American automatic interplanetary stations have completed flights in the direction of Venus, and in 1966 the Soviet station "Venus-3"

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Pages-18
NASA CR-109721 Cat-31

reached the planet Venus and delivered to its surface an emblem of the Soviet Union.

On October 18, 1967 the Soviet automatic station "Venus-4" entered successfully the atmosphere of Venus and conducted for the first time in history measurements of the physical-chemical characteristics of its atmosphere and finally it landed smoothly on the surface of the planet. The landing on the planet's surface and the direct measurements of the characteristics of the Venusian atmosphere represent a significant achievement of modern science and technology. This achievement constitutes a new stage in the study of the planets of the solar system.

## I. THE AUTOMATIC INTERPLANETARY STATION "VENUS-4"

The principal scientific mission of the automatic interplanetary station "Venus-4" was to determine the principle physical-chemical characteristics of the Venusian atmosphere. In addition there was also carried out a broad complex of scientific investigations along the flight path.

The station weighed 1,106 kilograms and consisted of an orbital section and a landing capsule. (See Figure 1.)

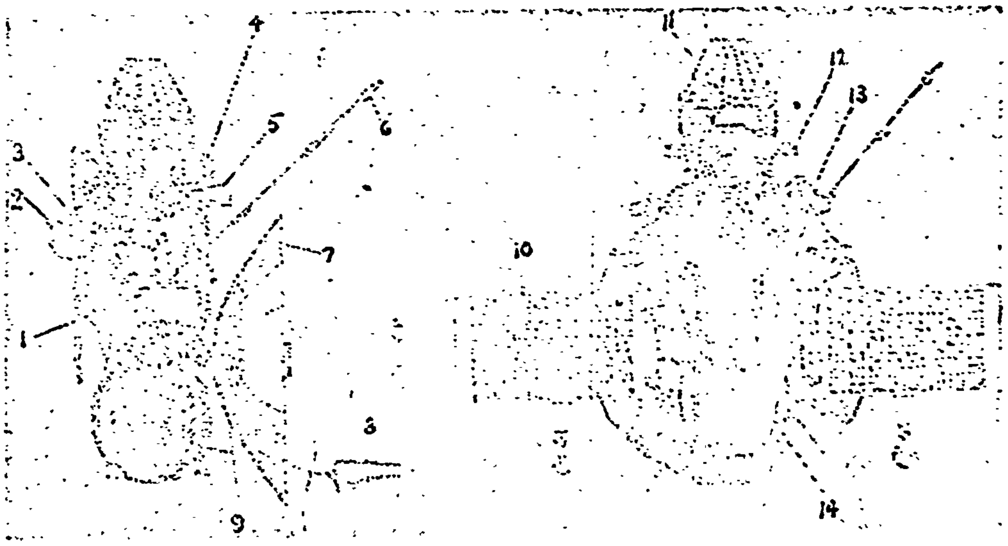


Fig. 1. 1) Orbital section; 2) Astro-orientation pickup; 3) Constant solar orientation pickup; 4) Gas containers; 5) "Sun-Earth" orientation pickup; 6) pickup and shaft of magnetometer; 7) High-directional parabolic antenna; 8) Omni-directional antenna; 9) Thermoregulation system radiator; 10) Solar batteries panel; 11) Corrective propulsion system; 12) Micro-engines of astro-orientation system; 13) Counter of cosmic particles; 14) Landing capsule.

## The Orbital Section

The orbital section represented with itself a hermetically sealed shell of a cylindrical form with elliptical end covers. Inside this shell are located the electronic instruments of the radio complex, the systems of astro-orientation and scientific instrumentation. Here are also installed the units of the automatic thermo regulation system, chemical power sources which are recharged by the solar batteries and the control system.

To the shell of the orbiting section are fastened: the landing capsule, corrective propulsion system, optical sensors and the operational units of the astro-orientation system, the deployable panels of the solar batteries, antennas and pickups of the scientific instrumentation.

The station is equipped with a liquid propellant reactive propulsion system for flight trajectory correction in order to assure an impact on the planet. The propulsion system is designed to conduct two corrections. The accuracy of the first correction was sufficient during the flight of the station "Venus-4" so that there was no need for a second correction.

## The Landing Capsule

The landing capsule, which is designed to conduct a complex of scientific investigations in the atmosphere of Venus, is shaped almost like a sphere with a diameter of 1,000 millimeters. Its weight is 383 kilograms. (See Figure 2.) It is known what difficulties a descending spacecraft had to overcome while traveling with the speed of the first cosmic velocity (orbital velocity -- JLZ) through the atmosphere of the Earth. The characteristics of such a descent have been well studied by now. It is easy to imagine how serious and complex was the task of developing a landing capsule for the station "Venus-4". A capsule which must enter the unknown to us atmosphere of Venus, not with the speed of an orbiting velocity but at the second cosmic velocity (escape velocity -- JLZ).

The entry into the atmosphere at an escape velocity and the successful deceleration of the spacecraft has been accomplished for the first time in the history of the world's technology. At that speed the temperature behind the shock wave, which occurs during the descent of a spacecraft, reached 10 to 11 thousand degrees.

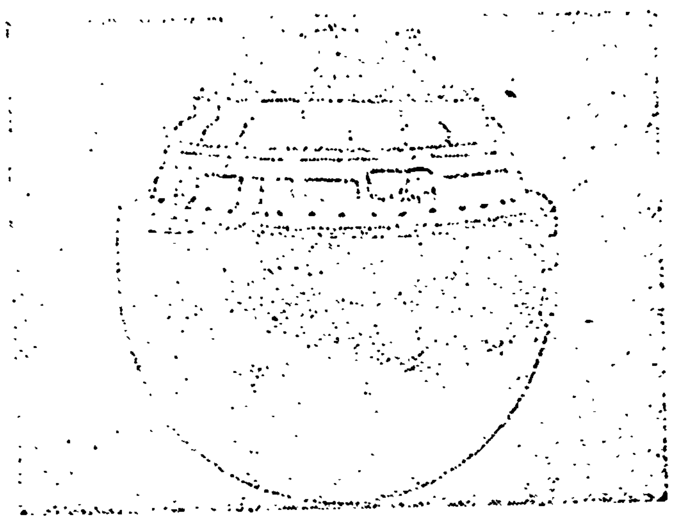

Fig. 2. Landing capsule.
(The heat shield is removed from upper part).

In order to decrease the penetration of the external heat into the spacecraft during the entry into the atmosphere as well as during the areodynamic breaking, and also from the "hot" atmosphere of Venus, the surface of the spacecraft's shell has been equipped with a special heat protection. At its lower part was installed a damper which decreased the vibrations of the spacecraft during its flight through the atmosphere of the planet.

The descending capsule consists of two hermetically sealed compartments -- an instrument compartment and a parachute compartment. Within the instrument compartment are located the transmitter, the telemetry system, a battery, a preset timing device, automatic control units, the thermo-regulation system, scientific instrumentation and a radio altimeter.

Within the parachute compartment is located a system of two parachutes -- a braking and main parachute -- made of heat resistant material and designed to operate at temperatures up to 450°C. In addition this compartment contains also the pickups of scientific instrumentation, a transmitting antenna and the antennas of the radio altimeter.

The parachutes are deployed by means of an automatic system which includes detectors of atmospheric pressure and loads, as well as preset timing devices. When the speed of the landing capsule drops, after aerodynamic braking, from 10,700 meters/second to a magnitude on the order of 300 meters/second, the braking and main parachutes are deployed by command from the external pressure detector and this decreases the speed of descent to several meters per second.

Simultaneously with the deployment of the main parachute are also deployed the antenna systems, the radio-altimeter is activated and the radio transmitter, which transmits scientific information to Earth, is switched on.

Before launching of "Venus-4" the landing capsule was subjected to sterilization.

The landing capsule contained two pennants bearing the image of the emblem of the Union of Soviet Socialist Republics which were delivered to the surface of the planet Venus.

The Radio Complex of the Interplanetary Station

The radio complex of the station assures the performance of trajectory measurements of the flight parameters of the spacecraft, recording and transmission of operational as well as scientific information and also the control of the operation of the system, following commands from Earth.

In addition to two receivers and transmitters the orbiting section contains also a telemetry commutator, decoders, memory devices and auxiliary electronic instrumentation. A part of the radio complex, which is located within the landing capsule, includes two transmitters, a telemetry commutator and a programming mechanism. In addition there is also installed an automatic switchover device for the transmitters in the event that one of them fails.

Contact between the station and Earth was carried out within the decimeter range of radio waves. Three onboard antennas were used along the flight path: one was a high - directional antenna with a parabolic reflector of a diameter of about 2.3 meters, and two omni directional antennas. Depending on the program of the communication session one of these antennas was selected by way of transmission of an appropriate command from the onboard automatic control unit, or from Earth. The transmission of information from the landing capsule during its descent by parachute was conducted by means of a special antenna which concentrated energy within a comparatively narrow cone which includes the Earth within its range. Along the flight path the transmitter of the landing capsule could be connected to any of the omni directional antennas of the orbiting section.

Between the communication sessions the onboard radio complex operated on a sentry mode during which the decoders of the command radio line and one of the receivers connected to the omni - directional antenna remained turned on. Additionally, during this mode of operation the readings of the scientific instruments were entered through the telemetry communicator into a special memory device. During any of the communication sessions this information could be transmitted from the memory device to Earth.

In the course of the communication sessions the instrumentation of the radio complex operated on various modes. For the purpose of telemetry transmission the appropriate commutator or memory device were connected to the transmitter by command from the onboard preset timing device or by command from Earth. The speed of information transmission was thereby established in respect to the receiving antenna and the distance at which the station was located.

During the planning stage and manufacture of the radio electronic instrumentation special attention was paid to the reliability of its functioning. The launching of the station was preceeded by lengthy tests of analogous instruments under more rigid conditions than the anticipated flight conditions. Individual most vital instruments were duplicated. It was, however, not necessary to make use of the auxiliary instruments during the flight, because all instruments operated faultlessly.

The technological complexity of receiving extremely weak signals from spacecraft, which are designed for the investigation of planets of the solar system, is apparent. In this case additional difficulties were presented by the fact that the most valuable information was transmitted during the period when the station approached Venus at a rapidly increasing velocity. The flight velocity of the transmitter, in respect to the receiver, changes the wavelength of the received radio signals. Therefore, during the reception of signals from the station, which was approaching Venus, it was necessary to readjust the receivers at the Deep Space Communication Center accurately and at a high rate of speed.

The Power Supply System

The power supply system of the "Venus-4" station consists of solar batteries mounted on two panels, chemical batteries and a control unit. The system assures a wide range of charge loads at a minimum weight, and is designed according to the "generator-buffer battery" schematic". In the capacity of a generator of electrical power serves a solar battery on semiconducor vonverters, and in the capacity of a buffer battery are used chemical batteries (accumulators). The buffer battery assures the supply of power to the instrumentation of the station during the communication sessions. These batteries are being recharged by the solar batteries during the entire flight.

Within the landing capsule is installed a battery, which is not used during the flight and its charge is maintained by a weak current from a separate section of the solar batteries. During the flight through the Venusian atmosphere this battery supplied power to all instruments of the landing capsule. The capacity of this battery was calculated so as to assure the operation of the landing capsule instruments during a period of not less than 100 minutes after separation from the orbiting section, for the purpose of receiving and transmitting information about the atmosphere of Venus.

The Orientation of the Interplanetary Station

In accordance with the flight program the station is oriented in space along its flight path in a strictly specified manner, by means of an orientation and stabilization system. This system carries out the following functions:

-- It assures the best conditions for the operation of the solar batteries and the system of thermoregulation;

-- the orientation of the parabolic antenna toward the Earth during the communication sessions;

-- accurate orientation and stabilization of the station in space during the period when the trajectory correction is in progress.

The system of orientation and stabilization consists of electro-optical sensors, gyroscopic instruments and control instruments. The station is turned in a desired direction by means of gas jet micro-engines. The position of the station in space is fixed in respect to astronomical reference points: the Earth, the Sun and the star Canopus. The orientation along all flight stages takes place as follows: the deviation from the prescribed orientation is determined by the optical pickups which emit signals toward the control system which, in turn, activates the micro-engines and the station begins to turn until it acquires the necessary position in space.

The constant orientation of the panels of the solar batteries perpendicularly toward the solar rays is the principle mode of flight of the station toward Venus. A special electro-optical pickup makes it possible to find the direction toward the Sun and to maintain this position of the station in space. Contact with the station is thereby maintained through the omni - directional antennas. The same mode of orientation can be accomplished by turning the spacecraft around the axis which is perpendicular to the plane of the solar batteries. This axis is pre-oriented toward the Sun.

The high directional parabolic antenna which is used during the communication sessions with the Earth, makes it necessary to orient the station in space with a great degree of accuracy. The high accuracy of orientation is achieved thanks to the fact that in this case the position of the station in space is fixed in respect to the directions toward the Sun and the Earth. After acquiring the Sun and the Earth within the field of vision of the pickups, the antenna proves to be directed sharply toward the Earth.

The highest requirement in respect to the accuracy of orientation are placed on the station during the execution of the trajectory correction. During that stage of the flight the spacecraft is oriented in space in respect to the direction toward the Sun and the star Canopus. During the rotation of the station both celestial bodies enter the field of vision of the optical tubes of the pickups and the axis of the engine acquires the necessary position in space.

The Thermo-regulation System

One of the important systems of interplanetary automatic stations is the system of thermo-regulation. This system is responsible for the maintenance of a prescribed temperature regime within all compartments of the station. The required thermal regime of the elements of the construction and the onboard systems is assured by a combination of passive and active means of thermo-regulation.

By means of the passive method of thermo-regulation is maintained the thermal regime of operation of the corrective engines, the solar batteries, the antennas and the instruments which are installed on the outside of the station. This is achieved by the selection of heat insulation, optical coefficients of the coatings and other means.

The thermal regime of the orbiting section and the landing capsule are maintained by the active system of thermo-regulation. The principle of operation of this system is based on the fact that a forced circulation of gas is established within all compartments of the station. After flowing around the heat emitting elements of the instruments and systems the gas becomes heated up and gives off the excess heat to the heat exchanger which, in turn, radiates that heat out into cosmic space. By regulating the consumption of gas which flows into the heat exchanger, the necessary temperature regime is achieved within the compartments. The thermo-regulation system carried flawlessly the assignments which were placed on it.

## II. THE FLIGHT TOWARD VENUS

The station "Venus-4" was launched on June 12, 1967. In the beginning the spacecraft, along with the last stage of the carrier-rocket was placed in a parking orbit around the Earth. After the flight along this orbit the last stage of the carrier-rocket imparted to the station the second cosmic velocity (escape velocity -- JLZ) and transferred the station to a flight trajectory toward Venus. As a result of the processing of radio measurements it has been established that the flight trajectory, which is close to the nominal trajectory, passes at a distance of 160,000 kilometers from Venus. (See Fig. 3.)

In order for the station to hit the planet, it was necessary to conduct a trajectory correction. The magnitude and the direction of the corrective pulse were calculated at the flight control center and transmitted to the station. The correction was conducted on July 29, 1967 when the station "Venus-4" was located at a distance of 12 million kilometers from the Earth. The correction assured a reliable impact on the planet and direct radio visibility of the station from the Deep Space Communication Center during the station's approach to the planet Venus.

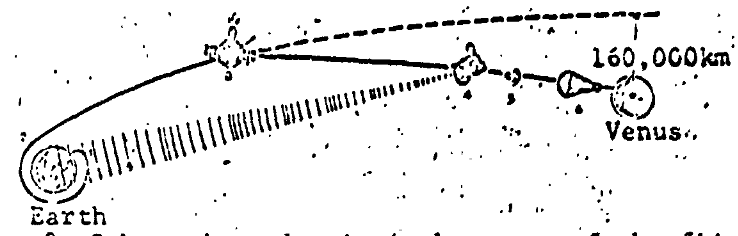


Fig. 3. Schematic and principal stages of the flight of "Venus-4"

1) injection into a parking orbit; 2) injection into a flight trajectory toward Venus; 3) Mid-course correction; 4) near-planetary communication session. Radio contact with Earth via parabolic antenna. 5) deceleration of landing capsule in the atmosphere of Venus; 6) Descend by parachute. Execution of scientific measurements and transmission of information to Earth; 7) soft landing.

During the more than 4 months of flight there were conducted 114 radio communication sessions with the station, in the course of which a great volume of information has been transmitted.

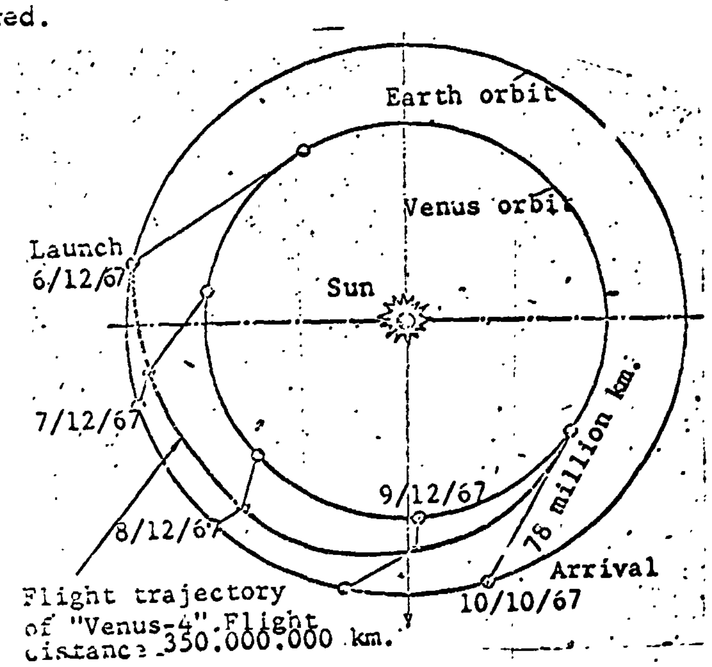


Fig. 4.

Flight schematic of station and the reciprocal position of the Earth and Venus.

In Figure 4 is shown the flight trajectory of the station and the reciprocal positions of the Earth and Venus during various stages of the flight. Executing a flight along a heliocentric orbit under the influence of solar gravity, just like a planet of the solar system, the station traveled a distance of about 350 million kilometers. At the moment of its meeting with Venus the station was located at a distance of 73 million kilometers from the Earth.

The greatest interest was presented by the last section of the flight which is schematically presented in Fig. 5. When the spacecraft was located at a distance of about 45,000 kilometers from the planet Venus, the near planetary sequence began. The station was oriented in such a manner that the parabolic antenna was directed toward the Earth. This position of the station was maintained until the entry into the atmosphere of Venus. After that the near planetary sequence was terminated and the landing capsule was separated from the space station. With the increase of atmospheric density the braking of the landing capsule increased rapidly in the beginning. The loads, thereby, exceeded by more than 300 times the terrestrial acceleration. When the velocity dropped approximately to 300 meters per second, the parachute system was deployed. This system assured an additional slow-down of the spacecraft and the transition to a mode of a floating descent and soft landing.

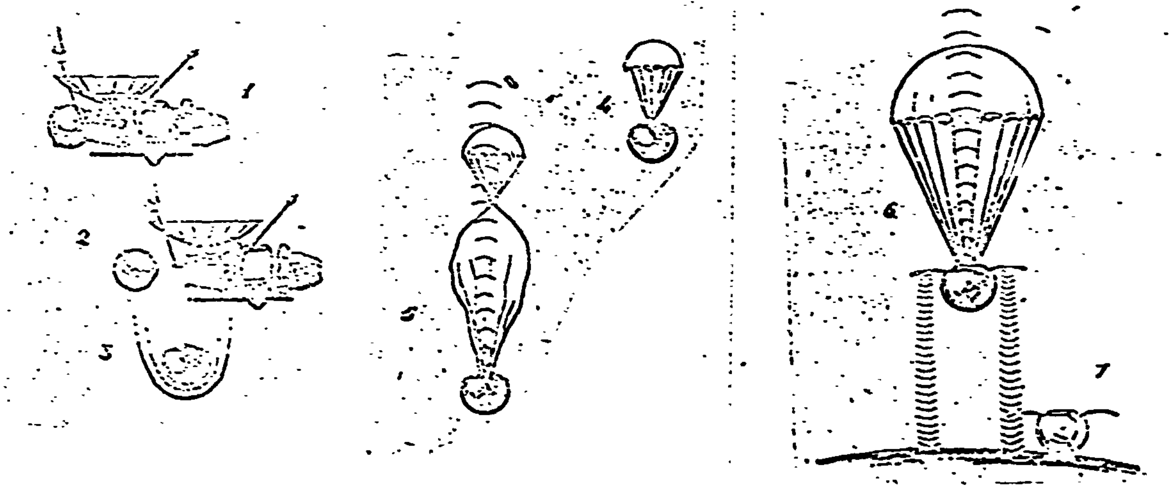


Fig. 5. Schematic of flight through the atmosphere and soft landing of landing capsule.

1) Beginning of near planetary sequence; 2) Separation of landing capsule from orbital section; 3) Deceleration of landing capsule in the atmosphere; 4) Deployment of braking parachute; 5) Deployment of main parachute. Beginning of transmission of radio-information from the landing capsule; 6) Start of operation of radio-altimeter; 7) Soft landing.

At the moment of deployment of the main parachute the transmitter of the landing capsule was turned on. The transmission of data on the atmosphere of the planet began. Measurements by means of the radio altimeter, which were conducted at that moment, indicated an altitude of 26 kilometers above the surface of Venus. The calculation of the further motion of the landing capsule was conducted according to the measured parameters of the atmosphere. At the beginning of the floating descent the rate of the descent comprised about 10 meters/second. As the capsule descended and the density of the atmosphere increased the rate of descent dropped and toward the end of descent comprised 3 meters/second. This assured a soft landing of the capsule on the surface of Venus. (This is the speed at which a body would drop to the Earth from an altitude of a half of a meter.) After 94 minutes the station ceased the transmission of information. Up to that moment the pressure and temperature of the atmosphere increased steadily all the time. The calculation of the rate of descent of the station to the end of data transmission confirms the fact that the station continued its transmission to the very moment of landing on the surface of the planet. The termination of the transmission of information after landing of the station on the surface of the planet might be explained by the fact that the capsule might have landed in such a way that the directional antenna was in an unfavorable position.

The processing of radio measurements has made it possible to establish the position of the projection on the surface of Venus of the point of entry of the station into the atmosphere with an accuracy of up to 500 kilometers. The landing area is located on the dark side of Venus near the equator at a distance of about 1,500 kilometers from the terminator. This makes it possible to conclude that the entire descent took place over the dark side of the planet.

## III. SCIENTIFIC INVESTIGATIONS

Scientific investigations were conducted by the station "Venus-4" during the entire flight duration from the Earth to Venus, in the near Venusian space and in the dense layers of its atmosphere. Within the orbiting section of the spacecraft were located the following scientific instruments: a three-component magnetometer with a measurement range of 50 gamma ($5 \cdot 10^{-4}$ oersted) and a sensitivity of 2 gamma; counters of particles of cosmic rays, an indicator of the ultraviolet radiation of the Sun which was dispersed by particles of hydrogen and oxygen for the purpose of registering these gasses within the near planetary space; traps of charged particles for the study of near planetary plasma (ionosphere).

These instruments have conducted measurements during the entire flight up to the moment when the orbiting section of the spacecraft entered the upper layers of the atmosphere of Venus and stopped functioning. Measurements obtained during the flight along the heliocentric orbit have confirmed the scientific data of previous interplanetary flights. At the same time the measurements which were conducted during the flight of the station "Venus-4" have shown that in 1967 the intensity of flareups of solar cosmic rays increased by a hundred times, as compared with 1964-1965. This is related to the increase of solar activity. It is possible to anticipate that during a maximum solar activity which is expected in 1969 there will be even a higher intensity of flareups of solar cosmic rays.

Observations during the near planetary section of the flight trajactory have shown that the flux of high energy cosmic particles remained constant up to a distance of 5,000 kilometers from the surface of Venus, and equaled the flux of such particles at a remote distance from the planet. During the further approach to the planet Venus the flux decreased due to the absorption of cosmic rays by the planet. Such a result proves that Venus does not have radiation belts as the ones present around the Earth.

One of the tasks of the station "Venus-4" was to investigate the magnetic field of Venus. It was established during the flight toward Venus by the American station "Mariner-2" in 1964 that the dipole magnetic field of Venus does not exceed 1/10 of the Earth's magnetic field. A preliminary analysis of the measurement results from the station "Venus-4" along its flight trajectory, up to several hundred kilometers from the surface of Venus, makes it possible to arrive at a conclusion that Venus does not have any magnetic field in which the dipole moment exceeds more than 3/10,000 of the dipole magnetic field of the Earth. This result has made significantly more precise the data received from "Mariner-2". This result is particularly interesting in connection with the fact that before the flights of spacecraft to celestial bodies there prevailed concepts to the fact that all planets of the solar system possess magnetic fields similar to the field of the Earth.

The forthcoming detailed analysis of experimental data will make it possible to define even more precisely this magnitude and, in addition, to determine if the planet exerts a disturbing influence on the magnetic field of the near solar space.

A preliminary examination of the results of experiments with the traps of charged particles has shown that the concentration of charged particles within the investigated region of the upper atmosphere of Venus (at altitudes of more than 100 kilometers) does not exceed 1,000 particles/cubic centimeters; i.e., at least by a factor of 2 smaller than the maximum concentration of charged particles in the ionosphere of the Earth. The problem in respect to an ionosphere of Venus has been discussed on numerous occasions during the past few years, whereby a number of authors have considered that the concentration of charged particles in the upper atmosphere of Venus exceeds by several orders the concentration in the ionosphere of the Earth. The measurements conducted by "Venus-4" have shown that in reality the opposite is true.

The instrumentation for the registration of scattered ultraviolet radiation of the Sun by particles of hydrogen and oxygen in interplanetary space, and in the atmosphere of Venus, has detected the presence of neutral hydrogen beginning with a distance of about 10,000 kilometers from the surface of the planet. The measurements have shown that the hydrogen corona of Venus contains approximately a thousand times less hydrogen than there is in the upper atmosphere of the Earth. The presence of a hydrogen corona is explained by the fact that hydrogen in the atmosphere of Venus, just as in the case of the atmosphere of the Earth, escapes into interplanetary space, creating an elongated envelope. As far as atomic oxygen is concerned, it was not detected during the entire period of entry of the orbiting section into the atmosphere, from which it follows that the amount of oxygen at an altitude of more than 200 kilometers is a 100 million times less than in the Earth's atmosphere at corresponding altitudes.

The landing capsule contains the following instruments for the investigation of the dense layers of the Venusian atmosphere; two resistance thermometers, a barometric pickup, an atmospheric density meter and 11 gas analyzer-cylinders.

These instruments made it possible to obtain the first direct measurement data of the temperature, pressure and chemical composition of the atmosphere of Venus.

The presence of an atmosphere on Venus has been proven back in 1761 by M. V. Lomonosov. Later on it was established by spectroscopic means that the atmosphere of Venus contains a considerable amount of carbon dioxide gas; however, its relative contents has not been known. The pressure of the Venusian atmosphere has also not been known. Radio astronomical observations have indicated a high surface temperature; however, the interpretations of the results of these observations were not completely in agreement with each other. Certain scientists have assumed that the increased intensity of radio noises emitted by Venus is caused by certain electrical processes in the atmosphere. Therefore, in order to reveal the actual condition, the direct experiment conducted by the landing capsule is of great significance.

The gas analyzer cylinders have collected samples of the atmosphere at two altitude levels. Directly after the deployment of the parachute at an altitude of about 26 kilometers a sample of the atmosphere was introduced into five of the cylinders. The remaining 6 cylinders collected samples of the atmosphere 347 seconds after the deployment of the parachutes at an altitude of about 23 kilometers. After collecting the samples the gas analyzer-cylinders were hermetically sealed. Each cylinder contained an active absorber which absorbed one of the chemical components of the atmosphere which made it possible to determine the contents of this component by lowering the pressure within the cylinder.

All analyzers operated properly. These instruments indicated at both measurement altitudes that carbon dioxide is the principle component of the atmosphere of Venus and comprises not less than 90-95% of the entire contents. The analyzers which had a threshold sensitivity of 7% did not register any presence of nitrogen. The contents of oxygen proved to be about 0.4% and water together with oxygen did not exceed 1.6%.

The temperature pickups were designed to measure temperatures of the surrounding gas from $0^{\circ}C$ to $400^{\circ}C$. Pressure was measured by standard barometric detectors of the aneroid type. The densometer had a measurement range for carbon dioxide from $5 \cdot 10^{-4}$ to $1.7 \cdot 10^{-2}$ gram/cubic centimeter.

The principle of operation of the densometer is based on the ionization of atoms and molecules of gas within the detector by rapid electrons emitted by sources of beta-radiation, and the measurements of the magnitudes of the ion flux which is the function of the density of atmospheric gas. The instrumentation operated continuously to the moment of termination of radio signals from the landing capsule. An analysis of the measurement results made it possible to conclude that the atmosphere of Venus is characterized by high magnitudes of pressure, density and temperature.

The identification of atmospheric parameters with altitude was conducted beginning from an altitude of 26 kilometers above the surface of Venus.

Further identification of instrument readings in respect to altitude has been conducted by two methods.

In the first case the rate of descent was calculated according to known aerodynamic characteristics of the parachute and the density of the atmosphere, as well as in the result of an integration, the relation of altitude to time was determined.

In the second case the change of altitude in respect to time was determined according to a barometric formula with the utilization of the obtained data on the composition, density and temperature of the atmosphere.

The results of calculations using both methods are in agreement with each other.

A diagram showing the temperature changes of the Venusian atmosphere in respect to altitude is given in Fig. 6.

The rate of the temperature change is close to being linear with a mean temperature gradient of about $10^{\circ}$ per kilometer. The shaded region corresponds to possible deviations in the instrument readings. The last temperature value, measured by a detector near the surface of the planet, comprises about $280^{\circ}C$ as is apparent from the presented diagram.

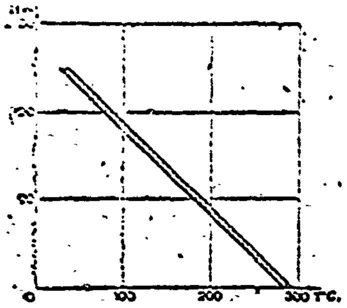

Fig. 6. Measurement of temperature in respect to altitude, in the Venus atmosphere.

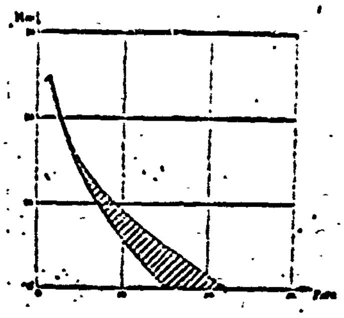

Fig. 7. Measurement of pressure in respect to altitude in the Venus atmosphere.

In Fig. 7 is presented the character of change in pressure in respect to altitude, as measured directly by the barometric detector, and also calculated according to the values of density and temperature in the case of a known gas composition. The pressure near the surface of Venus proved thereby to be within the limits of 15 to 22 atmosphere.

Thus we have obtained for the first time direct reliable parameter measurements of the atmosphere of Venus. This opened the road toward further reliable flights to Venus and toward new discoveries of its mysteries.

The data of the scientific measurements conducted by "Venus-4" are now subjected to a detailed study and more precise definition.

The results of the subsequent analyses will be published in scientific journals.

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The successful accomplishment of a flight and landing of the automatic station "Venus-4" on the surface of one of the most interesting planets of the solar system, and the conducted complex of scientific experiments, represent a new outstanding achievement of Soviet science and technology which have attained an unheard of level of development under conditions of socialism. This is one more brilliant evidence of the successful accomplishment of the grandiose program of communist progress as it was prescribed by the XXIII Congress of the Communist Party of the Soviet Union.

The flight of the Soviet station "Venus-4" has solved one of the most complex technological problems of interplanetary communication which turns a new page in the conquest of the near-solar cosmic space and the planets.

The unique scientific data obtained by the station "Venus-4" represents an important contribution to the science of the World.

The new victory in space represents a remarkable gift by Soviet scientists, engineers, technicians and associate workers of all organizations which participated in the development, launching and flight control of the automatic station "Venus-4" to the 50th anniversary of the Great October. This is their report of performance to the Communist Party and the Soviet people.