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# SOVIET BLOC
# IGY
# INFORMATION

Number 1

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Prepared by

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To: Recipients of the report Activities in the Arctic and Antarctic

In view of the close connection of arctic and antarctic activities with the International Geophysical Year program, information on Soviet Bloc polar activities of IGY interest will appear hereafter in the weekly report Soviet Bloc International Geophysical Year Information issued by the Office of Technical Services, US Department of Commerce. With the cessation of this report at the close of the IGY program, such information will again be published in the Activities in the Arctic and Antarctic.

All non-Soviet Bloc arctic and antarctic information and Soviet Bloc polar activity not of IGY interest will continue to be published in the report Activities in the Arctic and Antarctic.

PLEASE NOTE

This report presents unevaluated information on Soviet Bloc International Geophysical Year activities selected from foreign-language publications as indicated in parentheses. It is published as an aid to United States Government research.

SOVIET BLOCK INTERNATIONAL GEOPHYSICAL YEAR INFORMATION (1)

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# I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

## Study on Resistance of a Body (Satellite) Moving in a Rarefied Medium

M. L. Lidov, a member of the Interdepartmental Commission on Interplanetary Travel USSR, has written an article entitled "Resistance of an Unoriented Body Moving in a Rarefied Gas." Lidov considers that a body moving in a free molecular flow (in particular, the case of an artificial earth satellite), with no special orientation of the body relative to the direction of its motion, will rotate relative to the center of its mass with a variable angular velocity under the influence of random disturbances. Consideration of an ideal-unoriented body in the work makes it possible to calculate the average resistance of such a body without regarding the resistance of the individual angles of attack.

The exact determination of the coefficient of resistance of a sphere (this calculation is also reduced to the problem concerning the resistance of an ideal-unoriented body) usually required the calculation of quadratures which are a function of the parameter.

Lidov shows in the article that it is practically possible to expand this integral according to this parameter and to limit the calculation to the first terms. The coefficient of resistance of the sphere is calculated by a simple formula with the aid of a single tabulated function. This is useful in the analysis of a number of investigations which it is proposed to conduct in the upper atmosphere.

Expressions are given for the heat exchange and aerodynamic forces acting on the body, the number of particles striking a unit area per unit time, the pressure acting on the area, the frontal resistance of the impinging molecules, the influx of energy carried by these molecules per unit time, the full frontal resistance of the body, and the calculation of the coefficients of resistance of the sphere considering elastic or mirror reflection and diffused reflection of the molecules. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 12, Dec 57, pp 1524-1528)

[Comment: M. L. Lidov, together with A. G. Karpenko, secretary of the Commission on Interplanetary Travel, has also published an article, "On the Temperature Conditions of an Earth Satellite," which is summarized in the following item.]

Temperature Studies for Soviet Earth Satellite Program

A. G. Karpenko and M. L. Lidov, members of the Interdepartmental Commission on Interplanetary Travel under the Astronomical Council of the Academy of Sciences USSR, have written an article entitled "Temperature Conditions of an Earth Satellite."

They say that temperature conditions in an earth satellite will be determined by many factors connected with the design and orbital characteristics of the specific project. Works published at present along this line are devoted either to an evaluation of the extremes of temperature, which practically are unobtainable, or to the influence of separate factors, for example, the molecular affluence of a body, the corpuscular radiation of the sun, etc. Such an approach does not permit the determination of the possible ranges of the satellite's temperature fluctuations in its orbital motion with sufficient accuracy.

The authors propose, as an ideal satellite, a body with infinite heat conductivity completely without means of orientation in space, and say that, with such a concept, the specific design parameters of the satellite cannot be considered in the calculations.

The article presents calculations made for certain circular orbits and graphs of the minimum and maximum temperatures attainable by the body in relation to the nature and reflectivity of the surface. In this connection the following quantities were calculated: the influx of energy from an internal source, the influx of energy directly from solar radiations, and the influx of energy from the earth in the form of heat radiations and reflections of solar radiation. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 4, Apr 57, pp 527-533)

Soviet Review of Equipment, Instrumentation, and Experiments on Sputnik II

B. S. Danilin, Candidate of Technical Sciences, has published an informative article entitled "Invasion of the Cosmos," the full text of which follows.



When the news circled the world that the first artificial earth satellite had been successfully launched in the Soviet Union, military and political activists in the US applied their efforts to belittling the great significance of this scientific and technical achievement. They said that the satellite did not have any value for the conducting of scientific research. They stooped even to such irrational statements as the assertion that the small moon was only "a piece of iron hurled into space."

The flight of the first artificial satellite made it possible for our scientists to gain valuable information on the processes occurring in the upper layers of the earth's atmosphere. Observations of the flight path of the satellite and its rocket-carrier are making it possible to make more precise our notions concerning the density of the earth's atmosphere at high altitudes and its physical properties which condition the passage of radio waves of various frequencies, and to clarify the indirect causes of the change in characteristics of the ionized layers. These data are of primary significance in forecasting radio-wave propagation and ensuring reliable radio communications.

The launching of Sputnik II, a complete flying laboratory, was a new step forward in man's conquest of the cosmos. Scientific data and observations on the experimental animal obtained with the aid of instruments mounted on board Sputnik II have made it possible to significantly expand human knowledge in the field of physical processes occurring in cosmic space and to follow the vital activity of an animal under conditions of cosmic flight.

How the Second Satellite Is Constructed

As distinct from Sputnik I, which had the form of a sphere with a weight of 83.6 kilograms, Sputnik II is the final stage of the rocket-carrier with the power supply, containers, and scientific apparatus mounted on it and having a total weight of 508.3 kilograms. This is six times as heavy as Sputnik I. The maximum distance of Sputnik II from the surface of the earth is 1,700 kilometers, which is approximately twice the altitude achieved during the launching of Sputnik I. The period of revolution around the earth is 103.7 minutes, that is, 7.5 minutes more than the revolution period of Sputnik I at the instant of the beginning of its movement.

These data can hardly be compared with those data which, according to a preliminary assumption, are given for the first American satellite. In accordance with the IGY program, the Americans were supposed to have launched their satellite in July 1957. As the official American press reports now, the American satellite will be launched no earlier than March 1958. Its diameter, as proposed, will be equal to 50 cm (20 inches); weight, 9.8 kg (21.5 pounds); angle of inclination to the equatorial plane, from 35° to 40°; and maximum height of the flight path, 400 km (300 miles). On a published map of the proposed flight from the State of Florida, the American satellite should cover a relatively narrow band around the Equator not passing over European countries.

As is known, the dimensions of Sputnik II are significantly larger than the dimensions of Sputnik I. This made it possible to install on Sputnik II a greater quantity of different apparatus. The instruments on the satellite are situated in the following manner. The head section of the rocket is equipped with a reinforced frame. An instrument for investigating solar radiation in the ultraviolet and X-ray regions of the spectra, a spherical container (the construction of which is analagous to the first satellite) with radio transmitters, and a hermetic cabin with an experimental animal, a dog, are located in the forward section of the frame. An apparatus for studying cosmic rays, a radio telemetering apparatus, and instruments for measuring temperature are installed directly on the body of the rocket.

The external surface of the spherical container and the cabin with the animal were polished and subjected to special processing. This was done to reflect the sun's rays falling on them in order to prevent overheating of the interior of the cabin and the container. The instruments and containers installed on the frame were protected from the effect of aerodynamic forces originating during the passage of the rocket into the dense layers of the earth s atmosphere by a special cone which was automatically jettisoned after the entry of the rocket-carrier into the specified orbit.

Located within the spherical container, in addition to the radio transmitters, were sources of electric power and the sensing elements which record the changes in pressure and temperature, and also a system for regulating these parameters. One of the radio transmitters operated continuously on the 7.5-meter band. The signals of the second radio transmitter operating on the 15-meter band had the form of telegraphic transmissions with a duration of about 0.3 second with pauses of about the same duration. In case the temperature and pressure within the spherical container changed, the length of transmissions and the pauses between them also changed.

On the outside surface and within the cabin and also on the different structural elements and instruments, transducers for measuring temperature were placed. Within the cabin itself, transducers were set up with whose aid a continuous study of the vital activity of the animal was conducted. The results of all measurements were periodically transmitted to earth with the aid of a radio telemetering system.

Solar Radiation

What new data have we obtained as a result of the launching of Sputnik II?

The investigation of short-wave ultraviolet and X-ray solar radiation is of primary scientific and practical interest for physicists, astronauts, and geophysicists.

It is known that the earth's atmosphere completely absorbs the short-wave ultraviolet and X-ray radiation of the sun, protecting at the same time living organisms from their harmful action. At present, it makes it impossible to observe short-wave radiation of the sun from the earth.

Even though the total energy of the short-wave radiation of the sun in comparison with the energy radiated by the sun in the visible portion of the spectrum is comparatively small, this radiation more or less induces in the atmosphere various processes resulting in the formation of strongly ionizing layers which exert a substantial influence on radio-wave propagation conditions.

Under the influence of physical processes occurring in the little-studied external layers of the sun's atmosphere (chromosphere and corona), the ionized layers of the earth's atmosphere undergo continuous changes which may lead to the appearance of magnetic storms, disturbances of radio communications, etc. The use of high-altitude rockets was the beginning of research in this field of the solar spectrum. However, only the utilization of artificial satellites for the first time make it possible to conduct systematic measurements of the short-wave radiation of the sun over prolonged periods of time.

For this purpose, receiving devices were installed on Sputnik II. They are special photoelectron multipliers situated at an angle of 120° to each other. This was done to increase the probability of solar radiation striking the photo cathode of the receiver during the various positions of the satellite in relation to the sun.

How do these receivers work?

Under the influence of impinging X-ray or ultraviolet radiation, electrons emerge from the photo cathode. Bombarding a metal plate covered with a special composition, these electrons knock out of this plate so-called secondary electrons. These secondary electrons in turn bombard another plate and again knock out of it a great number of electrons. This same process is repeated in all succeeding stages until the electron flow with the final plate is gathered on a collector-anode. To obtain an idea of how much amplification may be achieved in the multiplier, suffice it to say that if each primary electron will knock out four secondary electrons and the number of plates (so-called emitters) is equal to ten, then the coefficient of amplification of the multiplier will be equal to one million.

A disk with a set of filters is located in front of the multiplier, and during the rotation of the filters the entry aperture of the photomultiplier is alternately covered by films of aluminum, beryllium, lithium fluoride, and polyethylene of various thicknesses. This makes it possible to separate the various bands in the X-ray region of the solar spectrum and the hydrogen line in the remote ultraviolet region. The transposition of various filters (two filters per second) is accomplished with the aid of a step-mechanism operating from a special generator.

Revolving around the earth, the satellite part of the time enters into the part of its orbit which is not illuminated by the sun. Therefore, with the aid of photoresistors and a system of automatics, the electrical circuits of the apparatus are switched on only when the sun falls within the field of vision of one of the receivers of radiation. This made it possible to use the electric power supply economically.

Signals from the receiver in the form of voltage pulses the number of which are proportional to the intensity of the radiation falling on the photo cathode are fed into a digital-integrating circuit coupled with a radio telemetering system with whose aid the transmission of signals to earth is accomplished.

Messengers From Outer Space

The use of artificial satellites for investigating cosmic rays uncovers prospects no less broad. Falling on earth from outer space, cosmic rays present themselves as streams of atomic nuclei possessing great energy. Falling on the earth's atmosphere, cosmic "heavy" nuclei are broken up into more easily forming new particles -- mesons, during whose decomposition electrons and photons originate.

The earth's magnetic field strongly bends the trajectory of movement of cosmic rays, creating around it something of peculiar energy barrier. The height of this barrier is at a maximum at the equator and gradually decreases toward the poles. Only particles having very high energy can reach the earth and low-energy particles reach only those regions situated near the North and South Poles.

As a result of the number of processes which occur in outer space with cosmic rays, the intensity and structure of cosmic rays change. Usually, the intensity of cosmic rays is faintly changed with the passage of time. However, during the time of storm processes on the sun, it greatly increases. During the past 15 years, five strong disturbances of the intensity of cosmic radiation were recorded; the strongest of these was observed on 23 February 1956. In this case the intensity even at sea level changed several times. Thus even during observations from the earth of short-wave radiation of the sun, the presence of the earth's atmosphere significantly hinders the investigation of cosmic rays. Therefore, that is why the observations which were conducted on the satellite for the first time at an altitude of several hundred kilometers from the earth's surface were so important.

For recording charged cosmic particles, two instruments were mounted on the satellite. The axes of the counters of both instruments were placed on the body of the rocket-carrier perpendicular to each other. In this case when an electrically charged particle passed through the counter, a spark was induced which gave an impulse to a radio circuit designed for counting the number of particles of cosmic radiation.

Then, when a specific number of particles was counted, a signal was sent to earth with the aid of a radio telemetering device, and the counter again began to register the particles, and when the number of pulses achieved the former value again a signal was transmitted to earth. The intensity of cosmic rays (that is, the number of particles passing through the counter per second) may be computed if one divides the number of registered particles by the time during which they were counted.

During the flight of Sputnik II, both instruments functioned normally, and the relation of cosmic radiation to geomagnetic latitude was distinctly manifested. By knowing this relation, the distribution of particles according to energy can be determined; that is, we can know the energy spectrum of cosmic radiation and can follow the changes in it during the entire period of operation of the apparatus, having compared these changes with those processes which take place in the space which surrounds us.

First Cosmic Passenger

In addition to information on processes occurring in the upper layers of the atmosphere, a no less important problem being solved with the aid of Sputnik II was the study of the behavior of a living organism in cosmic space. This is the first time that a living being had penetrated the cosmos. Observations of the animal will assist in clarifying a number of important rules for future cosmic flight.

The successful realization of prolonged flight of the animal in cosmic space was preceded by a large and broad program in research conducted with rocket ascensions of animals to an altitude of 100-210 km. Initially, the animals ascended in hermetically sealed cabins equipped with special small-size systems for regenerating air. After automatic separation from the rocket, the cabin descended to earth by parachute.

Later, the animals were placed in special high-altitude suits to which parachutes were attached and at an altitude of 100 km were automatically ejected from the cabin. The descent by parachute from that altitude lasted approximately one hour. In other cases, the animals completed "the slow jump" from an altitude of 40-45 km in which the parachute automatically opened only at an altitude of 4 km. The experiments conducted indicated that animals survived the flight in a completely satisfactory manner, experiencing no harm to the organism afterward.

However, it should not be forgotten that the conditions of short-period flight in rockets essentially differ from those in which the animal will be placed during prolonged flight in an artificial earth satellite.

After the launching of the multistage ballistic rocket, the flight velocity begins to increase rapidly until it achieves a magnitude necessary for overcoming the earth's gravitation. The effect of acceleration on the living organism depends on its magnitude, the duration of the influence, the rate of increase, and the direction in which the force of acceleration acts on the body of the animal.

During extended training the animals gradually were accustomed to endure such real accelerations which may occur during the movement of a rocket-carrier in the active part of its flight path to the entry of the satellite into its orbit. In addition, at present, for this purpose special pressure suits counteracting the disturbance of cerebral blood circulation which can occur as a result of the action of accelerations were created.

Then, when the satellite enters its specified orbit, the action of accelerations connected with the increase of velocity disappears, the force of the earth's gravitation also disappears, and the animal enters into new, extraordinarily peculiar conditions -- complete weightlessness. The effect of weightlessness on the living organism, besides the short-period tests with rocket flights of dogs, was studied also during airplane flights under specially developed conditions. It was established that, in the majority of cases, short-period exposure to the state of weightlessness does not produce any substantial disturbances of physiological functions in the living organism. However, the stability of the organism to the effects of weightlessness varies. Sometimes a disorder in the coordination of movements is observed, blood circulation is disturbed, and illusory sensations of various types originate. It is interesting that in repeated exposures of the organism to conditions of weightlessness the human gradually becomes adapted to this unusual state, begins to sufficiently and freely orient himself in space, and acquires an ability to perform accurately coordinated movements.

In order that the animal in the hermetic cabin of the satellite may more painlessly endure the effect of accelerations and the prolonged period under conditions of weightlessness, it is most expedient to place him in a prone position, the body restrained by straps in a special tray, but in such a manner that the animal is able to move its head freely and to take food.

At altitudes where the movement of the satellite takes place, atmospheric pressure, as a matter of fact, is lacking (billionths of a millimeter of a mercury column). Therefore, the maintenance in the cabin of Sputnik II of the necessary gas composition was accomplished with the aid of highly active chemical compounds providing the oxygen necessary for breathing and absorbing carbon dioxide and the excess water vapors. The amount of matter participating in these chemical reactions were automatically regulated with the aid of a special device. Since mixing of air was lacking under conditions of weightlessness, the creation of a system of positive ventilation was required. The maintenance within the cabin of a specific temperature regime was accomplished by a special system of heat regulation.

The problem of feeding the animal under conditions of cosmic flight was just as vital. You see, for maintaining the normal functioning of the animal organism, a liquid food is necessary. Under conditions of weightlessness, liquid, as is known, does not fall down in a specific direction and may therefore easily be circulated over the entire cabin. The giving of separate portions of food through earlier precisely determined intervals of time may be, for example, accomplished with the aid of a special programing mechanism and special relay devices.

The first animal, accomplishing prolonged cosmic flight around the earth, passed through an intensive preliminary training period. It was trained to spend long periods in special clothing in a hermetically sealed cabin of small volume. Gradually, the dog developed a resistance to the effects of vibrations and overloadings. As a result of this training and owing to the fact that in the hermetically sealed cabin all necessary conditions were created for ensuring normal vital activity of the animal, the animal excellently endured the prolonged effect of accelerations during the entry of the satellite into its orbit and the subsequent state of weightlessness.

The program of scientific research connected with the obtaining of data from Sputnik II was designed for 7 days, after which the radio station of the satellite and the inboard telemetering apparatus discontinued operation.

The medicobiological data obtained during these 7 days on the conditions of existence of living organisms during prolonged cosmic flights and the materials on the intensity of solar radiation and cosmic rays, on radio-wave propogation, and on temperatures and pressures are of positive interest to science. At present all these data are being subjected to careful processing and study.

Measurements of the intensity of the signals received from the satellites have very great significance of the study of radio-wave propagation conditions. The results of the reception of radio signals and the measurement of their intensity indicate that in the 15-meter band these signals frequently were received over vast distances exceeding 15,000 kilometers. Under certain conditions radio waves were received not through the shortest distance but by means of circling the earth in a very long arc. In separate cases, the phenomenon of round-the-world echo of radio signals was observed. All these phenomena point to the presence of ionospheric radio wave guides, and the position of the satellite near the area of maximum ionization creates especially favorable conditions for their utilization.

However, this by no means limits the circle of questions connected with the study of the upper atmosphere and cosmic space. New automatic laboratories which, undoubtedly, will appear in the cosmos, will permit the conducting of more detailed measurements of pressure and density of the upper layers of the atmosphere, the determining of the degree of ionization, the investigation of the composition of the ionized layers, the measurement of the intensity of the earth's magnetic field and the investigation of the corpuscular streams of the sun. The investigation of the streams of meteoric particles occurring in the earth's atmosphere from interplanetary space also has great significance for the study of conditions of future cosmic flights.

The successful launching in the USSR of the first two artificial earth satellites, the investigations of the upper layers of the atmosphere conducted by them, and the prolonged flight in cosmic space of a highly developed living being are a tremendous contribution of Soviet science to the successful solution of important problems connected with understanding the universe and its conquest by man.

[Note: The article is accompanied by a diagram illustrating the relative positions of the following equipment in the head section of the rocket-carrier: (1) protective cone, (2) instrument for investigating short-wave ultraviolet and X-ray solar radiation, (3) spherical container, (4) cabin with the experimental animal, (5) apparatus for studying cosmic rays, (6) radio telemetering apparatus, and (7) electric power supply.] (Nauka i Zhizn', No 12, Dec 57, pp 4-8)

A. A. Shternfel'd's Space Platform Project Described

In a 72-page pamphlet entitled Iskusstvennyy Sputnik Zemli (Artificial Earth Satellite), Yu. A. Pobedonostsev describes A. A. Shternfel'd's design for a space platform as follows:



"An artificial satellite, as well as a cosmic ship, according to Shternfel'd's design should be constructed and tested in the beginning on the earth. Then, it should be disassembled and placed in parts in a previously selected orbit where again it will be necessary to assemble it into a complete unit.

"According to the design, the construction of the satellite will begin with the launching of a three- or four-stage rocket.

"Let us imagine that the to last stage of the rocket establishing an artificial earth satellite, you fly a second rocket, then third and fourth.... All these rockets are joined into one unit. The cabins and tanks emptied of fuel and appropriately equipped previously on earth serve as living quarters, laboratories, workshops, etc. In all these quarters artificial atmosphere is created, and so that the air will not escape the entire structure is made leakproof.

"Gradually the station is equipped with special equipment brought up from earth. Gas turbines, various instruments, and the remains of fuel and oxidizer taken from the rockets moored together may be used on the artificial satellite.

"Artificial gravity may be created on the satellite by means of a device rotating around a part of it.

"In this article Shternfel'd proposes to use the final stage of the rocket, which is orbiting with the satellite and empty of fuel, as construction elements of the artificial earth satellite. It is reckoned that such tanks will be joined together and people will live within them, receiving goods, equipment and provisions from earth." (Moscow, Iskusstvennyy Sputnik Zemli, 1957, p 38)



Prolonged Life Predicted for Sputnik II





In an article entitled "The Second Satellite and its Passenger," by Peter Hedervari of the Lorand Eotvos Geophysical Institute, the author says that "During the planning stages, it was the general belief that the artificial satellites would stay aloft only a few days, or, at the most, a few weeks. Recently, however, the opinion has gained ground that Sputnik II may stay aloft for as long as one or 1 1/2 years." (Budapest, Repules, No 9, Dec 57, p 11)

## North Korean Astronomical Observatory Observes Sputnik II

Workers of the P'yongyang Astronomical Observatory observed Sputnik II on 5 November 1957 at 0647 hours. According to Yi Nak-pok, head of the observatory, the satellite could be seen with the naked eye traveling a west to north direction in the northwestern sky at an angle of about 60 degrees. (P'yongyang, Minju Choson, 6 Nov 57)

## Sputnik Potential in Cartography

In an article entitled "The Uses of Artificial Satellites in Geodesy and Cartography," Gyorgy Erdi-Krausz, Hungarian university lecturer, speculates on the possibility of photography from a satellite.

According to the author, a spherical surface having a spherical radius of 3,359 kilometers is visible at an altitude of 1,000 kilometers above sea level. The area of this spherical surface is 34,631,000 $km^2$. At a height of 500 kilometers, the spherical radius of the spherical surface would be 2,446 kilometers and its area 18,559,000 $km^2$.

If these areas were to be photographed with a camera having a focal length of 20 centimeters, a 128 by 128 centimeter film would be required in the former case, while a 96 by 96 centimeter film would be required in the latter case. However, from the cartographic view point, it must be remembered that the lateral rays reach the earth's surface tangentially, which creates considerable distortion. Consequently the entire area which would appear on the film could not be evaluated photographically.

There are ways of eliminating the distortion effects; however, it is very important that the picture be taken from a perpendicular direction and that it be possible to establish geographical location and altitude at the time the picture is taken.

Two questions remain open: one concerns which or what details the film would show if one were to make a map from it directly, and the other is how the film could be recovered. It is, of course, quite conceivable that the photograph could be televised.

A map made on this basis would exclude the more distorted portions of the film and would, consequently, be on a scale of between 1:3,000,000 and 1:6,000,000. (Budapest, Termeszettudomanyi Kozlony, No 10, Dec 57, p 437)

## Biographic Information on Soviet Artificial Earth Satellite Scientists

An article entitled "Artists of the Links of the Chain" in a Hungarian source gives a brief biographical sketch of Soviet scientists whose work is associated with the conquest of space.



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Leonid Sedov was born in 1907. After completing studies at Rostov University and at the Physics Faculty, Moscow University, he began work at the Central Aerohydrodynamics Institute, where his major field was that of hydrodynamics. In 1937, he was already teaching at Moscow State University. The discoveries he made while investigating liquid and gaseous bodies have enriched astrophysics in two important fields: the interaction of light phenomena and the calculation of the mass of celestial bodies. He is also renowned for his research on so-called "cosmic explosions." In 1956 and 1957, he participated in the International Cosmic-Dynamic Congress in the US and attended the International Conference on Astronautics.

Anatoliy Blagonravov was born in 1894. He attended the Conference on Rockets and Satellites in the US at the time of the launching of Sputnik I. After completing the university, he lectured on the technology of modern artillery shells at the military academy. In 1938, he acquired the title of Doctor of Sciences; then, as a member of the Academy of Sciences, he continued his work as professor at the academy. His more recent research in the field of ballistic weapons has been tremendously effective. He designed the "electronic brain" which is known to have played so decisive a role in the launching of the sputniks.

Yevgeniy Fedorov was born in 1910. He completed his studies at the Physics Faculty, Leningrad University. When he graduated at the age of 22, he was sent to the polar research station, where he studied the magnetic phenomena of the atmosphere. He was a member of the expedition which set up the first Soviet research station at the North Pole in 1937 and 1938. Since 1945, he has been director of the Geophysics Institute of the Academy of Sciences USSR.

Petr Kapitsa is one of the most renowned living atomic scientists. He was born in Brasov in 1894. He was studying at the university in St. Petersburg at the time of the Great October Revolution. In 1921, he lost both his wife and child during an epidemic. After this, he went to Great Britain, continued his studies at Cambridge, and later became an assistant professor at Trinity College. He was elected member of the Royal British Scientific Society. He returned to the USSR in 1934 and continued his work in atomic research. He is a member of the academies of sciences of France, Great Britain, and the US.

The persons most immediately connected with the launching of the sputniks are Kasatkin, famous for research in the field of rocket propulsion; Ambartsumyan, the outstanding Armenian astronomer; Skobel'tsyn, astrophysicist, director of the Institute of Physics of the Soviet Academy of Sciences; Maksutov, who built the world's most powerful telescope at Pulkovo; Blokhintsev, director of the Joint Institute of Nuclear Research; Pobedonostsev, renowned expert in the field of upper atmosphere research; Mikoyan, expert on flight technology, who worked with Tupolev on the construction of the TU planes; and Pokrovskiy, physiologist in whose institutes the sputnik dogs were trained, and who is studying the reaction of the living organism to high altitudes and cosmic phenomena. (Budapest, Orszag Vilag, No 30, 17 Dec 57, pp 2-3)

Soviet IGY Rockets to Number 133



In an article entitled "The Uses of the Satellites in Astronomy," Ivan Almar of the Institute of Astronomy, Hungarian Academy of Sciences, writes: "The Soviet Union....will fire a total of 133 rockets in the course of the IGY. Several of these will be used to launch artificial satellites.



"Efforts are being made to solve quickly the problem of recovering [redacted] (Budapest, Termeszettudomanyi Kozlony, No 10, Dec 57, p 440)

[Note: The official Soviet IGY program calls for the firing of 125 research rockets during the IGY.]



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## II. UPPER ATMOSPHERE

### Ionosphere Studies on Dickson Island



The following is a complete translation of the article, "Ionosphere Station on Dickson Island," by A. Kh. Khrgian.

The Arctic Scientific Research Institute (ANII) and the Moscow State University (MGU) are jointly organizing ionosphere observations in the western sector of the Soviet Arctic on Dickson Island. The program for observations and work at the Dickson ionosphere station will be extremely extensive, encompassing studies of electron concentration in the upper layers of the ionosphere, their variations in different seasons and on disturbed and quiet days, and observations on the absorption of electromagnetic waves in the ionosphere.

The location of the station, which is practically on the main belt of maximum recurrence of aurora (on the average about 240 days per year with radiations) and magnetic storms, imparts particular importance to its observations. Here, the periods of long polar nights and days present the interesting possibility of observing the processes of ionization and recombination of ions. Of particularly great significance is the  planned study of the connection of ionospheric and magnetic disturbances to the phenomenon of radio-wave impenetrability repeatedly occurring in the polar regions. At the boundary of the regions of polar days and nights, there appear great variations of temperature and correspondingly strong air currents. Such a form of current has already been discovered in the lower layers (to 30 km) and undoubtedly exists in the ionosphere, where it affects its structure. It is already known that turbulence has been observed in the ionosphere. Estimates of the dimensions of the "turbulent bodies" appearing in layers of the ionosphere are now available.

An automatic panoramic ionosphere station constructed at Moscow State University has already been set up in an installation assigned to the Arctic Scientific Research Institute on Dickson Island. Such a station is already in operation at Moscow State University. This station makes it possible to take high-frequency characteristics automatically for a 7-sec period and in the range from one to 18 Mc. The station is completely automatic and can operate on several programs without an operator, photographing the high frequency characteristics through 14 sec, 5 min, 15 min, etc.

The station was set up and adjusted by L. K. Nerovnya, associate at Moscow State University. The operation of the station and the processing of its observations is under the direction of A. O. Vyal'tsev, Moscow State University, and P. I. Astakhov, Arctic Scientific Research Institute. The station has been operating regularly since the end of December 1956.

A second ionospheric station was assembled by Moscow State University for Dickson Island. With its help, it should be possible to observe the absorption of electromagnetic waves in the ionosphere. Such problems connected with the dynamics of the ionosphere as the effective frequency of electron collisions, temperature, density, etc., will be investigated on the basis of the high-frequency characteristics and data on absorption. (Mezhdunarodnyy Geofizicheskiy God, Informatsionnyy Byulleten', No 3, 1957, p 93)

Murmansk Preparations for Aurora Investigations



The following is a complete translation of the article, "Preparations for Investigation of the Aurora in Murmansk," by S. I. Isayev.

"The Murmansk Branch of the Scientific Research Institute of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation (MO NIZMIR) of the Ministry of Communications USSR is conducting observations in the IGY program. A significant position in the work program of the branch will be occupied by investigations of the most interesting geophysical phenomenon, the aurora.

"The C-180 wide-angle camera, which was constructed in the Soviet Union under the supervision of Prof A. I. Lebedinskiy, was set up for photographing the aurora. Thirty four stations equipped with these cameras are located in the high geomagnetic latitudes: in the Antarctic and Arctic, Murmansk and Yakutsk, Verkhoyansk, and on Mys Chelyuskin, Mys Zhelaniya, and others (see Section IV of programs of the IGY in Byulleten' MGG, No 2, 1957). Unlike ordinary equipment, this camera, with 35-mm movie film, can automatically photograph the entire firmament down to the horizon. A convex aluminized mirror is used to reflect the sky.

"The wide-angle C-180 camera set up at the Murmansk Branch of the institute is represented in Figure one.

"An international test period for conducting observations of the aurora occurred in March of 1957, with the help of the C-180 camera. Taking into account the illuminations of diverse intensity, cloudy conditions, and other weather pecularities, still more than 3,000 pictures were taken with the C-180 camera for various programs (disregarding experimental and focusing shots). Synchronized experimental films of aurora and ionograms with exposures at minute intervals were obtained. The ionograms were developed at the automatic panoramic ionosphere station of the Murmansk Branch of the institute.

"In addition to the C-180 cameras, a spectral wide-angle C-180-S camera (patrol spectrograph) is also installed in Murmansk. Other polar stations on Bukhta Tikhaya, Mys Schmidt, Dickson Island, Bukhta Tiksi, etc., will be equipped with such cameras during the IGY.

"Prof A. I. Lebedinskiy and V. I. Shtannikov, the leading designer of the C-180 and C-180-S cameras, were present in Murmansk for tests of the apparatus.

"The associates of the Murmansk Branch of the institute, I. G. Frishman, A. Ye. Veller, L. S. Yevlashin, and also the young specialists N. I. Dzyubenko, D. A. Andriyenko, B. S. Moiseyev, and G. V. Starkov participated in the C-180 camera tests.

"Photometric tests of various types of film for photographing the aurora were conducted, along with inspections of the apparatus. Experimental measurements of the brightness of various forms of aurora were obtained, and a comparison was made with data on the ionosphere.

"During February and March, the observers were occupied with a 2-month course in preparation for the polar stations of the Main Administration of the Northern Sea Route and the Arctic Scientific Research Institute. More than 20 persons studied in the course.

"Spectral and photoelectric equipment for special investigations are being operated in addition to those for investigation of the aurora.

"In June, the Murmansk Branch of the Scientific Research Institute of Terrestrial Magnetism, Ionosphere and Radio-Wave Propagation participated in the test week of notifications from the world center concerning the appearance of magnetic-ionospheric storms and aurora. The adopted system of notification proved successful.

"Observations of the aurora with the C-180 and C-180-S cameras were begun by the Murmansk Branch of the institute at the beginning of the [redacted] (Mezhdunarodyy Geofizicheskiy God, Informatsionnyy Byulleten', No 3, 1957, pp 86-87)

III. METEOROLOGY

Central Aerological Observatory in the IGY

The following is a complete translation of an article entitled "Preparation of the Central Aerological Observatory for the International Geophysical Year," by V. D. Reshetov.



During the IGY, the Central Aerological Observatory (TsAO) will carry out a wide range of aerological observations (radiosonde, airplane, weather balloon, radar, and observations with the aid of captive balloons). Its associates, together with the associates of other organizations of the Main Administration of the Hydrometeorological Service USSR will take part in the expeditions of the Academy of Sciences USSR on the continent of Antartica, in the Atlantic on the expeditionary ship Lomonosov, and in expeditions of the Main Administration of the Northern Sea Route and the Artic Institute in the Artic.

The Central Aerological Observatory, as the leading institution on aerological problems, will work toward the improvement of observation methods in the aerological stations of the Soviet Union. Stations being enlisted for aerological observations during the period of the IGY are equipped through the assistance of specialists of the observatory with the new "Malakhit" radiotheodolite (Figure one), capable of highly accurate observations. This radiotheodolite, already installed on the grounds of the observatory, was tested and gave good results. The use of radiotheodolites permits wind observations up to altitudes of 20-30 kilometers in any kind of weather to be made. With the aid of radiosondes, simultaneous measurements will be made of the temperature, pressure, and humidity of the air.

An international conference was held in Payerne, Switzerland, in May 1956 to arrange for the possible comparison of results of radiosonde atmospheric observations. According to the decision of the World Meteorological Organization, representatives of 14 countries participated in comparing radiosonde data. The Soviet Union was represented by a group of scientific workers of the observatory and the Institute of Hydrometeorological Instrument Building, headed by G. I. Golyshev, director of the observatory.

The comparison showed that the RZ-49 radiosonde, being used at present in aerological stations, was overheated by the Sun's rays at high altitudes. Radiation correction is introduced by Great Britain, Japan, and Finland as a means of eliminating the effects of overheating on radiosonde readings. At present, a system of radiation correction is also being developed at the observatory for radiosondes launched in the USSR. This system allows for correction for heating in relation to the heighth of the Sun, the flight altitude of the radiosonde (air density), the vertical velocity of the weather balloon, and certain other conditions.

The following table gives an idea of the degree of radiation correction in the Soviet comb-type (grebenchatyy) radiosonde (RZ-49) at an altitude of 20 kilometers:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sun's height in degrees | -6 | 0 | 20 | 40 | 60 | 70 | 90 |
| Correction in degrees C | 0.2 | 2.7 | 4.9 | 6.7 | 7.6 | 7.7 | 7.2 |

Studies show that radiation errors double with each 5-6 kilometers of altitude. The system of correction was introduced in practice at the beginning of the IGY.

During the IGY, the Central Aerological Observatory, the Main Geophysical Observatory, and other Soviet observatories will also measure radiation balance, that is, the quantity of heat radiation entering from the sun in the form of direct and scattered radiation. Ozonometric observations for the absorption of the sun's rays at different altitudes, in the ultraviolet part of the spectrum, and others will also be conducted.

A new group of winter workers, among them associates of the Central Aerological Observatory who will conduct atmospheric soundings with the aid of radiotheodolites and radiosondes at Station SP-7, departed for the Arctic as replacements for returning scientific workers who had been conducting aerological observations at Station SP-4.

Soviet aerologists at Mirnyy, during 1956-1957, will send up over 600 radiosondes and 500 radar-tracked sounding balloons. The data of these investigations will provide valuable material for studying atmospheric circulation in the polar regions of the southern hemisphere. According to a report by G. Tauber and A. Shchekin, a preliminary analysis of the aerològical observations conducted at Mirnyy indicates one of the interesting pecularities of the structure of the atmosphere in the Antartic -- the very high location of the tropopause. There was the case when a radiosonde balloon exploded at an altitude of 17 kilometers and a temperature of -80° centigrade without having yet reached the tropopause. In the Arctic, as is known now, the tropopause is located at a level of about 10 kilometers.

A new group of associates of the observatory, replacing their own [redacted] will con- [redacted] (Mezhdunarodnyy Geofizicheskiy God, Informatsionnyy Byulleten', No 3, 1957, pp 83-85)

New Soviet Cloud Atlas



The following is a complete translation of the article "New Cloud Atlas."

"The Main Administration of the Hydrometeorological Service USSR and the Central Aerological Observatory are releasing the new Atlas Oblakov (Atlas of Clouds) which will serve as one of the basic manuals for the network of meteorological stations and aerological posts and for the weather service. The photographic materials for the atlas were compiled by such Soviet scientists as A. F. Dyubyuk, V. S. Samoylenko, B. L. Dzerdzeyevskiy, N. F. Gel'mgol'ts, G. M. Petrova, L. A. Aleksandrov, and others. This atlas will replace the old atlas of 1931-1932 (reissued by us in 1940). Based on the set contemporary international classification of clouds, it introduces certain new forms and variations in accordance with contemporary views on the formation processes of different cloud forms.

"Descriptions and information on the most probable altitude, magnitude, microstructure, forms and variations related to other forms, conditions for ground observation, optical phenomena, etc., are given in the text for each basic form, in addition to photographs. A special section of the text is devoted to cloud systems and combinations of clouds of stable and unstable air masses.

"An attempt for classification of clouds from above was given for the first time in the Atlas Oblakov (Figure one). Long strata of flat cumulus clouds [Pskov, 2 Aug 1947]. Local forms of clouds of mountain regions, coast lines, and seas are presented in detail. The special features of these local forms are explained in detail in a special section of the atlas' text.

"The atlas was composed by an editorial commission consisting of N. Z. Pinus, A. F. Dyubyuk, B. L. Dzerdzeyevskiy, E. S. Selezneva, I. A. Klemin, and A. M. Borovikov, with participation by A. S. Zverev and under [redacted] (Mezhdunarodnyy Geofizicheskiy God, Informatsionnyy Byulleten', No 3, 1957, pp 111-112)

## IV. GLACIOLOGY

### Investigations at the Zagorsk Station



The following is a complete translation of an article entitled "Investigations at the Zagorsk Station", by I. Ya. Baranov.

Included in the network of IGY stations is the Zagorsk glaciological station, which was established on the base of the permanent Institute of Frost Science imeni V. A. Obruchev near Moscow, located 20 kilometers west of the city of Zagorsk in Moskovskaya Oblast.

Basically, the program of investigations set forth here consists of complex problems of heat and moisture exchange between the soil and the external environment, the importance of these processes in the seasonal freezing and thawing of the soil, and also the heat balance in the troposphere, the heat regime of the underlying surface, and their interconnection. Up to now, geophysics as a whole paid little attention to the investigation of inflowing radiant energy of the sun to the earth's surface and its transformation on the surface of the soil into heat. The whole complex of problems of heat and moisture exchange is indicated as being very slightly studied in view of the scantiness and infrequency of the investigations. During the IGY, these problems will be studied in their unity and in their interrelations.

In equations of heat balance, up to this time, the quality of the different problems of radiation balance, and the heat and moisture balances, were considered jointly. Meanwhile, they should be considered separately, more deeply, and comprehensively than is done at present.

On the basis of investigations, the interrelation and interaction of radiation and heat balance and their relation to the moisture balance in the atmosphere and soil, it is seemingly possible also to obtain empirical data which will make it possible to determine the real interrelation and trace the whole complex of these most intricate physical and geophysical processes. The heat balance equation does not embrace all aspects of the geophysical processes connected with the entry of radiant energy and with its transformation into heat and conversion into chemical, mechanical, and other forms of energy in connection with its action on different (as regards composition and properties) spatially combined media. The solution of similar problems will constitute a new era in the development of the natural sciences.

Contemporary data on heat balance as yet does not permit solving problems concerning the concrete conditions of seasonal and perennial thawing and freezing of the soil.



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Calculations of the heat balance of soil which are carried out according to the data of temperature observations are doubly empirical and not connected with the naturally energetic interaction of the soil and of the external environment. They do not reflect the nature of the changes arising in the soil in the course of year.

The practical side of this problem is very real. Its solution can, in time, have a very substantial effect on agriculture and on the different kinds of construction, which, in this or any degree, depend on the general heat and moisture regime in the soil, the phases of conversion into ice and the reverse processes, and also their dynamics. In particular, the study of the last problem, which is connected with the study of the processes of freezing and thawing, will give a solution to problems of soil improvement, of combating drought, salt-contamination of the soil, and the formation of cyrogenic soil structures, which cause heaving and settling and leads to the deformation of buildings.

Attempts to solve the problems will determine the relative problems which will be developed at the Zagorsk station. The Institute of Frost Science imeni V. A. Obruchev, Academy of Sciences USSR, and the Institute of Geography, Academy of Sciences USSR, will take part in these investigations in the IGY.

The investigations mentioned have a particularly geophysical content and fit into the IGY program in the part on glaciology. These investigations will be carried out for certain multilayer natural systems different in structure:

1. Surface layer of airsoil with a bare surface

2. Surface layer of air - snow covers - plant (forest and meadow) covers - soil

3. Surface layer of air - snow and ice covers - water - bottom deposits

The following problems will come under this study:

1. Radiation and heat balance on the surface of the soil and in the outer medium

2. The temperature regime of soil and of bodies of water

3. Soil moisture regime

4. Heat flows in soil and in bodies of water

5. Heat-physical characteristics of thawed and frozen soils

6. Evaporation of moisture from the soil and from a water surface, and the condensation of moisture into the soil and on a water surface

7. Mechanism of seasonal freezing and thawing of the soil and others

Of particular interest are studies on snow cover: the study of its dynamics, metamorphism, heat-physical properties, etc. Snow covers are studied not only as a dynamic medium in which processes of heat and moisture exchange occur, that is, as the seasonal structural element of a physical system of the heat exchange of two interacting media, but also as the external condition of its heat exchange with air.

Four observation platforms are arranged in the station, each of which corresponds to the problems noted above. The platforms are provided with appropriate apparatus with an eye to the greatest utilization of self-recording instruments, among which are those with remote control, permitting the procurement of continuous photographic records.

Certain types of observations which do not lend themselves to continuous recording are conducted on the spot and in central observation points at specified periods.

It is natural that the study of the above-mentioned problems cannot be completed during the period of the IGY. It is also natural that what is accomplished during this time will undoubtedly have great value for theory and practice and will serve as a valuable contribution to geo- [redacted] (Mezhdunarodnyy Geofizicheskiy God, Informatsionnyy Byulleten', No 3, 1957, pp 74-75)

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