CIA/PB 131632-56

UNCLASSIFIED- SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

MARCH 6 1959

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PB 131632-56

INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION -- 1959

March 6, 1959

U. S. DEPARTMENT OF COMMERCE
Office of Technical Services
Washington 25, D.C.

Published Weekly
Subscription Price $12.00 for the Series

Approved For Release 1999/09/08 : CIA-RDP82-00141R000200570001-0

PLEASE NOTE

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

"INTERNATIONAL GEOPHYSICAL COOPERATION" PROGRAM -- SOVIET-BLOC ACTIVITIES

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Al'pert Discusses Satellite Studies of the Ionosphere

One of the problems which can be directly solved with the aid of artificial earth satellites is the study of the ionosphere. During its lifetime, a satellite traverses the entire outer part of the ionosphere and then falls to Earth as a meteorite, or, burning like a meteor, ends its existence in the lower layers of the ionosphere.

Prof Ya. L. Al'pert, Scientific Research Institute of Terrestrial Magnetism, the Ionosphere, and Radio Wave Propagation (NIZMIR) had the following to say on the direction of the investigations of the ionosphere being followed at present.

The ionosphere is the ionized part of the atmosphere, containing, in addition to neutral particles, free electrons and ions. Such a medium is called a plasma. It is characterized by clearly expressed electromagnetic properties. This is mainly why the ionosphere has such a great effect on the propagation of radio waves, and it is the use of the latter which is the most effective way of investigating its properties.

This ionization is found in the atmosphere beginning at a height of 60-80 kilometers. Here the electron concentration N consists, in various conditions, of hundreds to thousands of free charges per cubic centimeter. Gradually changing with altitude, the more of less complex form of N grows and reaches a maximum value N_M at a certain altitude. The value of N_M in the region of this main maximum in the ionosphere changes, for example, in the middle latitudes under different conditions within the limits of one up to several millions per cubic centimeter. The greatest value of N_M observed is about 5×10^6 electrons per cubic centimeter. The height of the main maximum of ionization varies in relation to the time of day and the latitude and longitude within the limits of 250-400 kilometers.

The electron concentration above the main maximum N_M remained unknown up to the advent of the artificial satellites. The study of the relationship of the electron concentration to altitude is also one of the basic problems solved with the aid of satellites. Data of this value in the outer ionosphere was obtained for the first time from observations of Sputnik I's radio signals.

Despite the fact that the ionosphere has already been systematically studied for more than 30 years, there is as yet no sufficiently complete and sound theory on its formation and, in many regards, its structure remains obscure. This is related to the fact that little is known on how the Sun's radiation interacts with the gases composing the atmosphere and how the ionization balance in the atmosphere is established.

The composition of this radiation and the nature of the changes in its intensity at different altitudes is not accurately known. There still is insufficient information concerning the structure of the atmosphere as a whole, on the density of neutral particles, on their chemical composition, temperature, etc., and, in particular, concerning the high regions of the ionosphere.

Another parameter of the ionosphere, a knowledge of which is very important is v, the effective frequency of the collisions of electrons with other heavier particles of gas. The value v depends on how frequently the collisions with ions or neutral particles occur, the temperature of the gas, and the density of the neutral particles and ions. Without a knowledge of the value of v, it is impossible to calculate such phenomena as the attenuation of radio waves in the ionosphere, the interaction of different waves between themselves, the action of the waves themselves on the electromagnetic properties of the ionosphere, and other effects.

At present, very little is known concerning the value v and concerning its changes in the whole depth of the ionosphere, which is connected with the particular difficulty of finding a method of measuring it directly.

It is only known that the value of v is of an order of 10^7 at altitudes of 65-80 kilometers, $v \approx (0.4-5) \times 10^5$ at altitudes of 100-130 kilometers and $v \cong (1-3) \times 10^3$ in the region of the height of the main maximum of the ionosphere. In not one experiment was there obtained, even for any condition, a complete relationship of v to altitude. Also not definitely known is where collisions of electrons with ions instead of with neutral particles begin to prevail, a fact that is necessary for understanding the character of the microprocesses in the ionosphere and, in particular, can help in determining the relationship of temperature to altitude, which is extremely difficult to compute for high regions of the atmosphere. This is explained by the fact that with a rise in temperature the number of collisions of electrons with neutral particles increases, and the number of collisions with ions, on the other hand, decreases.

Still another important group of problems connected with small-scale heterogeneity of the ionosphere remains. At present, it can be considered conclusive that in any limited part of the ionosphere, in a column with a diameter of several hundred meters and more, extending from its base up to the height of maximum electron concentration, there is always contained a great number of small-scale heterogeneous formations, the condensations and rarefactions of electron density. Studies of these heterogeneous formations or ionized clouds by means of radio wave propagation throughout the whole thickness of the ionosphere reveals that they have certain statistical regularities. They have a rather wide range of sizes ρ , changing within the limits of several tens to many hundreds of meters. It has been established that in the region from the 110-130 kilometer altitude up to the main maximum values of ρ_o of an order of 200-300 meters are encountered. The assumption recently arose that in the lowest altitudes, heterogeneties with linear measurements of only several meters are observed. These heterogeneities play an important role in ultrashort wave transmissions over great distances.

Heterogeneous ionospheric formations continuously appear and disappear. They move with a probable velocity, relative to the observer of v_o, changing within the limits of 2-5 meters per second. They are characterized by fluctuations of the electron concentration N, that is Δ N, reaching several percent.

It is still not clear whether the statistical properties of the ionosphere are indications of its pecularities or whether they are the results of the total interaction of all the heterogeneities at different levels in a column of the ionosphere taking part in the transmission of radio waves; thus the parameters of heterogeneities must change strongly with altitude.

Two possible mechanisms for the perturbation of small-scale heterogeneities in the ionosphere are turbulence of the ionosphere caused by the drifting of large regions and drawn out plasma waves, the result of the formation in them at any moment of a macroscopic region of surplus-charge electrons. In the latter case, the characteristic size of the heterogeneities scattering radio waves is the wave length λ of these longitudinal waves. λ grows with a rise in the temperature T of the medium and changes with an increase of the electron concentration N and the velocity v_o. Thus, if T=1,500 degrees and 300 degrees, and $N=2 \times 10^6$ and 2×10^5, the values which are observed at about the altitudes of the main maximum of electron concentration and the altitude Z at 110-130 kilometers, then with v_o equal to 2-5 meters per second, values of 200-300 meters are obtained for the wave length λ , which concides with the sizes of the heterogeneities ρ_o determined in the experiment.

Values, characterizing a heterogenous ionosphere and its relationship to altitude are closely tied to the study of its mechanisms, and that is why it is hoped this interesting problem will be solved by artificial earth satellites traveling in particular, almost horizontal, sectors of their orbits. High-altitude rockets are obviously less suitable for such experiments.

Experimental data obtained, characterizing the various processes in the plasma-ionosphere, on their part should contribute to the creation of a general physical theory of plasma waves and turbulence. This theory is still very little developed, particularly because of its great mathematical complexity and, in a known degree, because of the insufficient quantity of experimental data which could have been used as a base for their development.

A number of circumstances should be mentioned which it is necessary to consider in evaluating the application of the various methods and their accuracy and also for explaining the nature of the investigated values.

First, in radio wave investigations, direct measurement of this or any parameter of the medium at a given point is not considered. Rather, the values obtained are determined as an average of the values for a certain region in the neighborhood of a given point. The linear measurements of this region consist, as a rule, of the many wave lengths of the radio oscillations being used and in each separate case can be evaluated. Thus the radius of this region at a distance of about 300 kilometers from the radiator and a wave length of about 7 meters is approximately 1.5 kilometers.

Second, measurements are hampered by the complexity of the effects which arise in the neighborhood of the satellite and the nature of its interaction with the plasma. The phenomena arising in this manner have as yet been little analyzed theoretically. The thermal velocities of neutral particles of the atmosphere and ions at great altitudes are 1-1.5 kilometers per second, that is somewhat less then the velocity of the satellite, which is equal to about 8 kilometers per second. This means that in a certain cone-shaped area at the rear of the satellite a thinning of these particles occurs as the satellite passes them. On the other hand, the velocities of electrons here are 100-150 kilometers per second, that is, by far exceeding the velocities of the neutral particles. The thinned region can be filled by electrons flowing into this vacuum and cause an excess of electron concentration here, that is, a certain negative spatial charge, which will be diffused into the plasma in a oscillatory manner.

A negative charge is thus also acquired by the satellite. A "heterogeneous cloud," complex in structure, forms in the neighborhood of the satellite. The dimensions of this cloud can be rather large if we consider that the length of the free run of the particles is very large; thus, at altitudes of 300, 400, and 600 kilometers, they are equal to 6, 20, and 2,000 kilometers, respectively. Therefore, the lifetime of particles at distances equal to the length of the free run, lasts many seconds. The satellite, during this time, travels hundreds of kilometers so that this cloud arising in its path forms a trail which lasts for some time and can exert a marked effect on the results of the measurements.

In the selection of research methods, the properties of the satellite itself, and the nature of its interaction with the medium, should be considered first of all. Peculiarities of this flying laboratory are its great speed with relatively slow changes in its height while passing over the point of observation, the disappearance and appearance of both optical and radio visibility during each passage of the satellite, etc.

Because of the satellite's great speed, the frequency of its radio signals received by the observer on Earth are somewhat changed. This so-called doppler shifting of frequencies makes it possible to determine (in the case of a homogeneous medium) the coefficient of refraction of the medium and thereby its electron concentration, if the radial velocity of the satellite's radio transmitter and its frequency are known.

For example, if the ionosphere were homogeneous and its electron concentration were 5×10^6 electrons per cubic centimeter, then the doppler shifting during the satellite's passage would change from zero (when the satellite is at zenith) to 400-500 oscillations per second (when the satellite is over the horizon).

In a heterogeneous medium, as is the case for the ionosphere (because of the change N(z) of electron concentration with altitude), it is possible to determine directly the number of electrons in a column of unit cross section area extending from the observation point to the radiator. Thus, in actual conditions, the maximum values doppler frequencies can attain with a consideration of N(z) are several times less than the above-indicated values.

However, direct measurements of doppler frequencies are insufficiently accurate. This accuracy depends, first of all, on the uniformity of the frequencies of two independent sources of oscillations located correspondingly at the point of observation and on the satellite, and cannot be sufficiently high over a long period of time. For increasing the accuracy, it is necessary to control the source of radiation located in the satellite from the Earth. In this way, the oscillations being compared at the point of observation will be synchronized or cohered. Values which are of interest to us can be determined with considerably greater accuracy in this manner. Use of the coherent doppler method also decreases the error caused by an incorrect knowledge, at each given moment, of the radial velocity of the satellite for which it is necessary to register coherent doppler oscillations simultaneously in two frequencies. The results of these experiments make it possible to study other parameters of the ionosphere. Thus, by determining, by the indicated method, the number of electrons during the passage of the satellite in the neighborhood of the zenith, it is possible according to the change of this value because of the ellipticity of the satellite's orbit, to determine under quiet ionospheric conditions the electron concentration at the highest passages of the satellite.

Because of the influence of ionized clouds (the heterogeneities mentioned above) a schematic representation of the oscillations being compared on the ground will be in the form of alternately "compressed" and "expanded" waves, that is, the low-frequency oscillations obtained as a result of the addition of oscillations radiated by the satellite and the apparatus on the ground will have a period changing with time. A simple analysis of such an oscillogram reduced to a determination according to its median values of minimum and maximum periods and the time interval between them determines the parameters which characterize the small-scale heterogeneity of the ionosphere, that is, the values of ρ_o and ΔN, mentioned above.

The doppler effect can be used to conduct wide investigations of the ionosphere.

A certain peculiarity of the doppler effect can be used for determining the total electron concentration. This peculiarity appears because of the influence of the Earth's magnetic field on the propagation of radio waves in the ionosphere. The corresponding effect can be called the rotational doppler effect.

As a result of the influence of the magnetic field, the ionosphere becomes a double-refracting medium leading to the excitation of two waves in it, instead of one. Each of these waves has its own coefficient of refraction and, consequently, different doppler shift frequencies. The result of this is that the amplitude of the satellite signals being received change with time proportionally to the differences of these frequencies. Under actual conditions, this difference in frequency can be from zero (when the satellite is at zenith) to approximately one or less oscillations per second. These slow oscillations in the amplitude of the signals being received, the frequency of which can be measured with great accuracy, also make it possible to determine the total number of electrons in a column of a unit cross section.

Another method of investigating the electron concentration of the outer ionosphere, partially used in radio observations of Sputnik I, is that of observations of the "radiorise" and "radioset" of a satellite.

During the change in location of a satellite over the point of observation, the trajectory of its radio waves received on the ground is bent opposite the direction the satellite is moving. If the frequency of these waves is great in comparison to the so called critical frequency of the ionosphere, which depends on the value of the electron concentration at the altitude of its main maximum, then the propagation of radio waves is near that of the optical and the corresponding trajectory represents a direct line joining the point of observation with the satellite. In this case, the maximum horizontal distance of the reception of signals from the satellite is practically equal to the distance optically of its visibility. If the frequency of the wave is not too great, then the distortion of the wave's trajectory results in the horizontal distance of the reception of the radio waves becoming greater than the optical distance. This means that the "radioset" of a satellite begins later, and the "radiorise," to the contrary, begins earlier than the visible set and rise.

Assume that the values of the maximum distance (according to the data of the true orbit of the satellite) and the state of the atmosphere up to its main maximum, according to the data of an ionospheric station network, are known for the corresponding moments of the "radiorise" and radioset" of a satellite flying over the main maximum of electron concentration. Then, it is possible to calculate how the electron concentration in the outer ionosphere must change so that the experimentally obtained values for the maximum distance for the reception of the radio signals may be observed.

The relationship of the electron concentration to altitude in the outer ionosphere can be determined by the indicated method. This makes it possible to form a presentation on the change in these heights and other values, for example, the density of neutral particles, which it is possible to evaluate as a result of calculating the lifetime of the free electrons and the time between the different acts of ionization.

As the lifetime of electrons in the outer ionosphere is more than 24 hours, that is, it considerably exceeds the duration of a day and a night, it is obvious that the state of gases in this part of the atmosphere depends very little on the position of the Earth relative to the Sun, and is almost quasi-stationary. It is possible to show that under these conditions, the density of neutral particles is proportional to the ratio of the above-indicated time, as a result of which it is possible to estimate it according to the value of the electron concentration. ("The Ionosphere and Artificial Earth Satellites," by Prof Ya. L. Al'pert, Scientific Research Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation; Moscow, Priroda, No 10, Oct 58, pp 71-77)

Aeromedicine Discussed in Czechoslovakia

The following is a complete translation of the article "Biological Problems of Interplanetary Flight and Our Research," by Dr Josef Dvorak of the Institute of Aero Medicine, Prague.

The launching of the Soviet cosmic rocket -- the first artificial planet -- clearly indicated the importance of the problem of preparing for manned flight, at first in artificial satellites and later even further, into interstellar space. A considerable part of the national income of the major powers is devoted to research on rocket technology. Certainly, none really believes that any small country could achieve any of its own results from biological experiments in extraterrestial space. This, however, does not mean that research in interplanetary flight is the exclusive domain of the major nations and that it is impossible for us [in Czechoslovakia] to gain valuable and important results.

Results of research from artificial satellites and meteorological rockets show that if the technical problems for safeguarding existence in a hermetically sealed cabin are solved, the effects of the flight itself are not connected with any changes in the condition of the organism. The technical solution, however, is an extremely complex problem in actual practice, particularly for flights in excess of several hours. Consequently, much work remains to be done in laboratories on earth, based on the results of flights into space.

Which are the most important factors affecting an organism during extra-terrestrial flight?

1. During blast-off, considerable effects are caused by the force of gravity, noise, and vibration.

2. During the flight, it is necessary to assure certain hygienic conditions within the cabin -- sufficient pressure, renewal and replacement of consumed oxygen, removal of waste matter (particularly carbon dioxide and water), maintenance of certain temperature differentials, and provision for adequate quantities of water and food. In addition, it is necessary to work out a definite plan of activity, since the normal 24-hour day cycle is distorted during flight.

3. In space, the organism is affected by weightlessness and various form of radiation.

4. In cases of accidents, it is necessary to assure an emergency supply of oxygen and provide for sufficient time to adopt emergency safety measures.

5. During re-entry, it is necessary to protect the organism against deceleration in the atmosphere, and against overheating.

An analysis of the above factors and the establishment of norms and standards for technical equipment are the province of space medicine, which is a part of the branch of aeromedicine. Some of the problems are identical with the problems involved in safeguarding high-altitude flight in extremely fast aircraft; others are connected with basic questions in biology and physiology.

In all of these areas, research work is being carried on in Czechoslovakia to a greater or lesser degree (for the most part, to a lesser degree).

It would not be correct, however, to underestimate our potentials. The successes of Czechoslovak geophysicists and astronomers during the IGY offer convincing proof. Even in other branches of science, it is possible and correct -- to a degree corresponding to our potential -- to work on cosmic problems.

In many branches of the Czechoslovak Academy of Sciences, in school, medical, and other laboratories, research on a number of biological and physiological problems is being conducted and has a direct bearing on space flight. However, the fact that the majority of the work done was not aimed at interstellar flight and the fact that sometimes various authors were not even aware of the significance of their work in the field of cosmic flight testifies to the inadequacy of the centralized organization of this type of research.

Many years ago, noise problems (at the laboratories of the Czechoslovak Academy of Sciences), the effect of vibration on the nervous system (hygienic faculty), and the effects of excessive gravity were thoroughly investigated. Also, a prototype of a Czechoslovak protective suit against the effects of excessive gravity (anti-G suit) was developed. In numerous physiological laboratories, research was conducted on the effects of oxygen shortage (hypoxia) and the possibility of influencing resistance to hypoxia in the course of an individual's development. We have in our country a high altitude suit and a superpressure compensation suit for use in the event of a crash. Experiments were also carried out in which "boiling" of the body fluids was investigated in live animals at considerable heights (where the boiling point drops below 30 degrees Centigrade).

Noteworthy significance has been attained by the work of the biological laboratories of Academician Malek, which are concerned with the structure of certain marine plants and their modification. It is presupposed that in future years, it will be necessary to obtain food from rapid-growing micro-organisms -- simultaneously it would be possible, through their help, to renew the air in the cabins of rockets. A solution to this question could fundamentally change the method of renewing the air in interplanetary rockets. A great deal of work, especially in the physiology laboratories, has been devoted to questions on the effect of a change in the work period, lack of sleep, fatigue, heat, and protection against it. A special suit was also tested for use under conditions of extreme heat. The possibilities of the application of these results are obvious.

The dynamic weightless state was achieved in our country for the first time early in the 1950s during rests with aircraft. The significance of this was not comprehended by anyone at the time. The influence of rapid alternation between excess gravity and weightlessness lasting several seconds was also investigated. The results attained are in agreement with those of today. It was learned that weightlessness does not affect the proper muscle coordination in small movements. Furthermore, it was found that 10 percent of the experimental personnel got "air sick" as a result of the irritation of the sense of equilibrium in the middle ear. It was clearly confirmed that it is necessary to select pilots for flights.

The effect of radiation has been the object of basic research in our country for some decades, and it is associated primarily with the name of a Corresponding Member of the Czechoslovak Academy of Sciences, Hercik.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000200570001-0

At a recent congress of flight physicians in Lovan, which concerned problems in cosmic medicine, it was shown that the main share of research on the above-mentioned problems will be borne by work in artificial satellites. From this viewpoint, our results are modest but not, however, insignificant. Even with today's means, it would be possible to substantially increase the usefulness of the results obtained for interplanetary flights, if the work was well coordinated.

It would be immodest and unrealistic to count on independent work during actual interplanetary flight in the near future in our country. There is, however, a series of problems the solution for which we have very good prerequisites. They are, for instance, problems of cultivating plant microorganisms under conditions of motion, influencing their material changes and composition, mastering their growth; problems of enzymatic processes during the dissolution of carbon dioxide; the production of food, such as carbohydrates, fats, and proteins, directly from inorganic components, with the exclusion of plants; problems of protection from noise and heat; problems of ensuring microclimate in confined areas; the influence of various types of radiation; the influence on the normal processes in an organism during the course of the day; the processes of acclimation to new living conditions, etc.

Interplanetary flights will provide the development of science with an unusually significant stimulus. It would be proper to incorporate this kind of work in a unified plan and thus help to attain results which would correspond to the position of our science in the world.

A photograph accompanying the article is captioned Czechoslovak functional prototype of a high-altitude suit. ("Biological Problems of Interplanetary Flight and Our Research," by Dr Josef Dvorak, Institute of Aeromedicine; Prague, Rude Pravo, 18 Jan 1959, p 4)

New Soviet Satellite? Signals Picket Up in Belgium

Jadoule, an amateur radio operator from Boitsfort, has stated that he twice heard signals broadcast by a satellite on the frequency of 20.005 kilocycles on 5 February. It was certainly a satellite broadcast, he says, because the Doppler effect was very distinct. He heard these signals from 1951 to 1959 hours. The signals were broadcast on a nonmodulated frequency: one dash ("trait") followed by three or four [groups?] made up of five short bars ("barre"), or one dash ("trait") followed by another bar ("barre"), repeated several times. Jadoule recorded the signals received at 2131 hours. ("A New Russian Satellite? Radio Signals Picked Up in Belgium"; Brussels, La Libre Belgique, 7/8 Feb 59, p 3)

Model of "Mechta" To Be Displayed At Leipzig Spring Fair

A model of the USSR's first Moon rocket, "Mechta," which became the first artificial planet, will be displayed publicly for the first time at the Leipzig Spring Fair, 1-10 March. Models of Sputniks, I, II and III will also be exhibited there. (Helsinki, Hufvudstadsbladet, 12 Feb 59, p 5)

II. UPPER ATMOSPHERE

Radiotelescope With Scanning Radiation Pattern At Crimean Observatory

A radiotelescope for continuous observation of the Sun's radio emission has been installed at the Crimean Astrophysical observatory. Such observations were conducted on the 10-centimeter wave. The telescope was mounted on a parallactic stand, which facilitated automatic tracking of the Sun. The required noise immunity was attained by modulating the signal with an oscillating radiation pattern. The antenna assembly of the telescope consists of a truncated parabolic reflector with two horn radiators. The radiators are connected by a section of rectangular wave guide in such a manner that the planes of polarization are mutually perpendicular. A ferrite stub with a porcelain activator is mounted in the wave guide. Under the action of a variable magnetic field the ferrite stub rotates the plane of polarization in the wave guide by $\pm$ 45 degrees.

The radiotelescope is calibrated with the aid of a noise generator, which is mounted in the place of one of the radiators. The modulation frequency is 180 cycles. Sensitivity of the radiotelescope for the frequency band of 2.5 megacycles and a time constant of 3 seconds is 4-5 degrees. The effective antenna area is 13 square meters. The Sun's radio emission is recorded on a paper tape.

The design of the individual mechanical components of the radiotelescope was done by B. P. Abrazhevskiy and the radioengineering components by V. A. Yefanov, and P. N. Stezhka. ("Radiotelescope With Scanning Radiation Pattern Operating on 10 cm Wave," by I. G. Moiseyev, Gor'kiy, Crimean Astrophysical Observatory, Academy of Sciences USSR, Izvestiya Vysshikh Uchebnykh Zavedeniy, Radiofizika, No 3, 1958, pp 159-161)

III. METEOROLOGY

Subcommission on Actinometry and Atmospheric Optics Organized Under Academy of Sciences USSR

A Subcommission on Actinometry and Atmospheric Optics (Podkomissiya po Aktinometrii i Atmosfernoy Optike) has been organized within the Commission on the Physics of the Atmosphere under the Department of Physicomathematical Sciences, Academy of Sciences USSR. The following scientists are members of the subcommission: K. Ya. Kondrat'yev, chairman (Leningrad State University); G. V. Rozenberg, deputy chairman (Institute of the Physics of the Atmosphere, Academy of Sciences USSR); K. S. Shifrin (Main Geophysical Observatory); Yu. D. Yanishevskiy (Main Geophysical Observatory); G. K. Sulakvelidze (Institute of Applied Geophysics, Academy of Sciences USSR); and V. G. Kastrov (Central Aerological Observatory).

The subcommission's task is to collect information on works concerning the study of radiation conducted at various points and establishments, and to prepare suggestions for the development and coordination of these works. The subcommission will also prepare reports and observations on the study of radiation, etc., which has been conducted in the USSR.

The subcommission has intentions of convoking a conference on actinometry and atmospheric optics either late in 1958 or in early 1959. ("In the Commission on the Physics of the Atmosphere Under the Academy of Sciences USSR," Leningrad, Meteorologiya i Gidrologiya, No 11, Nov 58, p 69)

Conference of Subcommission on Actinometry and Atmospheric Optics, Academy of Sciences

A scientific conference held in Leningrad during the week ending 6 February was devoted to the most important problems of the study of radiant energy in the atmosphere (actinometry) and atmospheric optics. The conference was called by the Commission on the Physics of the Atmosphere of the Academy of Sciences USSR, the Main Geophysical Observatory, and Leningrad University. Representatives of the scientific research institutions of many cities in the USSR, and also scientists from China, Poland, the German Democratic Republic, Czechoslovakia and the Korean People's Democratic Republic, participated in the work of the conference.

The ever-growing importance of actinometric investigations for meteorology, agriculture, helioengineering, medicine, and other fields of the national economy and science was emphasized in reports by A. M. Obukhov, Corresponding Member of the Academy of Sciences USSR; K. Ya. Kondrat'yev, prorector of Leningrad University; Yu. D. Yanishevskiy, senior scientific associate of the Main Geophysical Observatory; and others.

Problems on the distribution of the Sun's radiant energy on the earth, the study of the transparency of the atmosphere, the possibility of measuring sunlight, moonlight, and other exoatmospheric light were discussed by the participants. A special session dealt with the effect of radiant energy on the longevity of building construction and the calculation of radiation in designing housing. ("Study of Radiant Energy": Moscow, Izvestiya, 7 Feb 59, p 4)

Soviet IGY Expedition Studies Atmospheric Conditions in Egyptian Desert

A study of atmospheric conditions in the Libyan Desert south of Aswan was made in connection with the IGY program by a Soviet group during October and November 1957. The station was set up one kilometer from the Nile and 200 kilometers from the Red Sea. The exceptional stability of the atmosphere for several hours before and after midday was noted. Measurements of polarization were made as a sensitive index on this stability. ("Scattering and Polarization of light by the Atmosphere in the Libyan Desert," by Ye. V. Pyaskovskaya-Fesenkova; Moscow, Doklady Akademii Nauk SSSR, Vol 123, No 2, 11 Nov 58, pp 269-271

Changes in the Color of the Twilight Sky

Photoelectric measurements of the distribution of the energy of a twilight sky at zenith were made with the aim of explaining the reasons for changes in the color of the sky. The results were compared with theoretical calculations.

A comparison of the calculated values of brightness with the observed values shows that the intensity of the observed twilight luminescence in all wave lengths in the visible part of the spectrum is rather close to the intensity of first order scattered radiation only in the intervals of setting of the Sun from 0 to 6.5 degrees. Beginning with 8.5 degrees, first order scattering plays a negligible role in the total flow of radiation in the sky at zenith in all parts of the visible spectrum. Color temperatures were used for characteristics of the color of the twilight sky. Because one value of temperature cannot represent the distribution of energy in the part of the spectrum being observed, the spectrum was divided into two parts: the first, from 370 to 440 microns; and the second, from 440 to 600 microns. Color temperature was determined by comparing the observed energy distribution with the Planck distribution, calculated for a series of temperatures.

The color temperature for the region of the spectrum from 440 to 600 microns changes in relation to the settings of the Sun under the horizon reaching a maximum value at about 10 degrees. In the blue part of the spectrum (370-440 microns), these changes were almost absent. Thus, changes in the color of the twilight sky in the investigated part of the spectrum are caused mainly by the region from 440 to 600 microns.

The character of the distribution of energy in the spectrum of the twilight sky is caused not only by the presence of ozone, but also by the general character of the absorption of light in the Earth's atmosphere. Of particular value in the formation of this spectrum are the altitudes of the so-called twilight rays for different wave lengths. The relationship of the altitude of an effective twilight ray to the degrees of setting of the Sun is shown. In the lower degrees of setting, the difference in the altitudes of an effective twilight ray for 370 and 700 microns reaches 20 kilometers. Since the effective twilight ray for short wave lengths appears above the rays for longer wave radiation at one and the same time, the spectral distribution must be characterized by low intensity in the extreme blue part of the spectrum, in comparison with the distribution which corresponds to Rayleigh scattering.

Since the difference in the altitudes of the effective twilight rays decreased with a progression of the degrees of setting of the Sun, the relative intensity of the blue radiation increases, and, as a consequence, the ratios of the intensity in the blue and yellow-green rays must increase.

In the analysis of the optical properties of the Earth's atmosphere by the twilight method, it must be considered that rays with different wave lengths give information on different levels of the atmosphere at one and the same time. In addition, it is necessary to remember that the width of a twilight ray is different for different wave lengths. In this respect, the blue rays are preferable, as their twilight ray is considerably narrower than for the red. ("Changes in the Color of the Twilight Sky," by V. B. Divari, Astrophysics Institute, Academy of Sciences Kazakh SSR; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 5, 1958, pp 795-798)

Theory of Scintillation of Terrestial Light Source Checked Experimentally

The scintillation and flickering of stars and other radiation sources both within and outside of the earth's atmosphere have recently received considerable attention in problems connected with astronomical observation and radiometeorology, the authors note, and a rather complete theory of these phenomena has been developed.

The results of the theory are summarized as follows for the case when fluctuations in the index of refraction of the medium are subject to the "2/3 law."

1. Fluctuations in light intensity have a logarithmic normal distribution.

2. The dispersion of the intensity I of a light wave is given by the formula

$$\sigma^2 = \overline{[\ln I - \overline{\ln I}]^2} = 10.5\, C_n^2\, \lambda^{-7/6} L^{11/6},$$

or $\sigma^2 \sim L^{11/6}$, where L is the distance the light travels in the turbulent medium, λ is the wave length, and C_n^2 is a constant from the expression for the fluctuations in the index of refraction n of the medium.

3. The correlation function of the fluctuations of the logarithm of the light intensity in a plane perpendicular to the ray is a function of $\rho/\sqrt{\lambda L}$, where ρ is the distance between points of observation. The correlation is of the order $\sqrt{\lambda L}$.

4. The frequency spectrum of the fluctuations is a function of the quantity $f\sqrt{\lambda L}/v_n$, where f is the frequency and v_n is the component of the mean wind velocity perpendicular to the ray.

Work carried out during 1956 and 1957 to verify these relationships experimentally is described. The experiments were made in a level region and a light source 2 meters above the earth was used. The values used for L between the source and the receiver were 250, 500, 1,000, and 2,000 meters. Graphs and tables of the experimental results are given. Agreement with the theoretical predictions was found to be satisfactory. ("Experimental Investigation of the Statistical Characteristics of the Scintillation of a Terrestial Light Source," by A. S. Gurvich, V. I. Tatarskiy, and L. R. Tsvang, Institute of Physics of the Atmosphere, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 123, No 4, 1 Dec 58, pp 655-658)

IV. GRAVIMETRY

Apparatus for Airborne Gravity Surveys Discussed

Recent years have seen great successes in the development and application of aerogeophysical methods of prospecting. This has led to attempts to widen the scope of these methods of prospecting and, in particular, to develop aerogravimetric methods. The first steps in this direction were reportedly made in the US by the invention of the aerogradientometer and its testing in Canada. Thus, gravimetry has entered into a new phase of its development, characterized by the gathering and application of aerogravimetric measurements. Certain considerations on the solution of the problem are presented.

The various problems faced in the use of airborne gravimeters are discussed. The use of the second derivative method of gravity interpretation is presented as the most effective means for the development of aerogravimetric surveying. Two systems of vertical gravitational gradientometers, one based on the use of two weights and the other on the use of the systems of two identical spring gravimeters are considered satisfactory for transducer constructions in the condition of flight.

The system of a double-differential astatic gravimeter appears the most suitable for the development of an instrument in motion, as changes due to temperature and the stretching of the springs will occur slowly, giving a total zero drift to the instrument. In addition, the vertical acceleration of the supports is completely excluded and the deviation of the instrument under the action of horizontal accelerations, within rather considerable limits, will have no effect on the readings of the instrument.

Elementary theoretical consideration confirms the possibility of developing apparatus for gravimetric surveys while in motion. ("Development of Apparatus for Gravimetric Surveys in Motion," by V. V. Fedynskiy, Institute of the Physics of the Earth, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 1, Jan 59, pp 146-152)

V. ARCTIC AND ANTARCTIC

New Mountains Discovered in Antarctic Interior

On returning from a flight into the interior of Antarctica, a Soviet plane piloted by Perov passed over a hitherto unexplored region. Several new discoveries were made during this flight. Quite unexpectedly, a pyramid-shaped, partly snow-covered mountain peak was discovered, 3,300 meters above sea level. Following this, a mountain range consisting of 17 peaks was discovered. At a point 74-10 S and 63-20 E, the Soviet explorers entered a massive, twin-peak mountain on the map.

In addition, six more mountain peaks were discovered, which represent the southern extremity of the Prince Charles mountain range; also six nunataks, several previously unknown ice cupolas, and a glacier. These were important discoveries, since mountains were found in a location where a level, uninterrupted ice sheet was believed to exist.

The overland detachment, moving toward the pole of relative inaccessibility, made seismic soundings of the ice thickness. As a result, it appeared that the elevation of the basic rocks increased toward the center of East Antarctica. The discovery of previously unknown mountains not only confirms the accuracy of Soviet seismic soundings, but it also proves that the basic rocks of East Antarctica are found at a higher elevation than had been assumed before. This fact supports the theory that Antarctica is a continent. ("Discoveries of Soviet Explorers"; Leningradskaya Pravda, 13 Dec 58)

Antarctic Flights and Discoveries

The current Antarctic summer has been unusually severe. There have been frequent blizzards and purgas. Under these conditions, synoptic weather forecasts are very important.

On a recent flight into the interior of the continent, a Soviet plane passed over the central regions of Antarctica, where no human beings had ever been before. At a point 75 S and 60 E, a hitherto unknown, pyramid-shaped mountain peak was visible from the air, rising about 3,500 meters above sea level. When the plane turned around in the direction of Mirnyy, a mountain range was visible on the left side. In a latitudinal direction, the mountains extended eastward. Over 20 peaks and individual mountain massifs were discovered in this region. Nothing had been known before regarding the existence of these mountains.

As soon as the plane returned to Mirnyy, a heavy storm and snowfall began. A cyclone covering a huge area was approaching the antarctic coast from the Indian Ocean. Such deep cyclones are very infrequent in this area, especially during the Antarctic summer. Similar cyclones had not been recorded by the members of earlier Soviet expeditions. The wind velocity at Mirnyy and on Drygalski Island, where weather observations were being conducted, reached 40-50 meters per second. ("A Harsh Summer"; Moscow, Vodnyy Transport, 22 Jan 59)

Current Activities in Antarctica

Soviet scientists will continue their research activities in Antarctica during 1959. The transcontinental sled-tractor train which is to reach three poles -- south geomagnetic, south geographic, and pole of relative inaccessibility -- will start in 1959.

Part of the Fourth Antarctic Expedition has already begun its activities. Our group arrived in Mirnyy just before New Year's on the Ob'. The remaining expedition members arrived on 21 January on the ship Mikhail Kalinin. The latter group included a group of Polish scientists headed by Wojciech Krzeminski. Soviet pilots transported the Polish scientists by plane and helicopter to the station Oazis, transferred to the Polish People's Republic by the USSR government.

In the near future, the Mikhail Kalinin will take on board the members of the Third Antarctic Expedition who are returning to the USSR.

The staffs at the interior Soviet stations were recently replaced. The new staff at the station Vostok, which is to spend a year at the south geomagnetic pole, consists of workers of the Arctic and Antarctic Institute. V. Ignatov, geophysicist and Candidate of Technical Sciences, is chief of the station. He and Ya. Baranov, radioman, previously wintered at the drift station Severnyy Polyus-7 in the Arctic. A Semochkin, mechanic, took part in the operation of two drift stations in the Central Arctic; and D. Nizyayev, magnetologist, participated in a number of high-latitude expeditions of the Main Administration of the Northern Sea Route. The new staff which has taken over the station Vostok is continuing to operate under the IGY program. ("Preparations for Spring"; Moscow, Vodnyy Transport, 24 Jan 59)

Ice Reconnaissance in the Arctic

On 10 February, a Polar Aviation airplane piloted by S. A. Petrov took off from Leningrad for the Arctic. On board the plane was a group of scientific associates of the Arctic and Antarctic Scientific Research Institute, headed by A. L. Sokolov, Candidate of Geographic Sciences. The scientists will study the ice cover of the arctic seas.

During a period of 3 weeks, the "ice reconnaissance team" will have to fly over 30,000 kilometers under difficult weather conditions. ("Reconnaissance of Polar Ice"; Moscow, Sovetskaya Aviatsiya, 11 Feb 59)

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