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UNCLASSIFIED INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM -- SOVIET-BLOC ACTIVITIES

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Pokrovskiy on Engines for Space Craft

An article by Prof G. Pokrovskiy, Doctor of Technical Sciences, which appeared in Sovetskaya Aviatsiya and deals with engines for cosmic rockets, is based on materials in the foreign press. Discussing the possibilities of building thermal rocket engines, Prof Pokrovskiy states that one of the most important theoretical problems is finding the means for speeding up the velocity of the jet gases. He rejects some of the suggestions for achieving this, as for example, that of using unstable-type molecules, the so-called free radicals, as being inefficient and yielding too low an acceleration. As for the use of nuclear energy for additional heating of the jet gases, Pokrovskiy explains that the heated gas molecules move chaotically in all directions, not only forming a jet, but also striking the walls of the combustion chamber and heating them to such high temperatures that they melt and are destroyed.

Pokrovskiy suggests a method of controlling the movement of the molecules involving the producing of ions through preliminary heating of the molecules. This means that the thermal jet engine would need to be replaced by an electric accelerator of elementary particles. The ions can be made to move in strong electrical fields. This is the ion rocket. It consists of an ion accelerator, the electric power for which would be produced from a compact atomic power plant in the body of the rocket. A possible obstacle to such a rocket is that the rocket and the ion stream will have opposite electrical charges which will cancel one another. This can be avoided by simply using two accelerators in the rocket, one emitting positive and the other negative ions.

It should be remembered that, in certain cases, the presence of a considerable electrical charge on a space craft can be a significant factor in space navigation, says Pokrovskiy. As is known, there are magnetic and electrical fields of force in the Universe which can be used for moving a space ship if a sufficiently large electrical charge (positive or negative) is imparted to it.

Pokrovskiy then discusses the photon rocket, saying that all present designs for such rockets are infeasible in that the photons cannot be controlled and given direction. They move chaotically, as do the heated molecules. Therefore, all plans of making a photon rocket are useless until this problem is solved.

The most promising form of rocket power, in view of present technical conditions, is the prospect of using the ion motor. This does not mean, says Professor Pokrovskiy, that the ion motor will completely supplant the thermal rocket motor. The latter will, no doubt, fully retain its value for slowly moving rockets and for the first stages of cosmic rockets. The ion rockets themselves will be used as the last stages of rockets intended for flights beyond the limits of the solar system. ("Cosmic Rocket Motors," by G. Pokrovskiy; Moscow, Sovetskaya Aviatsiya, 7 Aug 59, p 4)

II. UPPER ATMOSPHERE

Measurement of the Polarization of Skylight

The measurement principle, design, and operation of a new photoelectric polarimeter is described. The instrument operates together with a secondary electron multiplier and gives the degree of polarization immediately and directly. The special measuring procedure eliminates the influence of the sensitivity fluctuations of the multiplier on the measurement results.

The general design and the mechanical and electrical assembly of the measuring device were done by H. Krecker, special mechanic at the Gotha Research Station. His predecessor, K. Eichler, built the amplifier.

Sekera and his associates (Investigation of Polarization of Skylight, Final Report (1955), Contract No AF 19(122)-239) developed independently, at about the same time, a recording polarimeter which operates on a very similar principle. ("The Measurement of the Polarization of Skylight by a Photoelectric Quotient Method," by G. Dietze, Gotha Research Station; Berlin, Zeitschrift fuer Meteorologie, No 11/12, Nov/Dec 58, pp 344-352)

III. METEOROLOGY

Soviet Book on Aperiodicity of Synoptic Processes

The 196-page book Preyemstvennost' Nekotorykh Tipov Sinopticheskikh Protsessov (The Aperiodicity of Certain Types of Synoptic Processes), by E. A. Isayev, published in 1958 by Gidrometeoizdat, Leningrad, presents an exhaustive treatment of the data and evidence to support the theory of the aperiodicity of synoptic processes.

Chapter 1, which presents a general survey of the literature, discusses the Shuleykin theory of thermobaric waves, the dynamic peculiarities of waves and of synoptic processes, the application of peridogrammic analysis in meteorology, and a study of the rhythmic, as well as the aperiodic, properties of synoptic processes, including the rhythmic properties of synoptic processes according to B. P. Mul'tanovskiy.

Chapter 2 gives a brief account of the mechanisms of atmospheric circulation and discusses the interrelationship of activity centers and the mechanism of cold and heat waves from the viewpoint of rhythm (periodicity) or aperiodicity.

Chapter 3 discusses the aperiodicity of the various types of seasonal circulation.

Chapter 4 and Chapter 5 discuss the aperiodicity of the microsynoptical processes, which lead, in both spring and fall, to steady changes of temperature through 0 degrees, and divide these processes into four classes: early-accelerated, early-retarded, late-accelerated, and late-retarded.

Chapter 6 points out the aperiodicity of certain types of seasonal circulation leading to a drop of temperature over the European territory of the USSR and in Western Siberia. The discussion includes the aperiodicity of ultrapolar synoptical processes.

Chapter 7 gives synoptical data, including charts of the recurrence of cyclones and anticyclones. The probability of aperiodicity of synoptical processes and the probability of the recurrence of temperature within certain limits in the case of different types of processes are discussed.

Chapter 8 discusses the aperiodicity of synoptical processes which lead to a rise in temperature over the European territory of the USSR and Western Siberia. The aperiodicity of heat waves caused by southern processes and by western processes are emphasized.

An appendix gives 14 pages of data on which the probability of aperiodicity was established.

Machine Weather Forecasts Being Developed

The day is not far off when weather forecasts will be made entirely with the aid of machines, says L. Pubanova, in Sovetskaya Aviatsiya, in reporting on a trip to the Central Institute of Forecasts, where new, more accurate methods of weather prediction are being developed.

The idea of making meteorology a precise science was advanced 40 years ago. Standing before scientists was the problem of giving weather forecasts by a quantitive method. This was accomplished by the use of mathematical equations describing the physical processes involved. Solving these equations makes it possible to obtain a representation of how these processes take place.

The first attempt to work out equations was attempted in the 1920s but was not successful. A number of difficulties confronted researcher, one of which was that science lacked sufficient data on the different states of the atmosphere. In addition, technology was not sufficiently advanced to be able to quickly solve the complex equations.

The first correct approach toward the solution of this problem was made by the Soviet scientist Prof I. A. Kibel'. He succeeded in defining the most essential of the factors which form weather and, for the first times, pointed out a practically admissible method of solving equations for a short-range forecast.

The use of high speed computers made the rapid solution of difficult equations possible.

Specialized computers, designed for the solution of a specific class of problems, are now gaining wide circulation, along with universal computers. One such machine is the "Pogoda," which is being operated by the Central Institute of Forecasts.

The Pogoda contains about 400 tubes, several thousand semiconductor diodes, etc. The machine automatically carries out operations of addition, subtraction, derivation of square roots, etc. It produces calculations of certain elements of the weather necessary for the compilation of forecasts for different periods of time.

A system of command is employed by the machine, consisting of 14 instructions. Mathematical operations with five-digit numbers are carried out at a speed of 200 operations per second.

Engr P. Potievskiy described the machine's operation in calculating weather forecasts. Initial numerical material is placed on tape with the aid of a special code and is transferred by means of a keying device into a perforator by the operator. Here, the material is automatically placed on another tape. Two identical perforated tapes are prepared independently of each other in order to avoid errors in plotting. A control-reading device automatically checks them; the tapes pass under photodiodes and, in the case of an error, are stopped. The errors are corrected. Instructions to the machine, that is, the program of its operation, are plotted on these same perforated tapes. Then, the prepared tapes are introduced into the input device of the machine. If the results are the final aim of the solution of the problem, then they are given out by a printing apparatus. If these same results are only initial data for another problem (intermediate results), then they are placed in the machine for further calculations.

An enormous quantity of operations (over a million) are necessary for the solution of one of the problems of forecasting and require about 2 hours. However, the mathematical possibilities of the machine are still not exhausted. ("A Machine Will Compute Weather Forecasts," by L. Rubanova; Moscow, Sovetskaya Aviatsiya, 5 Aug 59, p 4).

New Soviet Instrument for Determining the Turbulent Flow of Heat

A new apparatus for direct measurement of the turbulent flow of heat by the pulse method was developed in the Institute of the Physics of the Atmosphere. The results of testing the instrument are given. The apparatus makes it possible to obtain directly the value of the turbulent flow of heat owing to the linearity of the transducers (acoustical microanemometer and a pulse resistance thermometer) being used and with the use of a correlometer. Pulse measurements are accompanied by gradient measurements.

Dimensionless empirical functions, entering in the formula for determining the turbulent flow of heat according to the data of gradient observations, are constructed. The case of unstable stratification is studied, and the value of a universal constant characterizing the regimen of free convection close to the value found by Priestley ("Free and Forced Convection in the Ground," Quart. Jour. Roy. Meteorol Soc., No 348, 1955, p 81), is obtained. ("Determination of the Turbulent Flow of Heat," by A. V. Perepelkina, Institute of the Physics of the Atmosphere, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 7, Jul 59, pp 1026-1035)

Electrical Charges of Cloud Droplets

The results of the investigation of the distribution of electrical charges in natural clouds in relation to the time of their existence are presented by A. P. Sergieva, Institute of Applied Geophysics, Academy of Sciences USSR. It is shown that the charges of the droplets affect their coagulation. The preferential charging of the cloud droplets is related to the ratio of the concentration of ions in the air during the period preceeding the formation of the cloud. ("Electrical Charges of Cloud Droplets," by A. P. Sergieva; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 7, Jul 59, pp 1018-1025)

Spider Webs No Longer Mar Operation of Potsdam Vertical-Current Measuring Device

The vertical-current meter described by the author in 1952 (Zeitschrift fuer Meteorologie, Vol 6, 1952, p 271) operated incorrectly during the summer months as a result of spider webs in the pick-up mechanism. Ordinary measures to keep the device free of spider webs met with only limited success. In a new pick-up device, those portions of the instrument which are vulnerable to spider webs now rotate, tearing apart the webs as they are formed.

The time constant of the pick-up device was also calibrated for the mean atmospheric conductivity value at the ground in Potsdam. This latter value is $1.1 \cdot 10^{-16}$ $Ohm^{-1}cm^{-1}$; the time constant for the air at the ground in Potsdam is, therefore, 805 seconds. ("Improvement of the Pick-Up Device of the Potsdam Vertical Current Instrument," by E. von Kilinski, Main Meteorological Observatory, Potsdam; Berlin, Zeitschrift fuer Meteorologie, No 11/12, Nov/Dec 58, pp 352-354)

Origin of Vertical Movements in the Atmosphere

In an article, the text of a lecture delivered at a section meeting of the East German Meteorological Society in Leipzig on 27/28 November 1958, the origin of vertical movements is approached from the equation of motion in vectorial form, from which, through individual derivations according to time, a relationship is obtained which indicates which variables can effect the initiation of vertical motions. These variables are: divergence and its vertical distribution, the vertical change of the horizontal wind, the ageostrophic portion of the north-south component of the wind, and the heat sources. ("On the Question of the Origin of Vertical Movements," by K. Kohlsche, Institute for Large-Scale Weather Research, Potsdam; Berlin, Zeitschrift fuer Meteorologie, No 11/12, Nov/Dec 58, pp 339-344)

Observation of a Luminous Column in the Atmosphere in Wittenberg in December 1958

Following is the text of a report on the observation of a luminous column at Wittenberg, East Germany, on 22 December 1958.

"I. The weather at the time of the observation: clouds --; 1/10 Cirrus densus, 8/10 As tra (altostratus translucent), Ac tra (altocumulus translucent), and lenticular; wind at the ground -- NE 1 Bf (Beaufort); visibility -- 2 kilometers.

"II. Condition of the sky: The entire sky was covered with an altostratus-altocumulus layer which was open only in the southeast. Here, there were dense cirrus clouds and individual altocumulus-lenticular clouds.

"With all types of clouds, the structure showed clearly a uniform direction from northeast to southwest.

"III. The light column: It appeared in the above-mentioned southeast direction, 0810 hours: From about 10 degrees to approximately 30 degrees above the horizon, a bright vertical streak appeared in the sky and slowly became brighter and brighter.

"0813 hours: About 20 degrees above the horizon, i.e., in the middle of the streak, an oval spot began to form in the horizontal position.

"0815: The phenomenon was completely formed. The parhelion-like spot was a brilliant white light. Its brilliance remained constant. The column of light, on the other hand, showed the colors of the rainbow, but the red and yellow were considerably dominant. The column light was somewhat darker than that of the spot, and the light of the column fluctuated in intensity several times from pronounced bright colors to a pale white light. Both ends of the column were obscured by the altostratus-altocumulus layer.

"0818: The fading out began. The lower part of the column faded first.

"0820: The bright spot faded out of sight.

"0822: The upper portion of the column also vanished. The progressive vanishing of the phenomenon from bottom to top might well have been caused by the rising sun.

"0828: The sun was visible over the horizon.

"From the time of the beginning of the observation until the sun had risen, the entire cloud cover showed a bright red color which extended in all directions almost to the horizon." ("Observation of a Luminous Column on 22 December 1958 in Wittenberg," (observer) Schuetze; Zeitschrift fuer Meteorologie, No 11/12, Nov/Dec 58, p 373)

IV. SEISMOLOGY

Study on Diffraction of P-Waves in Earth's Core

The possibility of estimating the shear modulus of the Earth's core on the basis of studying the character of the decrease in the amplitudes of P-waves in the shadow zone is considered. The investigations were conducted by a method of modeling because of the considerable difficulties arising in theoretical considerations of the diffraction of seismic waves in the Earth's core.

The studies revealed the possibility of estimating the shear modulus of the Earth's core (near its boundary with the mantle) according to the character of the P-waves diffracted in the core. It was shown that this value is close to zero or, in any case, less than 10^7 dynes per square centimeter. ("P-Waves Diffracted in the Earth's Core and Hardness of the Earth's Core," by L. N. Rykunov, Moscow State University imeni M. V. Lomonosov; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 7, Jul 59, pp 956-964)

V. OCEANOGRAPHY

Chinese Studies on Tidal Currents

An article, designated as "Research Report No 81 of the Institute of Oceanography, Academia Sinica," states that the institute, in June 1958, launched the third and fourth series of synchronized, continuous 24-hour observations from 48 observation points established in the Gulf of Chihli and the western part of the Northern Yellow Sea. Two research vessels of the institute, the Chin-hsing (金星号) and the Shui-hsing (水星子), were used. The sea current at the surface and at depths of 5, 10, 15, 20, 30, 40, and 50 meters, as well as close to the sea bottom, were measured with different types of current meters. The data thus obtained were used to determine the characteristics and the distribution systems of the tidal currents in the area under study. A method for compiling a perpetual tide table is discussed.

The authors mention two previous series of continuous 24-hour observations which were made from these stations in March and June 1958, respectively. ("The Distribution System and the Forecasting of the Tidal Currents of the Gulf of Chihli and the Western Part of the Northern Yellow Sea," by Yu Fang-hu (尤芳湖), Cheng I-fang (鄭义芳), and Pien Chia-ch'i (卞家漢), Institute of Oceanography, Academia Sinica; Peiping, K'o-hsueh T'ung-pao (Scientia), No 13, 11 Jul 59, pp 433-434)

VI. ARCTIC AND ANTARCTIC

Soviet Scientist Reports Warming of Arctic Weather

L. S. Petrov, scientific associate of the Hydrometeorological Institute, recently wrote his dissertation for the academic degree of Candidate of Geographical Sciences. In this dissertation, he makes the following statements: "...During the past 50 years, there have been four periods (waves) of warmer weather, of about equal duration, in the European-Asian sector of the Arctic. The first and most pronounced of these warmer periods began in 1915-1916 and reached its highest point within 5 years.

At present, the average annual temperature at all polar stations is higher than before the beginning of the last "warmer period." For example, in Barentsburg, the average temperature of the 6-month winter season during the past 5 years was 7-8 degrees higher than about 50 years ago. On Spitsbergen, on Zemlya Frantsa Iosifa, and in the northern part of Novaya Zemlya, the maximur average annual temperatures for the 20th Century were recorded during 1952-1956."

Petrov notes that the rise in temperature in the high latitudes of the Northern Hemisphere has been exceptional in the last 200-300 years, both as to its extent and consequences. As a result, the glaciers have rapidly retreated to the north, there have been changes in the flora and fauna of the Arctic, the ice regime of the seas has changed, and conditions of navigation have improved.

L. S. Petrov is of the opinion that the period of warmer weather has now reached its highest point; in a number of regions, temperatures have dropped. In the next few decades, cold and warm periods will probably alternate. ("The Arctic Is Getting Warmer," Leningradskaya Pravda, 26 Jul 59)

Activities in Antarctic

On 26 July, the present staff at Mirnyy completes 6 months of work in Antarctica. The present antarctic winter is more severe than it was last year. The average temperature at Vostok is minus 70 degrees centigrade. At the newly built station Lazarev, heavy snowstorms and hurricane winds have covered the buildings with snow. However, work at all stations is proceeding successfully. The scientific groups and teams of the expedition have obtained much valuable information on the nature of Antarctica.

The Mirnyy observatory maintains regular radio contact with many foreign scientific stations in Antarctica. Weather reports are exchanged daily.

Early in May, Soviet pilots flew to the Australian station Wilkes, about 800 kilometers east of Mirnyy, on Knox Land, to bring medical aid to one of the Australian scientists. The flight was made under extremely difficult conditions. The plane had to fly over mountains which were considerably higher than indicated on existing maps. (Such instances happen frequently in Antarctica. Even now, after 3 years of persistent explorations by many expeditions, the relief of the continent is still less known than that of the moon.) ("Antarctic Winter," Moscow, Vechernyaya Moskva, 25 Jul 59)

Winter Operations at Soviet Stations

During the first half of the antarctic winter, the weather at Mirnyy and at the new station Lazarev, 3,500 kilometers west of Mirnyy, was extremely windy. There were continuous snowstorms. All of the buildings at Mirnyy, except a few situated on elevated spots, and at Lazarev, were covered by snowdrifts.

The staff members at Mirnyy now consider that the weather is calm if the wind velocity is 15 meters per second. Frequently, the winds reach hurricane force. At such times, it is impossible to walk from one building to the next without holding on to the cables strung between them.

At the interior station Vostok, the air temperature recently dropped to minus 79.5 degrees centigrade. In such weather, it is hard to remain outdoors for more than 15-20 minutes. Breathing is possible only with special masks. Kerosene freezes, and diesel fuel becomes so thick that it cannot be pumped. The rubber casings of radiosondes crumble like glass at the slightest vibration. Despite these difficult conditions, the ten Soviet polar scientists headed by V. S. Ignatov, Candidate of Technical Sciences, are conducting regular complex scientific observations. Most of the scientific instruments at Vostok have been converted to remote-control operation.

In addition to planned research activities, a large number of observations are being conducted in Mirnyy, with the joint efforts of several teams.

The aerometeorological team, headed by V. I. Shlyakhov, Candidate of Sciences, has been studying the velocity of winds blowing off the interior (stochnyye vetry) at several remote points and at different altitudes. For this purpose, radar was used, in addition to anemometers. Observations of ice temperature at various depths were conducted, together with the glaciological team.

The aerometeorologists and machine shop workers constructed and set up an original "over-all" (summarnyy) snowstorm meter (metelemer). This instrument enables one to study the movement of snow during snowstorms, with different wind velocities and at different altitudes.

During a 2-month period, expedition members worked on Drygalski Island, 90 kilometers from Mirnyy. The climate and weather conditions on this island are very different from Mirnyy and even more different from the interior regions. The studies made on the island are of great interest. In the center of the island, a 43-meter hole was drilled for recording the temperature in various layers of the glacier. These observations, conducted parallel to those at Mirnyy, will provide new material for comparisons of weather in regions "at sea" (moristyye) and coastal regions.

For the first time, observations of auroras with the help of radar were organized at Mirnyy. Reflections of auroras can be observed in Mirnyy mainly from the region where the Australian station Wilkes is located (about 800 kilometers east of Mirnyy). Contact was established with this station, and it was decided to conduct joint studies of auroras.

The fall-and-winter interior expedition with "Pingvin" snow vehicles and trailers was completed successfully. A group of geophysicists, headed by S. N. Shcheglov, had to overcome great difficulties during this trip. Continuous snowstorms, strong winds, and temperatures of minus 40 degrees centigrade or even lower presented almost insurmountable obstacles. The members of the traverse party conducted a large number of meteorological, glaciological, and general geographical observations. They traveled 150 kilometers from Mirnyy and reached an altitude of over 1,500 meters above sea level. The whole trip lasted 78 days.

The transantarctic expedition to the three poles, i.e., the south geographic, south geomagnetic, and pole of relative inaccessibility, will take place during the spring and summer season of 1959-1960 and will complete the work of the present staff of the Antarctic Expedition. The traverse will be carried out with three "Khar'kovchanka" snow vehicles and one heavy tractor from the station Komsomol'skaya, where the snow vehicles are now located.

The aviation team under B. V. Osipov has given strong support to the scientists during the first half of the winter. The planes are now being prepared for spring and summer flights. In the near future, as soon as calm weather sets in, some of the planes will be transferred to the shore ice.

The Fourth Antarctic Expedition is considerably exceeding its work plan under the program of the IGC-1959. An extensive exchange of information with foreign antarctic stations is continuing. -- A. Dralkin, Chief of the Expedition ("On the Sixth Continent," Moscow, Pravda, 16 Aug 59)

The Work of the Czechoslovak, Antonin Mrkos, in the Antarctic

The large-scale action of the International Geophysical Year has given rise to lively interest in research work in the Antarctic. A whole series of scientific expeditions have been sent there by various countries, that of the Soviet Union occupying a foremost place with regard to its equipment and the extent of scientific work carried out.

Owing to extensive support and understanding by the Soviet Union, Czechoslovakia was enabled to participate in this great work by sending scientific worker Antonin Mrkos in the Third Soviet Antarctic Expedition, at the suggestion of the Czechoslovak Committee for the IGY. His task was to carry out the Czechoslovak program of observing airglow and twilight phenomena under the difficult Antarctic conditions. A. Mrkos left Czechoslovakia on 5 October 1957 and returned home, after 19 months, on 5 May 1959.

Observation of airglow and twilight phenomena, as well as aurora, was carried out by A. Mrkos at the Soviet Antarctic Station, Mirnyy, with an adapted photo-electric photometer of the same type that is used in Czechoslovakia at the Lomnicky Stit and Ondrejov stations. Before his departure, the necessary tests were carried out with his instrument and a comparison made with the photometer at Lomnicky Stit. The actual measurements in the Antarctic were carried out from September 1957 to mid-October 1958, when the Polar night ended. The results of the observations include measurements from 94 nights and 67 twilights and are now being processed and prepared for publication.

Apart from the above-mentioned work, A. Mrkos accompanied Soviet scientists on a march of 2100 kilometers into the interior of Antarctica, from mid-October to the end of December 1958. During this journey, they made, primarily, meteorological observations and ensured astronomical navigation.

On 30 January 1959, A. Mrkos sailed on the ship "Ob" to the coast of Queen Maud Land, where he took part in building the new Soviet Antarctic station "Lazarev." He left the Antarctic for home on 10 March 1959, continuing his observations of airglow and twilight phenomena right up to the coast of Great Britain, where fogs then made this impossible. He arrived at Murmansk on 20 April 1959, from which he returned, through Moscow, to Czechoslovakia.

It should be said, in conclusion, that the program drawn up for A. Mrkos by the Czechoslovak Committee for the IGY before his departure for the Antarctic was completely fulfilled. ("The Work of the Czechoslovak, Antonin Mrkos, in the Antarctic," by Jan Picha, Studia Geophysica et Geodaetica, No 3, 1959, pp 295-296)

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