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PLEASE NOTE

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SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Soviet Scientist on Cosmic Ray Studies With Satellites

L. Kurnosova, Candidate of Physicomathematical Sciences, Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR (Moscow), in an article entitled "Certain Results of Investigation Using Artificial Earth Satellites," writes as follows on the intensity of cosmic rays.

"The problem of measuring the intensity and the variation of the intensity of cosmic rays was set forth in a number of other scientific problems with the aid of Sputnik II.

"Two halogen cosmic ray counters installed in the satellite made it possible to measure the full flow of cosmic rays at different altitudes, the variation of intensity with latitude, and also the so-called variation of the intensity of cosmic rays, that is, the variation of the intensity with time. The magnitude of the variations in the intensity of cosmic radiation has a significant value, both for the solution of problems concerning the origin of cosmic rays, as well as for investigating the character of the emission of corpuscular flows by the Sun and an understanding of the nature of the magnetic storms associated with them.

"Up to now, variations of the intensity of cosmic rays were investigated mainly on the surface of the Earth, that is, the variations of secondary radiation, a considerable part of which are brought about by the influence of meteorological factors, were studied. At the same time, the intensity of low energy particles most subject to changes, were studied. But these particles almost never enter in the flow of charged particles near the surface of the Earth. Therefore, studying the variation of cosmic rays on the surface of the Earth does not give the opportunity to register all variations of cosmic rays which exist. It should be noted, however, that measuring variations at different altitudes on the basis of theoretical presentations developed by the Soviet physicists Ye. L. Feynberg and L. I. Dorman, it is possible to exclude the influence of meteorological factors and to determine the variations of the primary flow of cosmic rays. But such measurements require a wide network of stations, and the results obtained are associated with a number of hypotheses, the correctness of which in certain cases requires experimental confirmation. Therefore, it is clear that the study of the variations of cosmic rays by other methods cannot rival their study by a satellite. Work on cosmic rays was conducted by S. N. Vernov, corresponding member of the Academy of Sciences USSR, and N. L. Grigorov, Yu. I. Logachev and A. Ye. Chudkov, scientific associates of the Moscow State University.

"The installation of instruments in the satellite made it possible to secure in principle the different variations of the intensity of cosmic rays.

"Processing the results of the measurements of cosmic ray intensities, verified with the aid of counters, made it possible to show the relationship of the number of particles to altitude at great distance from the Earth's surface. It is well known that the curve of relationship of the intensity of cosmic rays to altitude has a characteristic form: up to an altitude of approximately 20 kilometers an increase in intensity is observed; after 20 kilometers, it falls; and beginning with 40 kilometers it remains approximately constant. The data obtained with the aid of the satellite showed that with an altitude of the satellite up to 700 kilometers, an increase in the intensity of cosmic radiation was observed of approximately 40 percent in comparison with that observed at an altitude of 200 kilometers.

"The increase in intensity at altitudes greater than 200 kilometers which were covered by the satellite was dependent on two factors. The "screening" action of the Earth decreased in proportion to the distance the satellite traveled away from its surface. This is due to the fact that cosmic ray particles, despite their tremendous energies cannot travel through the Earth's mass. Therefore, only the cosmic rays 'from above' are registered. Actually the cosmic rays in space arrive from all directions almost uniformly (that is to say, cosmic rays in space are distributed isotropically). Consequently, an instrument moving in space away from a planet will record twice as many particles as the same instrument at a distance of several tens of kilometers from the surface of the Earth. This variation in the number of particles registered by the instrument takes place gradually, with respect to its travel away from the Earth. At a distance of 1,500 kilometers, the increase in intensity, owing to this factor, consists of $\sim$15 percent.

"The other reason for the increase in intensity is that the deflecting action of the Earth's magnetic field has a bearing on what level over the Earth's surface the particles will reach. The closer the level is to the Earth's surface, the greater the deflecting action, and the less the number of particles reaching the level. Hence, it is clear that the higher the altitude over the Earth, the greater will be the number of particles penetrating the magnetic field and reaching the instrument.

"As a result of experiments on the satellite, data on the relationship of the number of particles to latitude and longitude were also obtained. It is now possible to draw certain conclusions concerning the fact that lines of equal cosmic ray intensity do not coincide with the geomagnetic parallels, as expected on the basis of theory. Thus, there exists a divergence between characteristics of the Earth's magnetic field obtained on the basis of studying cosmic rays by the satellite, on the one hand, and as a result of measuring the magnetic field on the surface of the Earth, on the other. During the satellite's flight, the instruments recorded a sharp change in the intensity of cosmic rays,

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while the ground station registrations of cosmic rays did not disclose any marked variations of intensity. It is possible that this phenomenon is associated with the generation of low-energy particles by the Sun which are highly absorbed by the Earth's atmosphere.

"Future systematic study of the intensity of cosmic rays and its changes with time, with the aid of instruments installed in satellites, will make it possible to solve a number of interesting and important problems connected with the origin of cosmic rays and how they reach us on Earth." (Priroda, No 6, Jun 58, pp 85-86).

West German Data On Sputnik I Published

The text of a review by J. J. Wisotzki of a monograph entitled Radiobeobachtungen des ersten kuenstlichen Erdsatelliten (Radio Observations of the First Artificial Satellite of the Earth), by W. Priester, H. J. Bennewitz, and P. Lengruesser, (38 pages, 21 illustrations, Westdeutscher Verlag Koeln and Opladen, DM 8.50), reads as follows:

"Four months after the launching of the first Soviet earth satellite, the first survey report on the most essential observation is now available.

"The results of observations of the observatories of the Physics Institute of the University of Bonn, of the Electrophysical Institute of Munich Technische Hochschule, and of the Darmstadt Radio Control Testing Station were compiled and collectively evaluated. The observation and data processing stations were organized and equipped for observing the planned US satellite. The conversion was effected rapidly, however, with the result that valuable data was collected.

"From the measurement of the Doppler effect and of the received field strength of the two satellites, conclusions could be drawn on the orbital elements and their change through air resistance and precession. For example, an air density of $4.7 \cdot 10^{-13}$ g cm^{-3} was determined for an altitude of 225 kilometers.

"The test results (in part as reproductions of the original oscillograms), the method of evaluating them, and the results [of the evaluation] are given in the report.

"The presentation is attractive and affords a good insight into the treatment of the problem." (Berlin, Experimentelle Technik der Physik, Vol 6, No 2, 1958, p 94)

First Soviet Photographs of Sputnik III Taken in Moscow

"The first successful photographing of both Sputnik III and its carrier rocket by Moscow observers was done on the night of 8 August.

"The photographing was performed by Yu. Sentsova and R. Khatnik, workers of the Station for Photographic Observations of the Astronomical Council, Academy of Sciences USSR. The photographs turned out well. They give an accurate presentation of the satellite's location in orbit." (Moscow, Izvestiya, 9 Aug 58)

II. UPPER ATMOSPHERE

Meteor Echoes Observed at Ashkhabad

Observations of meteor activity under the IGY program conducted in Ashkhabad in 1957 are described in a Turkmen scientific journal under the title, "Radar Observations of Meteor Activity in Ashkhabad from July to September 1957," by Yu. L. Truttse, A. Khanberdyyev and A. T. Belous, Institute of Physics and Geophysics, Academy of Sciences, Turkmen SSR. Tables showing the number of meteor echoes recorded are presented. A complete translation of the article follows.

"Regular radar observations of meteor activity according to the IGY program were begun on 1 July 1957 in the Ashkhabad Astrophysical Laboratory (Ashkhabad, Garden of Kesh, longitude 3 hours 53 minutes 23 seconds, latitude 37°57'). The following parameters of meteor activity were registered: (1) the number of meteor echoes per unit of time; (2) the moment of the meteor's flight; (3) the slant range; and (4) the duration of the echo.

"Observations were conducted on a standard radar apparatus with a pulse power of 80 kilovolts, a carrier frequency of 72.0 megacycles, and a pulse repetition rate of 50 cycles per second. A seven-element "Yagi" type antenna inclined toward the horizon at an angle of 22 degrees was used. The antenna was directed to the west. The center point of the antenna was located at a height of two wave lengths. The installation is equipped for automatic operation, ensuring the starting and stopping of the apparatus in cases of the [illegible] down of the electric network in the absence of observers. The voltage feeding the equipment is stabilized.

"The registration of meteor echoes was performed with a photographic attachment manufactured by the Khar'kov Polytechnic Institute. This attachment ensures a sufficiently reliable selection of meteor echoes amid noises. The registration is made on type RF-3 motion picture film. During observations, distance markings for every 50 kilometers and time markings from a chronometer are automatically registered on the film. Each hour on the film is plotted with the aid of an imitator of the markings of artificial meteor echoes of standard duration. This makes the determination of the duration of the echoes possible. Film speed is 310 millimeters per second. The film speed was increased in comparison to that recommended with the aim of decreasing the general background noises.

"During the period July to September 1957, observations were conducted for 630 hours. The observation conditions were rather unfavorable because of the high noise level, particularly in the daytime. In all, 1,760 meteor echoes were observed Of these, 115 had a duration of more than one second. The number of meteor echoes per hour for each month are given in the following tables.

Table 1. July 1957

GMT	01	02	03	04	05	06	18	19	25	26	27	28	$\bar{n}$
00-01	--	1	4	--	4	1	--	0	4	--	2	0	2.00
01-02	--	5	--	--	1	5	--	1	7	--	2	0	3.00
02-03	--	8	4	--	1	5	--	1	4	--	2	--	3.58
03-04	--	--	2	--	1	7		2	5	--	2	--	3.17
04-05	--	3	8	--	2	4	--	1	5	--	2	--	3.58
05-06	--	3	13	--	4	0	--	1	6	--	1	--	4.00
06-07	6	4	11	--	2	2	--	1	3	--	2	--	3.88
07-08	2	3	2	--	1	4	--	1	4	--	2	--	2.38
08-09	1	--	--	--	2	0	--	0	2	--	0	--	0.83
09-10	0	--	--	--	0	0	--	0	6	--	0	--	1.00
10-11	0	--	--	--	0	0	--	1	9	--	2	--	2.14
11-12	2	--	--	--	3	0	--	--	3	--	1	3	1.67
12-13	4	4	1	--	1	--	--	--	7	2	1	1	2.86
13-14	2	4	1	--	1	0	3	--	6	3	4	--	2.67
14-15	6	0	--	--	0	3	1	--	0	6	--	--	3.00
15-16	7	0	--	--	1	2	3	--	3	1	--	8	2.75
16-17	5	0	--	--	2	--	6	--	0	1	1	5	2.38
17-18	3	--	--	--	2	--	5	--	0	2	1	4	2.00
18-19	--	--	--	--	1	--	2	--	0	3	3	1	1.67
19-20	--	4	--	3	3	--	3	--	--	4	6	1	4.00
20-21	2	5	--	2	2	--	2	--	--	0	4	5	2.25
21-22	3	4	--	3	0	--	5	--	--	--	--	1	2.67
22-23	1	3	--	4	0	--	3	--	--	0	0	1	1.38
23-24	2	4	--	4	2	--	2	--	--	2	0	0	2.38
-- $\bar{n}$	2.87	3.18	5.11	3.20	1.35	2.2	3.18	0.82	3.9	2.16	1.81	2.36	

CPYRGHT

Table 2. August

GMT	03	04	05	06	07	10	11	12	13	14	15	25	26	n
00—01	—	—	0	—	—	5	13	13	—	—	7	—	—	7,60
01—02	0	1	5	—	2	1	8	6	—	10	—	—	—	4,13
02—03	2	4	5	—	7	2	3	7	5	9	—	—	—	4,89
03—04	1	3	3	0	3	2	—	3	7	7	—	—	—	3,22
04—05	3	—	—	1	—	5	9	5	2	3	—	—	—	4,00
05—06	0	7	5	3	1	4	12	—	—	1	—	—	—	4,13
06—07	—	7	8	4	4	4	—	6	—	—	—	—	—	5,50
07—08	8	7	0	1	—	7	3	3	5	5	—	—	—	4,34
08—09	1	1	0	4	3	5	6	5	9	3	—	—	—	3,70
09—10	—	0	5	3	5	8	7	3	7	4	—	—	—	4,67
10—11	—	3	—	4	1	4	9	3	2	1	—	—	—	3,38
11—12	5	2	2	3	8	4	4	3	8	1	—	—	—	3,00
12—13	4	—	7	—	—	5	—	—	—	—	—	—	—	5,34
13—14	—	—	2	—	3	5	8	5	4	3	—	10	—	5,00
14—15	8	—	6	5	3	—	2	7	5	4	—	4	—	4,84
15—16	4	2	3	4	2	15	1	4	5	5	—	4	—	4,40
16—17	6	1	3	2	—	5	1	11	—	1	—	5	—	3,89
17—18	7	—	—	3	3	4	1	6	—	—	—	0	6	3,75
18—19	—	5	—	—	1	4	2	9	—	0	—	6	2	3,63
19—20	2	5	—	—	—	8	6	—	—	12	—	7	2	6,00
20—21	2	4	—	2	2	7	5	8	12	8	—	—	—	5,56
21—22	3	6	1	2	—	—	—	8	7	4	—	—	—	4,43
22—23	1	3	—	2	—	—	—	2	6	—	—	—	—	2,80
23—24	2	4	—	2	—	19	6	7	5	5	—	—	—	6,25
n'	3,28	3,61	3,44	2,6	2,86	5,85	5,58	5,91	5,00	4,53	—	5,15	3,34	

Table 3. September

GMT	01	04	12	13	14	18	19	20	21	22	23	24	25	26	27	30	n
00—01	—	—	—	—	1	4	—	2	—	2	—	3	2	—	1	—	2,00
01—02	—	—	—	—	0	—	—	3	—	0	—	3	0	—	1	1	1,14
02—03	—	—	—	—	1	6	—	—	—	1	—	2	—	—	0	2	2,00
03—04	—	—	—	—	—	2	—	—	—	—	—	—	—	—	1	2	1,67
04—05	—	—	—	—	—	2	5	—	—	1	—	—	—	—	0	—	2,00
05—06	—	—	4	—	2	1	—	0	2	2	—	—	—	—	1	—	1,73
06—07	—	—	7	—	2	3	4	0	1	1	—	—	—	—	0	—	1,87
07—08	3	—	2	—	5	1	0	1	1	2	—	3	—	—	1	—	1,90
08—09	6	—	5	—	—	3	1	—	0	—	—	4	—	—	1	—	2,86
09—10	—	—	9	—	—	—	—	—	—	—	—	2	—	—	—	—	5,50?
10—11	—	—	—	—	—	—	—	—	—	1	—	3	—	—	—	—	2,00
11—12	—	—	—	—	—	3	—	2	—	1	—	3	—	—	1	—	2,00
12—13	—	—	—	—	—	—	—	3	—	0	—	—	—	—	1	—	2,00
13—14	—	—	—	—	—	—	0	3	—	0	—	—	—	—	1	—	1,00
14—15	—	—	—	—	—	—	3	3	—	1	—	—	—	—	—	—	2,33
15—16	—	—	—	3	—	—	1	—	—	—	—	—	—	1	—	—	1,67
16—17	—	—	—	—	—	—	0	—	—	—	—	—	2	1	—	0	0,75
17—18	—	—	—	—	—	—	1	—	4	—	2	—	1	2	1	0	1,57
18—19	—	—	—	—	—	—	2	—	3	—	3	—	3	2	1	1	2,14
19—20	—	—	—	—	—	—	1	—	—	—	3	—	2	1	2	1	1,67
20—21	—	—	—	2	—	—	3	—	—	—	4	—	0	1	0	1	1,57
21—22	—	—	—	—	—	—	3	0	—	—	2	1	—	1	0	0	1,00
22—23	—	5	—	2	—	—	0	—	1	—	6	1	—	1	1	1	2,00
23—24	—	—	—	1	—	—	0	—	3	—	6	1	—	3	0	0	2,00
n'	4,50	—	5,10	2,0	1,83	2,78	—	1,40	1,89	1,88	1,0	3,72	2,36	1,43	1,45	0,74	0,82

"In tables 1, 2 and 3, the following symbols are used: $\bar{n}$ -- the average number of meteor echoes per hour for a given hour; $\bar{n}'$ -- the average number of meteor echoes per hour for a given day; and a dash denotes no observations.

"The distribution of meteor echoes according to slant range is given in the following table.

Table 4

R	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159
N	13	9	15	27	36	40	47	73	63

R	160-169	170-179	180-189	190-199	200-209	210-219	220-229	230-239
N	94	108	107	86	66	86	89	59

R	240-249	250-259	260-269	270-279	280-289	290-299	300-309	310-319
N	82	55	55	58	46	48	34	29

R	320-329
N	43

"In Table 4, the following symbols are used: R -- slant range; N -- the number of meteor echoes.

"Further observations and processing of materials is being continued." (Izvestiya Akademii Nauk Turkmenskoy SSR, No 3, 1958, pp 118-120)

III. METEOROLOGY

Short-Period Forecasting of Troposphere Shifts

S. V. Nemchinov of the Institute of Physics of the Atmosphere, Academy of Sciences USSR, solves a linearized system of thermohydrodynamic equations in a quasigeostrophic approximation, taking into account the stratification and basic factors of a baroclinic model of the atmosphere.

The obtained solution for nonzonal shifts in the altitude of the absolute topography in the lower and middle troposphere is used for a 24-hour forecast of the 1,000-millibar barometric surface of the atmosphere. (Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 6, Jun 58, pp 752-764)

IV. GLACIOLOGY

Soviets Use Geophysical Methods for Determining Glacier Structure

The Zailiyskiy Glacier Expedition of the Academy of Sciences, Kazakh SSR, working under the IGY program, has conducted field determinations of the structure of the Tuyuks glacier by geophysical methods. This work was done in the summer of 1957 and winter of 1958 on the Central Tuyuks Glacier.

The determination of the thickness and structure of the glacier's ice by methods of electrical and magnetic prospecting was part of the program of investigations.

The seismic method of determining the thickness of ice has a number of shortcomings -- high cost of apparatus, the comparatively large complement needed for staffing, and the difficulty of transporting such cumbersome equipment in high mountain regions. These factors led to a search for other, more practical methods of geophysical investigation for solving this problem.

The results of certain work conducted on the Central Tuyuks Glacier is presented by B. A. Borovinskiy in "The Experience of Using Geophysical Methods in the Investigation of the Tuyuks Glacier."

In the work of electrical prospecting, an EP-1 potentiometer was used and a method of measuring somewhat different than usual. The feed electrodes were made up of steel stakes in groups of three and the receiver electrodes, of single copper stakes. A BAS-80 dry battery was used as a source of power.

The thickness of the ice was found by electrical sounding of a ommon symmetrical and combined arrangement. The usual VEZ (vertical electrical sounding) apparatus placed as usual, was spaced along the glacier's axis, as well as in the form of a cross, along and across the glacier's axes.

Combined sounding was carried out in this way: one feed electrode was placed in the rock bordering the glacier and the other electrodes were shifted along its axis, one up and the other down.

Two measurements of the apparent specific electrical resistance were made for each spacing in the combined sounding.

Sounding by the usual symmetrical arrangement was conducted in the summer of 1957. In February 1958, combined sounding was used, making it possible to construct geoelectrical profiles more accurately depicting the structure of the section than profiles constructed according to the symmetrical soundings, since inhomogeneities appear in each semispace. Combined sounding facilitates grounding.

The principal difficulties in the process of sounding the glacier arose as a result of the low sensitivity of the receiver line, the difficulty of establishing a good ground, and constant winds preventing measurements.

Magnetometric observations were conducted with the M-2 magnetometer. The primary magnetometric problem consisted in improving the profiles of the contours of the rock and of determining the boundaries of the vein, dikes, and fractures in the glacier's rock bed.

Interpretation of the VEZ curves revealed the electrical inhomogeneity of this structure. According to the electrical conductivity, it was possible to distinguish a two-layer structure of the ice. An upper layer with low specific electrical resistance at a depth of 0 to 15 meters and a lower layer of high specific electrical resistance. In addition, it was possible to distinguish a bottom layer of lower electrical resistance.

A study of the temperature regime showed an irregularity in the distribution of temperature with depth. The temperature curve, as does the VEZ curve, distinguishes a particular zone at a depth of 0 down to 15-20 meters.

A geoelectric cross section was compiled as follows. The VEZ curve of each semispace was interpreted accordingly on graph sheets. The boundary layers obtained were related to surface points which lie at a distance of twice the depth of the boundaries from the center of the sounding in the direction of the given semispace. The geological structure of the region was calculated. After determining the thickness of the ice at several points, they were tied in with magnetometric graphics.

Visual investigation of the rock in the given region makes it possible to assume that the rock at the bottom of the glacier is uniform according to their own magnetic properties, and therefore it is proposed that variations of the magnetic field are caused by changes in the relief of the bed. For eliminating the effect of the relief of the ice surface, graphics were reduced to one altitude. After interpretation, profile of the glacier tongue was constructed.

Borovinskiy concludes by saying that the geophysical method of determining the thickness of ice gives good results with a small expenditure of capital and time. Expensive and cumbersome apparatus are not required for such work, and the entire operation of transportation and observations can be carried out by three or four men.

The method was used only on glaciers of limited thickness (up to 150 meters), and, says Borovinskiy, it is not known to what extent it can be applied to thicker glaciers. (Vestnik Akademii Nauk Kazakhskoy SSR, No 5 (158), May 58, pp 40-44)

New Glacier Found in Khibiny Mountains

V. F. Perov, of the Khibiny Geographic Station of the Moscow State University imeni M. V. Lomonosov, reports the discovery of the first firn glacier in the Khibiny Mountains. The finding was made in September 1957 during field work being conducted under the IGY program.

The glacier is located in the northern part of the Lyavochorr mountain range, in the upper reaches of a short glacial trough of the main right tributary of the Kaliok River. The body of the glacier forms an amphitheater almost abutting the edge of the plateau. The glacier is not large, being 300 by 80 meters, or about 0.02 square kilometers.

The absolute altitude of the upper edge is 1,073.2 meters, with the highest point of the mountain being 1,172.0 meters. The location of the glacier near the brow of the plateau and the strongly drawn out form makes it necessary to classify the glacier as a stationary drift-type firn glacier.

The glacier lies almost due north, the azimuth of its axis being 350 degrees and the slope of its surface, 34-36 degrees. The thickness of the ice, judging from its shape and measurements, can be of an order of only several meters. The cross section of the glacier is arched, and mound-like bulges are found on the otherwise smooth surface. A very thin layer of firn, frequently several centimeters in thickness, covers the surface of the ice. A considerable part of the area is free of even this thin layer. Then, the dense turbid firn ice appears, permeated with numerous miniature run-off channels.

There is almost no firn cover on the glacier. This is related to the unusual meteorological circumstances of the past year. Little snow fell in the winter of 1956-1957, and the following summer was rather warm. The glacier was found at the end of the thaw period, at which time only its bare nucleus was seen.

The active crushing of rock on the edges of the glacier was noted. The rubble had fresh fragments and sharp edges.

Perov says that the finding of the glacier was not accidental, as the existence of snow remaining through the summer and the presence of avalanche activity indicated the possibility of finding embryonic forms of glaciation.

It is possible that this glacier in the Lyavochorr mountain range is not the only one in the Khibiny. However, it already has aroused definite scientific interest from the viewpoint of the formation and activity of glaciers in their embryonic form. (Priroda, No 7, Jul 58, p 88)

V. OCEANOGRAPHY

Heat Balance Studies of Atlantic Ocean

The components of the heat balance of the Atlantic Ocean, calculated per unit of its surface, were determined in a number of interesting and important regions during voyages of the oceanographic ship Sedov. These investigations are reported by V. V. Shuleykin, V. F. Gushchin, and P. I. Peskov in an article titled "Fluctuations of the Heat Balance of the Atlantic Ocean."

Fluctuations of all the components and their day-to-day totals to be used in further investigations on the thermics of the Atlantic Ocean Associated with the transfer of heat from layer to layer and with the fixed temperature regime of the waters are analyzed for the first time.

The excess of amplitude of the diurnal fluctuations of heat balance over the fluctuations of heat balance from one latitudinal zone to the other and from month to month is presented.

The role of cloudiness and wind in controlling evaporation from the surface of the ocean is sharply manifested. (Isvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 6, Jun 58, pp 729-740)

Pacific Deepwater Trench Discovered by Vityaz

The operations of the Soviet expeditionary ship Vityaz, Institute of Oceanology, Academy of Science USSR, under the IGY program included detailed studies of the bottom relief of the Pacific Ocean, particularly its deepwater trenches. These, as is known, are long, narrow, and deep depressions with steep sides. They form an almost continuous belt along the western brim of the Pacific Ocean from Alaska to New Zealand and then along the eastern margin of the ocean near the shores of South and Central America. Most of these trenches were discovered at the end of the last century and the beginning of this one. The last to be discovered was the Guatemalan Trench. After that time (the 1930s) no new deepwater trenches were discovered. However, with the use of modern research technique (pathometers) much new material has been introduced in representation of the morphology and maximum depths of these trenches.

The discovery of the northern half of the Kurile-Kamchatha depressions and the western end of the Aleutian was made in 1953 by the Vityaz. In 1957 the Vityaz considerably added to the knowledge of the maximum depths in the Tonga and Marianna depressions, finding depths of 10,841 and 10,990 meters, respectively.

G. B. Udintsev, Candidate of Geographical Sciences, Institute of Oceanology, Academy of Sciences USSR, discloses the "Discovery of a Deepwater Trench in the Western Part of the Pacific Ocean" by the Vityaz.

In February 1958 the Vityaz cruised north along the meridian, 170 16 E. The path of the vessel passed through the north Fiji depression and a large underwater mountain which bounded this hollow on the north. This underwater mountain extended approximately along the meridian, 12 S in a direction away from the islands of Samoa and Santa Cruz. The depths in the north Fiji depression varied by about 3,300 meters, sharply decreasing while crossing the underwater mountain in the region of Mitre Island and the Strathmore Banks (200-300 meters); then to the north of this mountain the depths increased rapidly down to 6,100 meters. Further north the depths again decreased up to 4,500-5,000 meters in the region of the bottom of the depression limited on the east by the Ellice and Gilbert Islands and on the north by the Marshalls.

A deep, narrow trench, was crossed by the Vityaz in the region of 10 25 S. A cross section of the trench showed it to be V-shaped, with very steep sides. Its bottom, almost horizontal, was about 4 miles wide. The greatest depth measured by the Vityaz was 6,140 meters. This trench was a previously undiscovered feature of the underwater relief of this region and definitely not typical of a great expanse of the bottom.

It was also unusual, because, judging from the general area, surrounded by islands, no such depths could be supposed to exist.

The geological significance of this discovery is evident if the location of the new trench is considered in connection with other large-scale structures of the bottom relief. A striking feature of the relief of the western margin of the Pacific Ocean is the almost continuous chain of deepwater trenches (the Aleutian, Kurile-Kamchatha, Japan, Ryukyu, Philippine, Bonin, Marianna Yap, Palau, Bougainville, New Hebrides, Tonga, and Kermadec). Each of these trenches is linked with large-scale mountain structures which are either peninsulas, island groups, or underwater ridges. These mountain structures have received the name of island arcs, since they are mostly connected with chains of islands curved in the form of an arc.

The island arcs and deepwater trenches together form a single, extremely characteristic morphological complex. The connection of this morphological complex with such geological phenomena as high seismicity, deep fractures, active volcanism, high gravimetric anomalies, and a boundary of distribution of andesite rock is notable. Finally, attention falls on the association of island arcs and deepwater trenches with the outer boundary zone of the continental slope, the zone of transition between the continents and the ocean bed. This is accepted as a basis by many for considering island arcs and deepwater trenches as specific forms of the relief of the transition zone; also many see in them the morphological expression of the characteristic structural peculiarities of the present highly active geosynclinal zone.

The chain of deepwater trenches on the western margin of the Pacific Ocean appears to be continuous, all having the same fault. They are associated for the most part with the transition zone from one system of island arcs to another and with a thinning out of the trenches interlinked with this system. Usually, the extent of the breaks between the trenches on the western margin of the ocean are not considerable. However, in two regions the breaks between them are very large. These are the breaks between the Philippine and Bougainville trenches and between the New Hebrides and Tonga trenches.

The trench discovered by the Vityaz is exactly in the locale of the second of these breaks, being, as it were, a missing link in the enormous chain of deepwater trenches. Judging from the Vityaz data, this trench is smaller than the others. However, morphologically it is rather well defined. As in the other trenches, it is connected with a mountain structure -- an underwater mountain ridge supporting the islands of Ellice, Mitre, Duff, and numerous banks. While the trench has comparatively small depths, its adjoining mountain structure also has a comparatively low height, the greater part of the latter being covered by the ocean. Thus, on the whole this morphological system is not as sharply expressed as its neighboring systems, for example, the Tonga Island arc and trench. It can be supposed that this morphological complex occurred in the relatively early stages of the development and accordingly reflects the earlier stages of the development of a given part of the zone of transition. Consequently, the results obtained by the Vityaz aid in fully understanding the order of the development of the transition zone on the western margin of the Pacific. A more detailed investigation of the trench discovered by the Vityaz must be the subject of future investigations.

The name of the Vityaz was given to the newly discovered trench, as is the custom for trenches where there is no adjoining island arc or land.

The maximum depth of the depression discovered by the Vityaz known at present is 6,140 meters. (Priroda, No 7, Jul 58, pp 85-88)

VI. ARCTIC AND ANTARCTIC

Antarctic Station Komsomol'skaya

The station Komsomol'skaya, located at 74 05 S and 97 29 E, was established on 7 March 1957. In addition to conducting scientific studies, the station, which is near the south geomagnetic pole, was also meant to serve as a landing field for airplanes and a supply base for various kinds of freight, fuel, and building materials, on the way to the interior stations Vostok and Sovetskaya.

Scientific observations conducted at the station included meteorology, actinometric measurements, launching of radiosondes, and magnetic and glaciological research.

The maximum temperature during the entire period of operation of Komsomol'skaya was minus 19.6 degrees Centigrade during the warmest month, i.e., December. The minimum pressure was 450-460 millimeters.

Actinometric observations included measurements of the total solar radiation, reflected and scattered radiation, and the radiation balance of the active surface. The results of these observations are now being processed and carefully analyzed.

The data on gradient temperature observations enable scientists to analyze changes in temperature of the snow layer and of the air at various depths and elevations. Thermal elements were determined at the following levels: in the snow, at depths of 3.2, 1.6, 1.2, 0.8, 0.4, and 0.2 meters; and on the snow surface and in the air, at elevations of 0.5, 1.0, and 2 meters. Gradient observations at this station were conducted four times daily.

Magnetic observations included the determination of absolute elements of the constant magnetic field, as well as research on the nature of magnetic disturbances, i.e., of the variable magnetic field in the area of the station.

To determine the normal daily course of variations of magnetic elements and the nature of their disturbances, a systematic registration of the variations of declination D, the horizontal N, and the vertical Z, components of the earth's magnetic field, was made. The observations indicated a marked change of magnetic variations in the area of station Komsomol'skaya and disclosed their normal daily variations with the following amplitudes of their fluctuations by elements: for the declination, up to 1.5-2.0 degrees; and for the horizontal and vertical components, more than 300-400 gammas.

Preliminary calculations of absolute determinations make it possible to establish the following values of magnetic elements for the area of station Komsomol'skaya: western magnetic declination in degrees, 95.5; horizontal component in oersteds, 0.13200; and vertical component in oersteds, 0.61400.

Preliminary data on glaciological research have disclosed that the temperature within the snow layer increases at first with depth and equals minus 54.7 degrees Centigrade at a depth of 4-6 meters. With increasing depth, i.e., up to 15 meters, the temperature remains stable at 53.9 degrees Centigrade and remains unchanged at even greater depths. Inside the snow layer is a so-called zone of zero temperature gradient. As confirmed by numerous observations of several scientists, the temperature of the zone of zero temperature gradient in different places on the Earth is the mean annual temperature of the air above the surface of the given area.

Meteorological and aerological observations at the station Komsomol'skaya indicate a very strong cyclonic activity in the atmosphere above the antarctic snow plateau, with a deep penetration of the cyclones. Further observations and the accumulation of data from all antarctic scientific stations are very valuable, not only for the study of the climate of Antarctica and the Southern Hemisphere, but also for determining the influence of the Antarctic continent on the general atmospheric circulation of the Earth. -- V. Pelevin, chief of station Komsomol'skaya (Moscow, Morskoy Flot, No 7, Jul 58)

Geophysical Research in Antarctica

The geophysical detachment of the Soviet Antarctic Expedition at Mirnyy has conducted stationary observations in the fields of seismology, terrestrial magnetism, and the ionosphere. The magnetic and seismic pavilions were built at a distance of about 300 meters from the main group of buildings of the settlement and electric station, and about 450 meters from the transmitting radio center, in order to eliminate the effect of mechanical and electromagnetic interference on the readings of sensitive instruments. The pavilion for ionospheric research and the antenna field required for this purpose were located at the end of the settlement, 300 meters away from the transmitting radio center.

Seismological Research

During the first 7 months of operation of the seismic station at Mirnyy, under seismologist A. D. Sytinskiy, almost 200 earthquakes were registered. However, in only 20 percent of the cases was it possible to determine the coordinates of the epicenters, and for about 50 percent of the earthquakes it was possible to calculate the epicentral distances. In the antarctic region only a few earthquakes have been recorded. The focuses of most of the earthquakes registered were located in the southwest part of the Pacific seismic zone, near the islands of Tonga, Samoa, and Fiji. No earthquakes have been observed on the continent of Antarctica itself. A confirmation of this fact in the future will have great significance in the study of the geological history of this continent.

The seismograms obtained in Mirnyy are continuously registering, in addition to earthquakes, periodical small earth tremors called microseisms. They result from a special kind of ocean waves during the passage of a cyclone. The fluctuations of water masses are transmitted to the ocean bottom and spread over very great distances. In the area of Mirnyy, frequent cyclones occur and their centers pass to the north of Mirnyy.

There are installations for registering microseisms according to the indicators of seismographs, located at some distance from one another. This makes it possible to trace the course of the movement of a cyclone in the ocean, where the network of meteorological points is usually widely scattered. Therefore, the study of the connections between microseismic tremors and the synoptic conditions in this region may be useful for weather forecasts. Much attention is being given to the study of the relations between microseisms and meteorological processes.

At present only general information on the nature of microseisms, their period, and amplitude is available. During the winter and spring period, when the surface of the sea is covered with ice for hundreds of kilometers, microseisms with a tremor period of 6-10 seconds are especially frequent. During the summer and fall period, with the approach of the ice edge to the shore, microseisms with a shorter period and an increased amplitude of tremors, up to 7μ, occur more frequently. Therefore, on the background of these microseisms, it becomes difficult to process the earthquake readings. In some cases, a sudden increase of the amplitude of microseismic tremors was noted, which was apparently connected with the crossing of a boundary by a cyclone center: (a) of a sharp change in the ocean depth or (b) of the division between various geological structures on the ocean bottom.

Study of the Ionosphere

The study of electromagnetic phenomena and of the upper atmosphere during the years of maximum solar activity is of special interest. The maximum solar activity during 1957-1958 is noted for its extreme intensity, which had not been observed before. Therefore, it may be expected that the effect of solar radiation on the upper atmosphere during this period will be very intense.

An automatic ionospheric station for the study of the ionosphere has been installed in Mirnyy. With the help of a motion-picture camera, the high-frequency characteristic is fixed on the film, and this makes it possible to obtain a picture of the condition of the ionosphere at a given time.

Long-distance radio contact between Mirnyy and Moscow on short waves is usually maintained during the evening and night. It has been observed in this connection that during this period radio waves are propagated mainly over a shorter distance (15,000 kilometers), while in the afternoon hours the more intense signals passed through the zone of the South and North poles (25,000 kilometers).

Some peculiarities of the propagation of radio waves -- of the "ground" wave -- above the ice mass have been discovered. As a result of the absorbing effect of the ice layer, radio communications on a medium-wave range with a point in the interior of Antarctica are possible only over short distances. In the direction of the sea, the intensity of radio signals weakens much more slowly, and the distance over which it is possible to have dependable radio contact is considerably greater than in the direction of the continent.

Stationary Geomagnetic Observations

In a special building (the magnetic pavilion), assembled from wooden logs without a single iron part, regular studies of the absolute values of elements of the Earth's magnetic field (i.e., declinations of the horizontal and vertical components, as well as inclinations) and continuous photographic registration of their changes in time (variations), are being conducted. The combination of absolute and variational observations makes it possible to obtain the value of the component of the magnetic field at any time. For the registration of variations of horizontal components of the field, special instruments are used, which consist mainly of magnets suspended on quartz threads so that they can move freely in a horizontal plane. Another magnetic system, which is supported by agate blades on special "cushions," is arranged in such a way that it has freedom of movement only in a vertical plane and can follow the variations of the vertical component. A magnetic theodolite, a quartz magnetometer, an induction inclinometer, and an electric Z-magnetometer were used for absolute determinations of elements of the field. Before the departure of the expedition, the instruments were regulated with absolute instruments of the magnetic observatory of the Soviet Union (Krasnaya Pakhra, near Moscow). As a result, the instruments of the expedition had instrumental corrections and conversion factors, making it possible to determine the elements of the magnetic field in any other point of the Earth.

According to the results of field research of the first expedition, values of the magnetic field in a number of points of the Antarctic coast and along the Mirnyy-Pionerskaya profile were obtained. These results, together with data of subsequent expeditions, will permit the compilation of magnetic charts, which are required for aerial and maritime navigation.

Variations of the magnetic field in Mirnyy are distinguished by disturbances of the field during daytime hours (local time), which is characteristic for high latitudes. The maximum of magnetic disturbances is observed during the noon hours or afternoon hours of local mean time. It is interesting that the moment of maximum disturbances during the daytime in Mirnyy practically coincides with the time of the maximum phase of disturbances theoretically assumed by A. P. Nikol'skiy of the Arctic Institute. During the winter (May-August), in addition to the daytime maximum of disturbances, there is a second maximum of the same intensity around the local midnight hour. During the summer (November-January), as compared with the winter, a general increase of magnetic disturbances is noticeable, which is connected with the increase in intensity of daytime disturbances.

All these seasonal changes of magnetic disturbances are characteristic for the region situated within the zone of maximum frequency of auroras. In Mirnyy, auroras are observed mainly in the northern part of the firmament.

Magnetic disturbances during the daytime provided additional possibilities for errors in observation, which caused serious difficulties in the work of aeromagnetic survey. In a number of cases, this work was done in the early morning or evening hours so as to obtain more exact observations.

In the area of Mirnyy, an amazing "locality" of magnetic variations has been determined, which had not been observed anywhere before. It is known that the magnetic variations are dependent on electric currents passing through the ionosphere, i.e., at altitudes of 100 kilometers or more above the Earth's surface. Therefore, it is natural that variations of the Earth's magnetic field in adjacent points are usually the same. Especially in the middle latitudes, magnetic variations are practically the same on an area with a radius of several hundred kilometers. In high latitudes, where the magnetic field is much more frequently disturbed, magnetic variations are usually the same in points located at a distance of about 100-200 kilometers from one another.

However, the study of magnetic variations in Antarctica has given some unexpected results. In the recordings of variations, an unusual mobility of the variation curve of the vertical component is strikingly apparent. Magnetic variational observations were conducted near Mirnyy to discover the reasons for this phenomenon. Magnetic variational field stations were established at four points: 0.3, 0.5, and 10 kilometers in the direction of the continent and 13 kilometers from the magnetic pavilion in the direction of the sea (on the fast ice). It appeared that the magnetic variations obtained in the pavilion and at the points located at distances of 10 and 13 kilometers were essentially different. In the pavilion, the amplitude of individual fluctuations of the vertical component was 20-25 percent greater than at the indicated points; the amplitude of the horizontal component and of the declination, on the contrary, was usually smaller, while the general similarity of variations of identical components was preserved. At points located at distances of 0.3-0.5 kilometer from the pavilion, the variations were somewhat different.

The work conducted by magnetologists in 1957 under the supervision of S. M. Mansurov confirmed his theory that the source of the local character of variations is the electric current of abnormally great density, which circulates in the coastal zone of the sea.

In 1956, experimental recordings of earth currents along a single line were made in Mirnyy. The ground connections in the form of lead sheets were laid in a depression among the rocks and covered with sand moistened in an alkali solution. The difference of potentials between the ground connections is measured by a specular galvanometer and is registered on photographic paper.

The analysis of observation materials from Antarctica has revealed a number of interesting facts. The amplitudes of fluctuations of earth currents are very great and reach several hundred millivolts per kilometer. The daily changes of disturbances of the field of earth currents and of the Earth's magnetic field have a similar nature. "Individual groups of fluctuations (tsugi), which usually precede the disturbances, are less pronounced in Antarctica than in temperate zones. In a number of instances, the tsugi of fluctuations," despite their small amplitudes, enveloped the northern and southern hemispheres simultaneously.

The Second Antarctic Expedition, which began to work early in 1957, organized the observations of cosmic rays and auroras over again.

To study the variations of the hard (meson) component of cosmic rays, an ionization chamber (ASK) was installed at Mirnyy in 1957. The special method of measurements made it possible to make continuous recordings of the declination of ionization from the average level by photographic means.

Observations of auroras are conducted with the help of an S-180 camera, which automatically photographs the whole sky on an extra-sensitive film at regular intervals. Studies of the spectrum of auroras are also made at Mirnyy.

The station Oazis conducts observations of terrestrial magnetism and currents, auroras, and seismology; and the station Pionerskaya, studies of terrestrial magnetism.

At the end of 1957, the station Vostok was organized at a distance of 1,400 kilometers from Mirnyy (78 27 S, 106 52 E), near the so-called south geomagnetic pole. The studies made at this station make it possible to examine the geographic distribution of a number of characteristics of the variable magnetic field, of the ionosphere, and of auroras, connected with the Earth's magnetic field.

Early in February 1958, the Third Antarctic Expedition organized the station Sovetskaya (78 24 S, 87 35 E), located, the same as Vostok, at a distance of about 1,400 kilometers from Mirnyy. In the future, it is planned to move this station further into the interior of the continent. -- P. K. Sen'ko, Candidate of Geographical Sciences, Arctic Scientific Research Institute of the Main Administration of the Northern Sea Route (Moscow, Priroda, No 7, Jul 58 pp 59-62)

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