# MEETINGS AND CONFERENCES

## Scientific session of the division of general physics and astronomy of the Academy of Sciences of the USSR

(March 28-29, 1973)

A scientific session of the Division of General Physics and Astronomy of the Academy of Sciences of the USSR was held on March 28–29, 1973 in the Conference Hall of the P. N. Lebedev Institute of Physics of the Academy of Sciences of the USSR. The following reports were presented at the session:

1. É. R. Mustel'. Action of Solar Particle Fluxes on the Lower Layers of the Earth's Atmosphere.

2. A. D. Sytinskii. Relation Between Seismic Activity of the Earth and Solar Activity.

3. V. I. Moroz, L. V. Ksanfomaliti, and A. É. Nadzhip. "Mars-3": Astrophysical Studies of the Lower Atmosphere and the Surface of the Planet.

4. M. A. Kolosov and N. A. Savich. Study of the Space Plasma by the Dispersion-Interferometer Method.

5. M. A. Kolosov and O. I. Yakovlev. A Study of Propagation of Radio Waves in the Solar System Using Soviet Space Stations.

6. G. S. Ivanov-Kholodnyĭ, A. V. Mikhaĭlov, and N. A. Savich. Formation of the Ionosphere of Mars.

The content of the reports is published below.

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**É. R. Mustel'.** Action of Solar Particle Fluxes on the Lower Layers of the Earth's Atmosphere. The report briefly relates results of studies on the problem of action of solar particle fluxes on the lower layers of the Earth's atmosphere, i.e., in essence, on the problem of the effect of solar activity on the weather and climate of the Earth. These studies were performed in the Laboratory of Sun-Earth Relationships of the Gidromettsentr of the USSR and in the Astronomical Council of the Academy of Sciences of the USSR.

The first fundamental problem of the studies consisted in proving the reality of sun-atmosphere coupling. Statistical methods of analysis were adopted, in particular, the method of superposition of epochs. In this method, the major role is played by the so-called "reference" (or key) event. The mean time behavior of the studied parameter with respect to this event is constructed (many such events being used). The atmospheric pressure at the Earth's surface was mainly studied in our research.

In order to avoid many uncertainties, we did not use solar-activity data, but the so-called geomagnetic events (days), which were treated as the reference events for statistical analysis. The geomagnetic event $t_m$ actually corresponds with the first day of very intense interaction of the Earth's magnetosphere with a particle flux that has just entered it. These geomagnetic days $t_m$ have been chosen for the period from 1890 to the present. Thus far, geomagnetic events have been used for statistical analysis that correspond to particle fluxes ejected from regions of chromospheric flares. On the average, these fluxes give rise to very strong geomagnetic perturbations with relatively sharp maxima. In all, 280 of these events have been selected for the period from 1890 to the present, and they are all quite independent of one another.

Preliminary statistical analysis has shown that after the event $t_m$ we observe in certain, very extensive regions of the Earth an increase in the atmospheric pressure on the Earth with a certain maximum. At the same time other extensive regions of the Earth show a decrease in pressure having a certain minimum. The mean time that elapses between the event $t_m$ and the pressure extrema (maxima or minima) is about three days. This time has been called the reaction time of the atmosphere. The analysis further showed that the pattern of distribution of signs of pressure change (increase or decrease) over the surface of the Earth differs in different seasons. Hence, the problem of the reality of particle-atmospheric coupling must be studied separately for each season. This implies that the number of independent events $t_m$ must be decreased by a factor of four, and it is approximately equal to 70. Moreover, we have found that the statistical "noise" of the applied method of imposed epochs proves to be of the same order for $n \approx 70$ as the studied pressure oscillations (of solar origin), owing to the great inertia in atmospheric processes, and that we must have $n \gtrsim 500$ for a clear isolation of the signal. It is precisely the failure to account for this fact that has been the fundamental reason for the great number of failures of previous investigators who have worked on this problem. In order to overcome this difficulty, data have been used from meterological stations lying sufficiently distant from one another (with distances $L \gtrsim 3000$ km). Then the readings of individual meterological stations are practically independent of one another. All of this has permitted increasing the number of independent parameters n to the above-stated value ($n \approx 500$). Here the application of different statistical criteria (as yet for the winter period) has led to the firm conclusion that particle-atmospheric coupling is real. Supplementary studies are being conducted now on this problem (other seasons are being used, additional meterological stations, and other methods of study).

Studies along other lines have been conducted in parallel with analyzing the problem of the reality of particle-atmosphere coupling. We can formulate briefly the results of these studies as follows:

a) It has been found that the entrance of a solar particle flux into the Earth's magnetosphere (the event $t_m$) changes the nature (or type) of atmospheric circulation. Here each season possesses its own specific changes in atmospheric circulation. An especially important property of the studied changes is enhancement of the meridional components of the circulation, which usually causes the most substantial changes in the state of the atmosphere (changes of weather and climate). Very interestingly, in a cold period of time, the regions of Iceland and the Aleutian Islands prove to be regions of very noticeable fall in atmospheric pressure after the events $t_m$. This fully agrees with the presence in these regions of the Earth (also only in a cold period) of deep regions of reduced pressure, or so-called "centers of action of the atmosphere." This fact directly indicates that solar particle activity is one of the fundamental causes of cyclonic activity on the Earth.

b) It has been found that these transformations of the atmospheric circulation are characteristic not only of the lowest atmospheric level, but also of the higher tropospheric and stratospheric layers.

c) It has been found that appreciable changes in the intensity of jet streams near the tropopause are found after an event $t_m$.

d) It has been found that a general increase in the energy of atmospheric movements is observed after events $t_m$.

Naturally, there are yet many problems demanding solution in the problem of effects of solar particle fluxes on the Earth's atmosphere. A very important one is the problem of a possible mechanism of these effects. There are strong indications that here the fluxes are only one particular factor that disturbs the equilibrium of atmospheric masses in the regions where this equilibrium is most unstable. Hence the original energy required for appearance of particle-atmospheric phenomena can be much smaller than the energy contained in already-formed cyclones and anticyclones, and which is drawn from the total energy of the entire atmosphere. Moreover, an all-sided study is needed of the problem of how the energy introduced by the solar particle flux into the upper (ionospheric) layers is transmitted down to the stratosphere and the troposphere. Work is being conducted on all these problems and on others not mentioned here, and it requires not only using ordinary meterological data and hydrodynamic theories, but also setting up special experiments using geophysical rockets and artificial Earth satellites.

The material of the report can be found in No. 24 of "Nauchnye Informatsii" (Scientific Information) of the Astronomical Council of the Academy of Sciences of the USSR for 1972.