2) The question of the use of cosmic ray measurements in meteorological investigations requires further study. It appears to us that one can calculate $\delta \overline{W}_{\text{tropospheric}}$ given average tropospheric temperature profiles corresponding to typical meteorological situations. Assuming that the observed variations of $\delta \overline{I}_h$ are caused basically by changes in the temperature profile, i.e., $\delta \overline{I}_h \approx \delta \overline{W}$, one can calculate the contribution of the upper layers of the atmosphere, $\delta \overline{W}_{\text{upper}} \approx \delta \overline{I}_h - \delta \overline{W}_{\text{tropospheric}}$, corresponding to each typical meteorological process in the troposphere. The variation $\delta \overline{W}_{\text{upper}}$ can be considered as an indirect, though objective, factor that can be used along with other meteorological data in studying the character of the relationship of tropospheric processes with those in the layers above. As is well known, this relationship is not very well understood (References 4,5, and others).

In conclusion, I would like to express my gratitude to Prof. E. L. Feinberg, Iu. G. Shafer, and G. A. Tolstobrov for their advice and help.

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The Contribution of Meteorological Changes in the Earth's Atmosphere to the Diurnal Effect in Cosmic Rays

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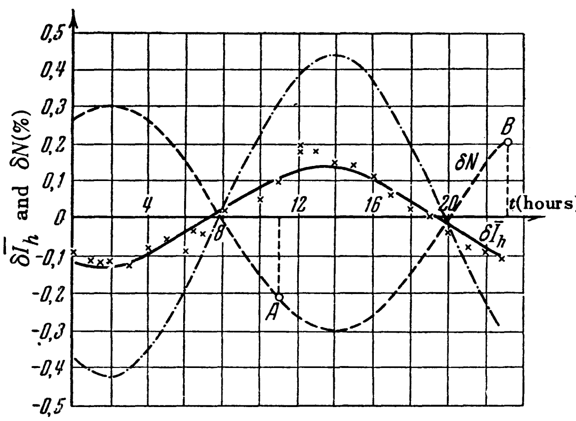
1. IT is important in the investigation of the diurnal effect on the intensity of cosmic rays, as well as in the study of other regular and irregular fluctuations, to isolate those effects related to meteorological changes in the earth's atmosphere. The contribution to the diurnal effect by meteorological factors has been investigated previously (in studies 1-3 and others). In all of these investigations, however, the effect of the redistribution of the atmosphere[4] was not considered. This is as important as the effect of simple absorption of mesons, caused by variation in the mass of air overhead and the change in altitude of the meson-generating layer accompanying a change in the temperature of the atmosphere. Further, in one work[2] the so-called "temperature effect"[5] is incorrectly taken into account.

The present paper reports very accurate determinations (to a precision of several tenths of a percent per hour of observation), at a height of 100 meters, of the global intensity of the hard component of cosmic rays, δI. The analysis was based on a theoretical scheme proposed by Feinberg[4] and generalized by Dorman[5] to include μ-meson production throughout the atmosphere by the disintegration of the π-mesons produced by the primaries.



2. The Figure shows the diurnal variation of the intensity of the hard component, δI_h, corrected for the barometric pressure (barometric coefficient $k = -0.14\%$ per 1 mb), obtained by averaging the data obtained during continuous observation from July 1949 to May 1952. The solid line shows the first harmonic, with the experimental points indicated by x's. The two points A and B are values of δN (the intensity of the hard component theoretically expected from consideration of the meteorological effect) calculated from averaged meteorological data. Data were used only from those days on which radio-sonde flights extended to at least 12 km height during both the day and the night periods. This requirement avoids the danger of bias in the results due to an unequal distribu-

tion of successful flights during the year between day and night periods. In all, there were 72 paired flights, 17 in winter, 20 in summer, 14 in spring, and 21 in autumn. Table 1 presents the results for δN, the calculated meteorological effect (day-night), and δI_h, the observed variation of the intensity of the hard component of cosmic rays corrected for barometric pressure.

TABLE I

	Winter	Spring	Summer	Autumn	Average
δN in %	-0.08 ± 0.02	-0.40 ± 0.03	-0.83 ± 0.02	-0.73 ± 0.02	-0.35 ± 0.01
δI_h in %	0.34 ± 0.09	0.46 ± 0.1	0.14 ± 0.08	0.28 ± 0.08	0.21 ± 0.05

It is evident from the Figure and the Table that, first of all, the calculated effect, δN(day-night), and the observed variation of δI_h are in opposite phase, contrary to previous findings[2]; and secondly, the meteorological effect correction doubles the diurnal effect in the intensity of the hard component. The absolute values of the results in Table 1 could be in error on the high side only through systematic errors in temperature measurement resulting from the influence of solar radiation on the radio-sonde equipment[6]. This could be significant only at high latitudes in the summer, when the sun's elevation above the horizon is at a maximum. On the other hand, it is known[6] that at northern latitudes 60°–62° this increase reaches about 2° C at a height of 13 km. It can be shown, assuming an exponential decrease of density with height, that at 6 km this error is of the order of tenths of a degree, and at the level of our meteorological observations, only hundredths of a degree. Hence, the absolute value of the expected meteorological effect, "day-night" during the summer season cannot be in error by more than 0.2%. Thus, the meteorological effect is opposite to the one observed, and has a value of about 0.4%. The correctness of this conclusion is supported by the fact that the average height at which the pressure equals 300 mb is found from three years of radio-sounding to be higher during the daytime than at night, as is shown in Table 2. It is also seen in Table 2 that the positive difference in height between day and night does not change very much from season to season. A comparison of Tables 1 and 2 suggests that a significant role is played by the redistribution of the mass of the atmosphere below the 300 mb level in the variation of the diurnal effect from season to season.

TABLE II

	Winter	Spring	Summer	Autumn
Average difference between the height of the 300 mb level during the day and at night, in meters . . .	46	38	37	30

3. In order to evaluate the full significance of the influence of meteorological changes on the diurnal effect, one would require frequent, round-the-clock sounding of the atmosphere, more frequently than is presently done by meteorologists. Nevertheless, from careful analysis by Selezneva[7] of the aerological data obtained over many years at Slutsk, it is evident that the diurnal variation of temperature above 3 km has an independent character and increases with height. The basic maximum of temperature occurs at about 1300-1400 local mean solar time. Therefore, if the maximum temperature of the entire troposphere occurs at 1400 on the average, it can be assumed that the calculations of the meteorological effect reflect about 70% of this effect, as these results apply to moments of time displaced by three hours from the experimentally observed temperatures. The value of the possible meteorological effect should be 0.6% on the average (the assumed diurnal meteorological effect, δN, is shown by the dashed line in the Figure). Then, using the observed $\delta \overline{I}_h$, one concludes that the diurnal variation of the intensity of the hard component of cosmic rays has a non-meteorological origin and amounts to about 1% (shown in the Figure by the dot-and-dash line).

4. It should be noted that the seasonal variation of the diurnal effect of cosmic rays can be explained by the seasonal change in the diurnal fluctuation of meteorological factors. It is known[7] that the largest diurnal temperature fluctuations of the troposphere occur in summer, the smallest in winter. If the diurnal variation of the intensity of cosmic rays predicted by the meteorological effect is opposite to the one observed, then one should expect that the diurnal effect observed should be smallest in summer and largest in winter. This indeed occurs, as is seen in Table 3, where are shown the amplitudes of the first harmonic, calculated from the seasonal averages of the diurnal variation of the intensity of the hard component of cosmic rays, $\delta \overline{I}_h$. It is seen that the diurnal effect in summer is only half that in winter, and this agrees with the increase in the diurnal meteorological effect in summer (Table 1).

TABLE III

	Winter	Spring	Summer	Autumn	Year-round
Amplitudes in % . . .	0.18±0.004	0.15±0.004	0.09±0.004	0.12±0.005	0.13±0.002
Time of maximum (in hours).	13.9	13.9	13.4	13.3	13.4

However, the data in Table 3 contradict the work of Duperier[1] who observed, by a coincidence method, that the total intensity of cosmic rays exhibited a larger effect during summer months than in winter. This disagreement could be explained by a considerably larger contribution of the diurnal variation of meteorological factors to those measurements than to ours, because the average particles observed there were softer. For this reason, perhaps, the seasonal changes of the diurnal effect observed there directly reflected the meteorological component of the diurnal effect of cosmic rays.

In conclusion, the author thanks Prof. E. L. Feinberg and Iu. G. Shafer for valuable suggestions and advice. The author also thanks G. V. Skripin for his help in the calculations and analysis of the data.

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Nuclear Fissions Associated with Heavy Unstable Particles

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1. WITH the aid of thick photoemulsions there have been found to date over one hundred nuclear fissions in which there are produced hyperons (charged hyperons $Y\pm$ and Λ^0 particles) and heavy mesons of mass $\sim 1000\ m_e$ (K and τ mesons). There were also detected about thirty secondary fissions produced by the nuclear capture of stopped negative heavy mesons.

This note gives a brief account of some results of the statistical analysis of these fissions. The conclusions should for the present be considered as likely hypothesis in need of additional verification and more complete proof.