Abstracts of the Papers Printed or to be Printed

THE TIME VARIATION OF COSMIC-RAY AT HIGH LATITUDE* (PART 1)

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高緯度における宇宙線強度の時間的変化*

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The time variation of cosmic-ray (meson component) observed during the year 1959-60 at Syowa Base, Antarctica, is analysed.

The points to be discussed are as follows.

1) Atmospheric effects. a) In order to get correct negative temperature coefficient, it is better to take the isobar higher than 50 mb in high latitude, on the contrary to 300 mb in middle latitude.

b) The amplitude of diurnal variation of cosmic-ray shows the clear seasonal variation. It seems likely that it is due to atmospheric origin. From these seasonal variation, about 30 m of diurnal variation of level in summer and 12 m in winter at 50 mb isobar level are expected from the facts mentioned above.

2) The related phenomena between the magnetic disturbances especially polar elementary magnetic disturbances and cosmic-ray intensities are examined. It is shown that there are no effects of polar elementary magnetic disturbances on cosmic-ray.

Apparatus The apparatus used at Syowa Base is Scintillation Counter which is combined with two plastic scintillators 50×50×10 in size and E.M.I. 6262 photomultipliers.

Atmospheric effects. When we give rise to discussion for the time variation of cosmic-ray, meson component, the most problem is the atmospheric effects, especially the temperature effects.

As the meson have the decay time, say about 10^{-6} sec., the intensities observed at the ground are depend on the distances between the position of meson productions and the ground.

When we examine the correlation between the intensities of cosmic ray at the ground and the some isobar levels, we get the best correlation at the 300 mb level in middle latitude, but it is not so good correlation in high latitude when we take the 300 mb level. We can guess, it mest be due to the differences between the atmospheric conditions in middle and the high latitude.

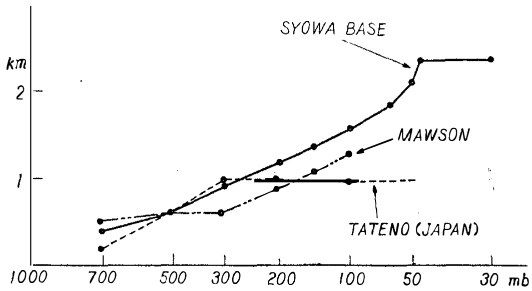

Fig. 1. The max-min range of heights of various kinds of isobar in middle and high latitude through the year.

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Fig. 1 shows the max-min range of heights of various kinds of isobar in middle and high latitude through the year. The curve has a clear knee at about 50 mb isobar, as you can see, in high latitude, contrary to this at about 300 mb in middle latitude.

From the results described above, it is clear that in order to get the correct correlation between the intensities and temperatures of the upper atmosphere we have to take consideration such a high altitude.

Figs. 2 and 3 show the curves of $r_{IH \cdot N}$ and $b_{IH \cdot N}$ (partial correlation coefficient and temperature coefficient) versus the several kinds of isobar. It is obvious that the more we take the isobar level higher, the more we can get the correlation better.

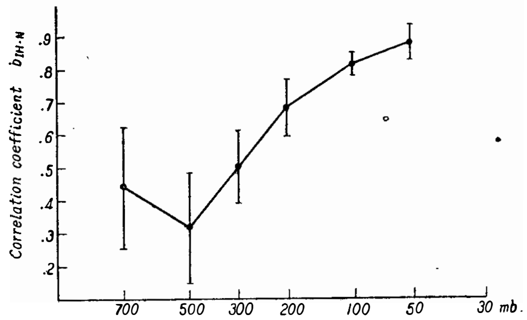

Fig. 2. Partial correlation coefficients of cosmic-ray intensities with isobar levels.

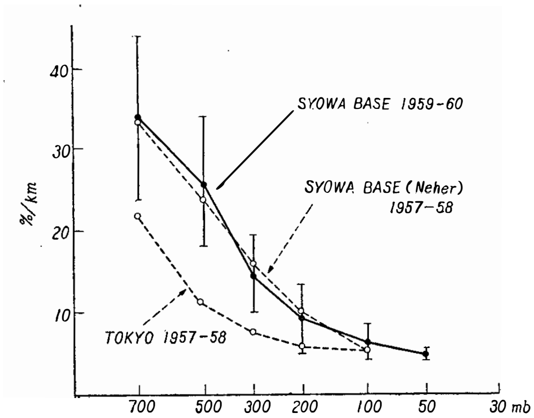

Fig. 3. Atmospheric temperature coefficients of cosmic-ray.

Diurnal variation The surface temperature at Syowa Base shows clear difference between the winter season (4, 5, 6, 7 and 8) and summer season (9, 10, 11, 12 and 1), that is summer season have clear diurnal variation but winter season not.

According to the results of the analysis of Neher type ionization chamber, the amplitude of cosmic-ray diurnal variation shows the clear difference between these summer and winter seasons.

In this paragraph the farther detailed analysis this point is made.

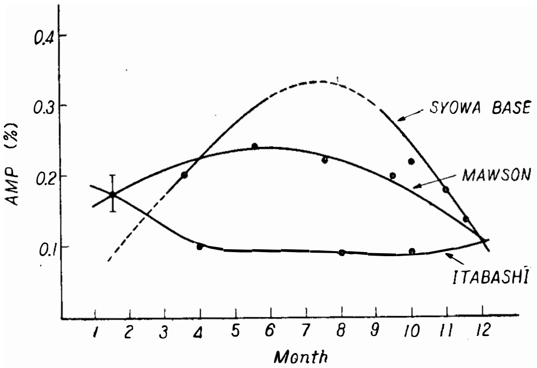

Fig. 4. The seasonal variation of the amplitude of diurnal variation of cosmic-ray in Antarctica and in middle latitude.

Fig. 4 shows the seasonal variation of the amplitude of diurnal variation of cosmic-ray in Antarctica (Syowa Base, 1957–58; 1959–60; Mawson, 1958–59) and in middle latitude (Itabashi 1959–60).

The difference between the high latitude and middle latitude is obvious. We consider that this may be due to the atmospheric conditions.

In order to extract the atmospheric parts from the curve in question, we have to eliminate the parts of primary cosmic-ray changes from the curve. We used the data of Neutron Monitor at Mawson 1959–60 as the primary cosmic-ray changes.

Table 1 shows the results.

Now there may be raised one question. That is, in order to get the diurnal variation of level from the residual parts subtracted the primary cosmic-ray changes, what number of coefficient between the height and intensities we should use?

From the result obtained from preceding paragraph, the coefficient is about 5%/km. But

Table 1.

	O	I	A	A/coef.
Apr.	1.9‰	2.5‰	−0.6‰	20 m
May	1.9	1.6	0.3	10
Jun.	2.2	2.0	0.2	7
			mean	12
Oct.	2.0	1.4	0.6	20
Nov.	1.7	1.4	0.3	10
Dec.	0.8	1.7	−0.9	30
			mean	20

O: Observed amplitude of diurnal variation of cosmic-ray intensities.
I: Ideal change of the amplitude of diurnal variation of cosmic-ray intensities infered from the changes of the primary cosmic-ray (Neutron data).
A: Atmospheric Part, i.e. Obs-ideal parts.
Coef.: It was used 3%/km as the coef.

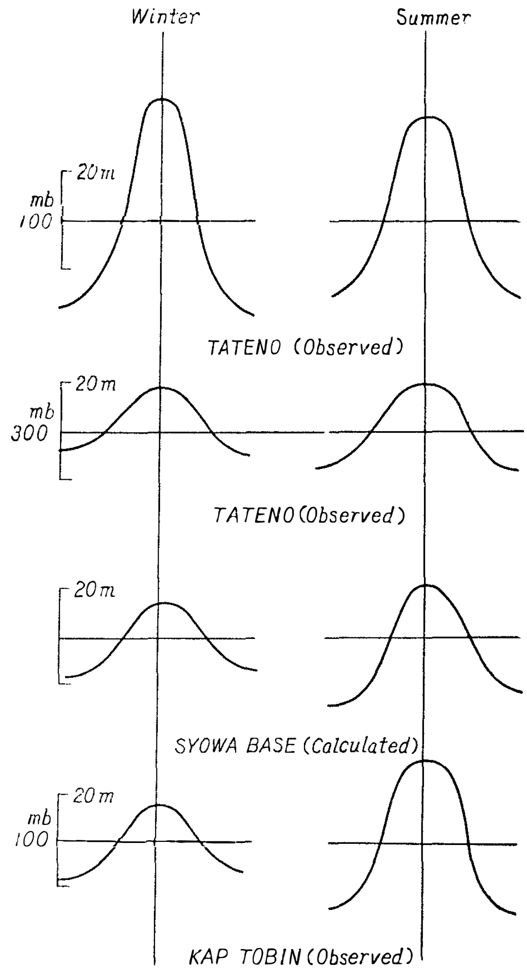

Fig. 5. Calculated (Syowa Base) and observed (Tateno and Kap Tobin) results of the diurnal variations of isobar levels.

according to another various considerations and works, we should prefer to take more small value, say 3%/km, and then we can get the values of diurnal variation of level about 20 m in summer and 12 m in winter season respectively.

In order to compare with the observations, we show the results obtained from the observation of Radio Sonde at Tateno (Japan) and Kap Tobin (east coast of Greenland) in Fig. 5.

Correlation to the magnetic disturbances Beside the correlation to the world-wide magnetic disturbances, we discuss here the correlation to the polar elementary storms only.

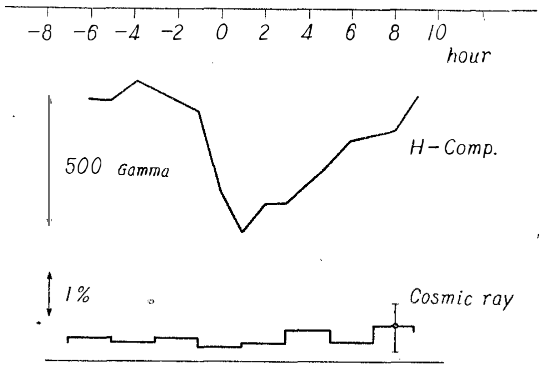

Fig. 6. Correlation between the cosmic-ray intensities and the polar elementary magnetic storms.

Fig. 6 shows the correlation between the cosmics-ray intensities and the polar elementary storms. We used here about 30 examples. Here 0 means the beginning of disturbances and 1, 2, ⋯ and −1, −2, ⋯ are 1 hour, 2 hour, ⋯ later and before the time of beginning of the magnetic disturbances respectively.

From these result, we can conclude that there is no relation between the cosmic-ray and the polar elementa.:y storm. This result may be important in relation to the origin of the polar elementary storms rather than in cosmic-ray itselves.

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