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Dedicated to the Memory of my father

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S T A T E M E N T

In January 1959 the author undertook the maintenance of a neutron monitor which was already in operation at the Physical Research Laboratory, Ahmedabad. This neutron monitor was of the standard IGY design and had two independent but identical sections, each having 3 enriched BF_3 counters. The counting rate of the neutron monitor was about 12500 counts/2 hours. It was decided to expand this neutron monitor and increase its counting rate so that small changes in the cosmic-ray intensity can be reliably studied on a day-to-day basis. For this purpose enriched BF_3 counters were purchased from the Atomic Energy Establishment, Trombay, India. Due to limitations of space in the existing building a new geometry of the neutron pile was tried in which there were two layers of BF_3 counters separated by 2" of lead. A 16-counter neutron monitor was set up in the above design. This was divided into two independent sections each having 8 BF_3 counters (4 upper + 4 lower). The total counting rate of this neutron monitor was about 50,000 counts/2 hours. Reliable data from this neutron monitor were obtained for the years 1962 and 1963.

On account of the geometry of the neutron monitor differing from the standard IGY instrument, the barometric pressure coefficient was experimentally determined and

was found to be about -0.86%/mm of Hg. The variations in the pressure corrected monthly mean counting rate were compared with the data from Mt. Norikura neutron monitor. A part of the variation seems to be due to the atmospheric temperature effect on the nucleonic component.

With the existing facilities it was not possible to further increase the counting rate of the Ahmedabad neutron monitor. However, with the beginning of the IQSY, several high counting rate neutron monitors started functioning at various locations. A study of the modulation of the galactic cosmic-ray intensity was therefore made by using the data from these neutron monitors. It is well known that the electromagnetic conditions of the interplanetary space, relevant to the modulation of the intensity of galactic cosmic-rays are under solar control. In order to relate the ground based cosmic-ray measurements with the conditions in the interplanetary space and those on the sun, a study was undertaken to establish statistical relationships between the solar coronal intensity at 5303 A^{o}, solar wind velocity measured in the interplanetary space and the intensity of galactic cosmic-rays observed at the earth. The solar coronal intensity was particularly chosen since it seems to be closely related to the conditions in the solar corona which are relevant to the solar wind velocity.

The data on λ 5303 intensity have been obtained from the maps of the sun, supplied by the Fraunhofer Institute, Freiburg, while the data on the solar wind velocity, measured on Mariner-2 and IMP-1, have been made available by the respective investigators.

The above study includes the following investigations:

(1) The 11-year variation of the galactic cosmic-ray intensity is compared with the average λ 5303 intensity at each 5^{o} heliolatitude for the period 1957-1967.

(2) Using cross-correlation analysis, an empirical relationship between λ 5303 coronal intensity and solar wind velocity, as measured on Mariner-2 and IMP-1 is established.

(3) The 11-year variation of the solar wind velocity, confined to low heliolatitudes ($\pm 5^{o}$), is estimated for the period 1957-1967 by using (a) the empirical relationship between λ 5303 intensity and solar wind velocity and (b) by using the available data on the temperature of the inner corona following Parker's polytrope model of the expansion of the solar corona.

(4) An empirical relation is established between the long-term variation of cosmic-ray intensity and solar wind velocity at low heliolatitude ($\pm 5^{o}$). In terms of the diffusion-convection model of Parker, the

empirical results are used to estimate (a) the cosmic-ray intensity in the nearby interstellar space and hence the residual modulation at the solar minimum in 1965; (b) radial gradient of galactic cosmic-rays and diffusion coefficient, K_{11}, along the interplanetary magnetic field direction and their rigidity dependence.

(5) Distributions of cosmic-ray intensity perpendicular to the ecliptic plane are empirically estimated by using the distributions of λ 5303 intensity in heliolatitude. Following Subramanian and Sarabhai (1967), numerical calculations are carried out to estimate the diurnal and semi-diurnal anisotropy of the cosmic-ray intensity resulting from these distributions for assumed value of the interplanetary magnetic field strength.

(6) Longitudinal distributions of long-lasting active regions in the solar corona and long-lived Ca plages are studied in relation to the 27-day recurrent variations of (a) isotropic intensity of galactic cosmic-rays measured on the earth (b) anisotropic characteristics of galactic cosmic-ray intensity (c) K_p and (d) low energy cosmic radiation observed by satellites and space probes.

The present study represents perhaps one of the few attempts to quantitatively analyse the relationships of solar activity with conditions in interplanetary space and their effects that are measurable on the earth through cosmic-ray modulation and geomagnetic changes. The results provide interesting insights relevant to the models of the modulation of the galactic cosmic-rays through changes of the electromagnetic conditions of the interplanetary space.

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C O N T E N T S

CHAPTER I. INTRODUCTION