27-Day Oscillation in the Cosmic-Ray Intensity and Shorter Periodicities.

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Summary. — Average diurnal data of cosmic-ray intensity, recorded in the time intervals between July 1955 and December 1958 (maximum solar activity, IGY) and between November 1963 and April 1965 (minimum solar activity, IQSY) at Huancayo with one neutron monitor and one ionization chamber, and at Resolute Bay with one neutron monitor and one cubic telescope of G.M. counters, have been analysed with respect to the recurrent variations of the 27-day period and of shorter periods (approximately 12 days and 6 days). Results of the analysis are herein reported and discussed; it emerges that: a) the amplitude values obtained at the same time with different counters are of the same order of magnitude; b) in the period of maximum solar activity these values are much higher and more correlated (solar modulation effect) than in the period of minimum solar activity (local atmospheric effects).

1. - Introduction.

The intensity changes of cosmic radiation are notoriously related partly to extraterrestrial and partly to terrestrial phenomena. Among the first group (apart from the anisotropy effects of the cosmic-ray flux in the Galaxy) are predominant the variations of solar origin associated with primary spectrum variation of the cosmic radiation outside the terrestrial limits. These changes can be connected to some processes that occur in the Sun and in the solar system: precisely there are modulation effects of the primary cosmic radiation (variations of 11 years, 1 year, 27 days, solar diurnal variation, ...). Furthermore, in certain circumstances (for example in connection with large solar flares) there is sporadic production of cosmic radiation in the Sun itself that can be revealed by the detectors on Earth. The terrestrial variations are
largely caused by atmospheric factors (pressure and temperature changes and the concomitant change in mass distribution of the air column above the observation point) in addition to geomagnetic effects, which are not easy to evaluate.

2. – Object.

Continuous registration of cosmic-ray intensity is generally carried out by means of neutron monitors (NM), counter telescopes (T: Geiger-Müller counters, and sometimes scintillation counters) and, for the measurement of the total intensity of the hard component, by means of screened ionization chambers (I). For particular studies other types of detectors are used. Regarding the meteorological factors, the nucleonic component, revealed by neutron monitors, is subject to the barometric effect only. Instead the muonic component, which is detected by means of counter telescopes (furnished with suitable screens for eliminating the soft component) and screened ionization chambers, in addition to the simple barometric effect, is influenced by the whole distribution in the air column. The result of the latter is the so-called temperature effect, which is not easy to account for exhaustively. Therefore after the correction due to the barometric effect, variations are left, caused by the meteorological effects, which add to the extraterrestrial ones.

Therefore, it is interesting to compare, particularly in the case of quasi-periodic variations, the data of the cosmic radiation intensity revealed by detectors of the nucleonic (NM) and muonic (T and I) components working in the same place, during the maximum and minimum solar activity. In this way, it is possible to compare the relative influence of the temperature and the extraterrestrial effects, and to verify the statements that: a) during the minimum solar activity the quasi-periodic variations (27-day cycle) observed with telescopes and ionization chambers are local, and purely caused by the meteorological effects; b) the amplitude of such variations measured by neutron monitors are almost zero (1).

3. – Experimental data and analysis procedure.

We examined the average diurnal data, already corrected for barometric effect, collected during two different time intervals, July 1957-December 1958 (maximum solar activity, IGY 1958) and November 1963-April 1965 (minimum solar activity, IQSY 1964), and in two different places. We chose Huancayo (latitude 12.05° S, longitude 75.3° W and altitude 3350 m above sea-level) equipped with one neutron monitor (NM) and one ionization chamber (I), and Resolute Bay (latitude 74.7° N, longitude 34.9° W, altitude 17 m

(1) L. I. DORMAN: Progress in Elementary-Particle and Cosmic-Ray Physics, 7, 98 (1963).