CHAPTER I

INTRODUCTION

1.1 Cosmic radiation

Cosmic radiation arrives at the earth from space. The primary radiation is composed mostly of protons and α- particles. When a particle of the primary cosmic radiation with sufficient energy collides with a nucleus in the atmosphere, a shower of secondary particles is generated. From these the meson, nucleons, and soft components of the secondary cosmic radiation are formed.

1.1.1 The meson component

The mesons thus created are mostly $\pi^{\pm}$- mesons which disintegrate into $\mu^{\pm}$- mesons and neutrinos with a mean life of 10^{-8} second :

$$\pi^{\pm} \longrightarrow \mu^{\pm} + \nu$$

Also π^{0}- mesons are produced in the reactions. These are transformed in most cases into two γ - quanta :

$$\pi^{0} \longrightarrow \gamma + \gamma ,$$

There is a probability that the $\pi^{\pm}$- mesons are transformed into the $\mu^{\pm}$- mesons in the atmosphere with a certain minimum energy increase, for the following reasons :

1. the atmospheric density decreases at the altitude of the maximum occurrence of the $\pi^{\pm}$- mesons.

2. the travel direction deviates from the vertical, in which case the $\pi^{\pm}$- mesons have a higher probability of proceeding into the region of lower atmospheric density.

3. the energy of the $\pi^{\pm}$- mesons approaches a certain required meson energy as long as it stays above it.

Because of the first reason, the intensity of the mesons increases at the surface level as the temperature increases in layer where the $\pi^{\pm}$-mesons are usually created. The second reason causes severe difficulties in theoretical calculation. It follows from the third reason that the positive temperature effect is most prominent for the fast $\pi^{\pm}$-mesons, because they are to a large extent lost in the interaction with matter before they disintegrate spontaneously.

1.1.2 The soft component

The electrons in the soft component are produced in μ-meson decays, ionization processes , pair productions, and photon-electron cascades.

The soft component is observed by the effect produced, mainly with the photon-electron cascades. The effects produced in interactions with the matter are so complicated that it is hopeless to estimate the total intensity of this component with the aid of the phenomena involved.

1.1.3 The nucleon component

The nucleon component consists of neutrons and protons. Experimentally their relative numbers at sea level have turned out to be

$$\frac{N_n}{N_p} = \frac{W^2}{W^2 - (mc^2)^2},$$

Where N_n is the number of neutrons, N_p the number of protons an W the total energy. The number of protons and neutrons are equal at high energies but the neutrons out number protons at lower energies because of the ionization energy loss of protons.

Protons are stable and neutrons have a half life of about 13 minutes. Accordingly, the nature of the particles stays constant in the component. Therefore, temperature changes in the atmosphere do not cause appreciable variation in the intensity of the nucleon component.

The meteorological variations of the secondary cosmic radiation are simplest in the nucleon component, because it has, among first order effects, only the pressure variation. This variation is in addition very precisely exponential, so it can be avoided by correction the recordings into a constant pressure, if the effect disturbs the measurements. The nucleon component has, further more, the largest known latitude effect (1), so that it is also suitable for studying the intensity variations of the low energy primary radiation. For these reasons, the nucleon component offers the easiest way to study the variations of primary cosmic radiation.

1.2 Neutron momitor

Knowledge of cosmic radiation has accumulated rapidly during the past few decades. Now detection devices have been developed. The most notable of these is the neutron monitor.

When one measures the intensity of the nucleon component, it is experimentally easier, more reliable, and more accurate to use low energy neutron counters instead of counters based on direct ionizations because the low energy neutrons are emitted isotropically from reacting nuclei (2).

The BF_3 - neutron counter is sensitive to low energy neutrons, and therefore it counts neutrons which are produced in its close neighbourhood and moderated in the surrounding matterial. The counter situated in the free air space is, however, sensitive to changes in the neighbourhood, such as movement of heavy objects, snowfalls, etc. So the recorded intensities are relatively low.

For the geophysical year 1957/1958, J.A. Simpson developed a neutron monitor which has been later called Simpson's standard monitor. The weaknesses previously mentioned have been avoided by using a massive lead construction around the BF_3 - counters in order to produce neutrons and by protecting the system against the outer disturbances with a paraffin layer. The details of this have been described by Pairoaj Tiranathanagul (3).

1.3 The necessity of stabilized circuit

Electronic circuits are the coupling between the counters and the recorder. Stability from oscillating and changing of the operating point of the active element is the most important thing for the work. Nonstabilizing circuit will cause the recorder to record undesired signals. The result obtained will be useless. The nonstabilizing biasing problem is due primarily to the change of transistor parameters with temperature and the variation of these parameters between transistors of the same type.

The stabilizing circuit is quite important for the neutron monitor because this instrument is run day and night. Anyhow, in his work, Mr. Pairoaj Tiranathanagul (3) did not aim at this point, therefore, the long-run data would give unreliable results all the time.