CHAPTER I

INTRODUCTION

Since the discovery of cosmic rays at the end of the nineteenth century, cosmic rays have been utilized primarily as a natural source of high energy particles and these investigations later led to the discoveries of fundamental particles such as mesons, hyperons, etc.

Johnson (1) was the first to detect the East-West asymmetry and noted that the effect was geomagnetic. The geomagnetic theory was first developed by Störmer (2) and later in detail by Lemaitre and Vallarta (3). Since then there have been many experiments performed all over the world to verify this theory. From the East-West asymmetry one can predict the sign of the charge of the primary particles coming to the earth from extraterrestrial origin. It is now known that primary particles consist mainly of about 80 % of protons, about 20 % of α -particles and heavier nuclei up to about atomic number 31. Their most outstanding property is the great energy possessed by the individual particle. After their interactions with oxygen and nitrogen in the air on the way down in the earth's atmosphere, the secondary particles are produced. These secondary particles propagate through the atmosphere and may interact or decay depending upon their properties and energies.

At sea level, most particles are μ - mesons, neutrons and some protons. The intensities of cosmic rays at various depths of the atmosphere are shown in Fig. 1.

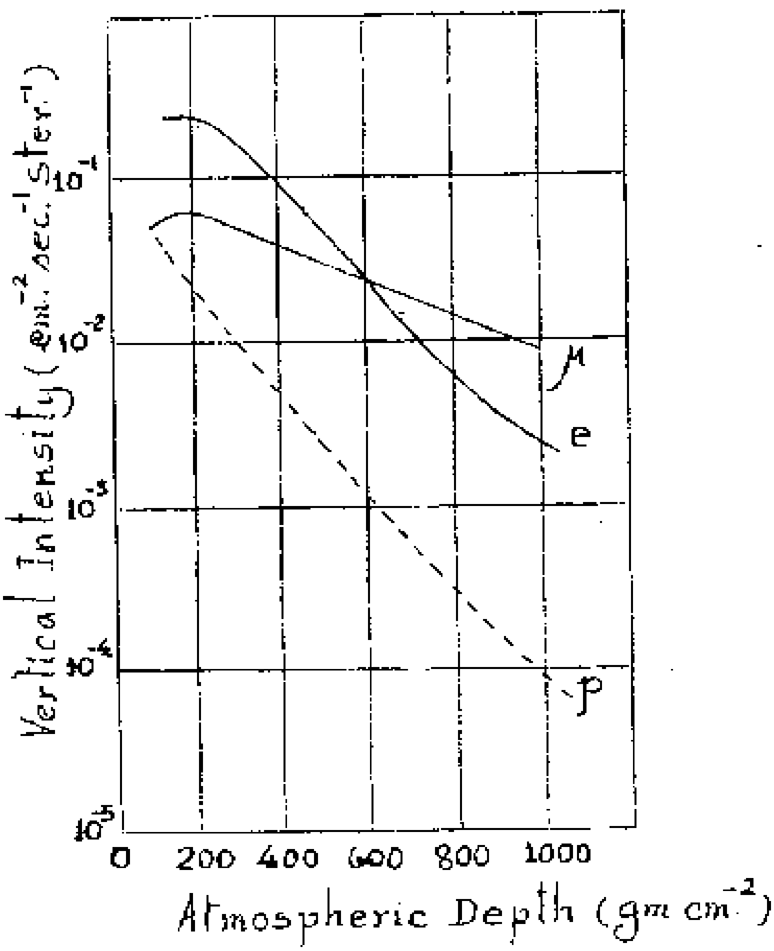

Fig. 1: Vertical Intensities of the Cosmic Radiations, as a Function of Atmospheric Depth

Because the primary particles coming to the earth, are mostly positively charged, they should be deflected by the earth's magnetic field. If a particle comes to the earth in geomagnetic equatorial plane in vertical direction, it will suffer maximum deflection. At the pole, the particles approach the earth in the direction nearly parallel to the earth's magnetic field so that no deflection is occurred. The deflection may cause two variations of primary cosmic rays phenomena. Firstly, the intensities of the cosmic radiation decrease to minimum at geomagnetic equator and rise to maximum at about latitude 60° . This is called latitude effect. Secondly, because the particles are mostly positive, they will be deflected so that their paths will be from the westerly direction in accordance with Störmer theory (2), Lemaître and Vallarta (3) and others. This causes the difference in intensity of particles in easterly and westerly directions. This phenomenon is called the East-West asymmetry, first observed by Johnson, and later by many investigators. The main results are that the asymmetry increases with increasing altitude and decreasing latitude. This effect is expected to be most preponderance at geomagnetic equator and should fall off to zero at the pole. In this region (latitude 13° 46' N), this directional effect has not yet been measured by using cosmic ray telescopes, although the East-West asymmetry of nuclear interaction components were made previously by using nuclear emulsions (4).