it was required that the proton density in the primary fluxes be 4×10^3 particles cm^{-3}; such fluxes have not yet been indicated by the auroral hydrogen emission studies.

It is of interest to point to the possibility of explaining the observed phenomena by the acceleration of electrons in the outer atmosphere by variable magnetic fields in the solar corpuscular fluxes. This acceleration would take place in the conduction loops along the Earth's magnetic force lines in the outer atmosphere and be completed through the ionosphere. The faster electrons are expected in this case to enter at the polar regions, rather than at lower latitudes, as the polar regions connect magnetically to a larger volume of space. The increase of the electron fluxes during the day-time might be explained by the ionization increase at the boundary of the exosphere. As a result of the ionization increase, a great number of ionized particles may get into the outer atmosphere. This may also happen due to magnetic variations P_c, which are more intense during the day-time. Acquiring some speed, the electrons may oscillate along the curved magnetic force lines of the Earth.

The group of Soviet scientists headed by K. I. Grinhauz since 1954 has been investigating the ionosphere by means of very high frequency-dispersion rocket-borne interferometers. The distribution of electron concentration up to the height of 473 km has been obtained. It has been found that above the maximum of the F_2-layer, at heights of 290 km and 473 km, the electron concentration is $1{\cdot}8 \times 10^6$ and $1{\cdot}0 \times 10^6$ electrons cm^{-3} respectively. Below the maximum of the F_2-layer, no strongly pronounced layers of the ionosphere had been found. In general the ionization continuously increases from the bottom up to the maximum of the F_2-layer with many small fluctuations. The F-region and the maximum of the F_2-layer are located 50–150 km lower than is indicated by the results of the usual ionospheric probings.

The group of research workers headed by K. I. Grinhauz has conducted an investigation of the ionosphere by ion traps and probes—the equipment carried by the third sputnik. For the time being the treatment of the experimental results is in its initial stage; thus only some preliminary information characterizing the measurements can be given.

We confine ourselves to considering the measurements at those points of the sputnik's orbit relating to the first day of its flight. These results are typical, although lower values were observed. At a height of 242 km, a density of $5{\cdot}2 \times 10^5$ cm^{-3} for the positive ions, and an effective electron temperature of 7000° K have been recorded during the daytime. At a height of 795 km on the same day the density of $1{\cdot}8 \times 10^5$ cm^{-3} for the ions and an effective electron temperature higher than 15,000° K have been registered.

The indicated investigations show that there exists a large scale height for ionized particles that agrees well with that of the upper atmosphere indicated by observations of the drag experienced by the sputniks. The increase of the electron temperature with height, as well as for the gaseous discharge, can be explained by the increase of the length of the electron mean free path, if electromagnetic fields are present in the ionosphere. Such fields can arise in the process of circulation of the electro-conductive upper atmosphere in the magnetic fields frozen into the corpuscular fluxes of the Sun and interplanetary gas passing by the Earth.

9. SOME RESULTS OF OUTER IONOSPHERIC STUDIES BASED ON RADIO OBSERVATIONS OF THE FIRST SPUTNIK

Y. L. ALPERT

ABSTRACT

The method and results of the study of the outer ionosphere based on the 'rise' and 'set' of radio signals of the sputnik are given in full in the paper of which this is an abstract. Results of the theoretical calculations of the maximum horizontal distance r_M of signal

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reception, which are needed for the treatment of experimental data, are also described. Calculations were carried out for a spherical Earth, and the resulting elliptic integral was tabulated by means of the high-speed electronic computer of the Academy of Sciences of the U.S.S.R. A parabolic model of the lower ionosphere and an exponential decline of electronic concentration in its outer part were accepted.

Parameters of the lower ionosphere (z_o, z_m, ω_c) obtained from observations by the net of ionospheric stations were used for the analysis. The altitude of the sputnik and its horizontal distance from the observational points were determined from observational data and from other investigations of the sputnik's actual trajectories.

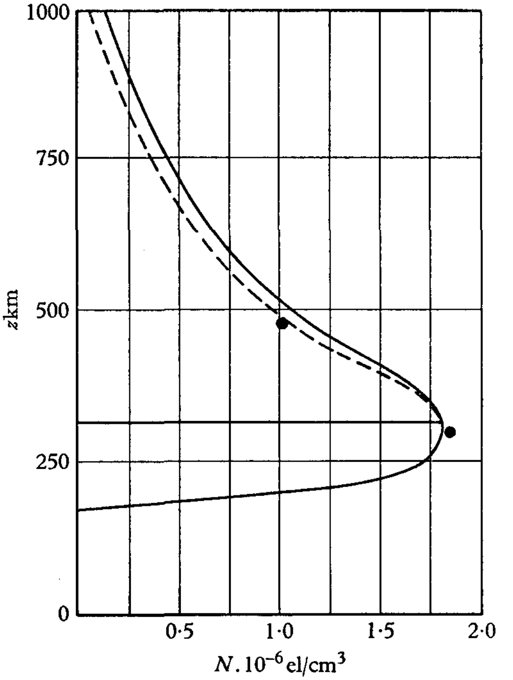

Fig. 1. Electron concentration N as function of height ('altitude') z in kilometres.

The increase of the electron concentration $N(z)$ up to the altitude of its maximum concentration N_m is 5–6 times faster than its decline at higher altitudes (see Fig. 1). The most probable value of $\alpha \sim 3{\cdot}5 \times 10^{-3}\,\text{km}^{-1}$ was determined for the model $N \sim N_m e^{-\alpha^2}$. This gives the number of electrons in the outer part of the ionosphere about 3·6 times that in its lower part. An extrapolation of data obtained for the heights $z \sim 300$–700 km to $z \sim 3000$ km shows that at $z \sim 2000$–3000 km, $N \sim 200$–300 el/cm^3. According to the lifetimes of electrons and the times between different processes of ionization, a density curve $n(z)$ for neutral particles of the atmosphere was plotted. The value of n is of the order of one particle per cm^3 at the same altitude. That is why it is suggested that the 'boundary' of the atmosphere, i.e. the region where it probably comes into contact with interstellar gas, is of the order of 2000–3000 km.