3) N. P. Carleton: Phys. Rev. 107 (1957) 110.

- 4) T. Hikosaka: Rep. Ionosph. Res. Japan, 12 (1958) 469.
- 6) Il'in et al: J. Exp. Theor. Phys. 36 (1959) 41.
- 7) D. Barbier: Ann. Geophys. 14 (1958) 334.
- B. P. Sandford: J. Atm. Teerr. Phys. 21 (1961) 177.

5) M. J. Seaton: loc. cit.

Discussion

Roach, F.E.: Prof. Barbier has found that the N. G. of N_2^+ are not exist in his "mono-chromatic" arc.

Hikosaka, T.: The process is endo-thermic by $\Delta E = -5 \text{ eV}$. Therefore, as Massey's criterion shows, the cross section should be small if the energy of the incident protons becomes too low. This might explain the fact.

Tohmatsu, T.: Protons of several killoelectron volts have rather long life time for geomagnetic mirror motion. Can you explain the duration of the red aurora? Did you assume the possibility of primary excitation of N_2^+ bands?

Hikosaka: (1) This long life is just the needed feature. Because the aurora of this type persists for even several hours without remarkable change. This long persistence and the extreemly large latitudinal and longitudinal extension of the arc, I believe, can only be explained by the "leakage-proton model", that is, the protons which leak out from the Van Allen Belt. (2) There are direct experimental proves that our process occurs with large probability.

Takayanagi, K.: You have used the energy distribution for the secondary electrons calculated by Bates et al for neon. Because of the big difference in ionization potentials, I am afraid, one can not apply their result on the case of oxygen and nitrogen to draw any quantitative conclusions.

Hikosaka, : Some small difference may exists, but the essential conclusion that the energy of the ejected electrons must be small will not fail. It is certified by the conservation law of momentum.

JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN Vol. 17, SUPPLEMENT A-I, 1962 INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-4-10. Balloon Observations of Auroral Zone X-Rays*

Rovert R. BROWN

Department of Physics, University of California, Berkeley 4, California, U.S.A.

A series of balloon flights launched from the vicinity of College, Alaska during the summer months of 1960 show that auroral zone X-Rays are detectable with Geiger counters approximately 10% of the time at pressure altitudes in the range 10–15 mb. The results of these flights indicate that the daily flux of electrons with energies greater than

* No manuscript has been received and the preprint is reprinted. 50 kev over the auroral zone was 6×10^{10} particles/cm² at this time. The results from a similar series of flights carried out in 1961 will be compared with the earlier observations. In addition, observations of X-ray events during periods of extreme geophysical disturbance will be presented, showing the extent to which the electron bombardment of the atmosphere can grow during such conditions.