I-2. Disturbances in Polar Regions

Chairman: J. A. RATCLIFFE
Co-chairman: H. UYEDA

Date	Time	Paper Numbers
Sept. 4	11 : 30 – 13 : 30	from I–2–1 to I–2–7
Sept. 4	15 : 00 – 17 : 30	from I–2–8 to I–2–17
Sept. 5	11 : 30 – 13 : 30	from I–2–P1 to I–2–P4

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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-2-1. Large-Scale Electron Bombardment of the Atmosphere at the Sudden Commencement of a Geomagnetic Storm*

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A large-scale electron bombardment of the upper atmosphere was observed in time coincidence with the sudden commencement geomagnetic storm at 0146 *UT* on June 27, 1960. The electrons, by their ionizing effects, produced a brief increase in ionospheric absorption of cosmic radio noise which was observed by riometers located in Alaska, Sweden, and Norway as well as *X*-ray effects, by bremsstrahlung, which were observed by a balloon-borne radiation instrument over Central Alaska. High latitude riometers located at Thule, Greenland, and Resolute Bay, Canada, did not show increased absorption at the time of the sudden commencement, indicating that the electron bombardment was confined to lower latitudes in the vicinity of the auroral zone. Balloon observations of the *X*-ray burst associated with the event indicate that the electron bombardment lasted about 5 minutes, a total of $3\text{-}9\times10^9$ electrons with energy greater than 50 kev hitting one square centimeter of the atmosphere in this time. Possible mechanisms responsible for the electron precipitation will be discussed.

Discussion

Shapley, A. H.: Could you repeat the date of the principal event you have discussed?

Brown, R. R.: 0146 UT, June 27, 1960.

Waddington, C. J.: Do you have any data on the energy distribution of these electrons?

Brown: No, of the order of 50—200 kev.

* No manuscript has been received and the preprint is reprinted.

Obayashi, T.: Is there any significant onset time difference with respect to the difference of energy precipitating into auroral zone? For example comparing with balloon observations and riometer.

Brown: Nothing of this sort has been observed—as far as we know the balloon X-ray data agree in time with the riometer data.

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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-2-2. The Types of Blackout, Their Time Variations, and the Mechanisms Producing Them*

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Two initially unexplained results appeared in early statistical studies of blackout: (1) Duration increases with latitude, and (2) Maximum percentage of time of blackout has a later local time of occurrence at higher latitudes. The first is the result of the fact that the polar cap absorption events are produced by solar protons entering the earth's atmosphere over periods of days (during a given event) while blackout at lower latitudes has an entirely different primary production mechanism. The explanation offered here for the second is based in part on the difference between the two primary production mechanisms. In addition, it is suggested that at auroral (and lower) latitudes blackout is produced primarily by electrons from an outer Van Allen belt rendered asymmetric by the effects of the solar wind, that photo-detachment is effective during daylight hours in maintaining the absorbing ionization, and finally that (at sub-auroral latitudes) the pre-dawn maximum in blackout occurrence is a result of moderate absorption occurring during the hours of low maximum ionization density in the F-region.

Early statistical studies of the occurrence of polar blackout [Meek, 1952; Cox and Davies, 1954; Agy, 1954] led to two unexplained conclusions:

1) The duration of blackout increases with increasing latitude (in spite of a greater prevalence of blackout near the auroral zone) —Fig. 1; and

2) The maximum frequency of occurrence of blackout is at later local times at higher latitudes—Fig. 2.

The first of these, confirmed in more recent work by Kasuya [1960] has now been explained [Bailey, 1957; Hakura *et al.* 1958; Reid and Leinbach, 1959] as due to a very real difference in type between blackouts normally observed over the polar cap and those observed near the auroral zone. The polar cap absorption events usually begin, at least, within a few hours of the time of occurrence of a solar flare. They can be attributed to the ionizing effects of high energy protons emitted by the sun (at the time and from the vicinity of the flare) and arriving at the earth more-or-less directly. There can be little doubt about their continued arrival at the earth for periods of several days over large areas of the polar cap, although it is unlikely that the emission itself is of long duration. The auroral zone blackouts, on the other hand, are of relatively short duration and are usually limited to relatively small areas—on the order of some hundreds of kilometers in extent. The polar cap absorption events may often occur during magnetically quiet periods, while the auroral

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