pare these results with surface magnetograms, as the closest magnetic observatory is about 500 km south of the scattering region. Without at least one more receiver spaced remote from the two used in this experiment, it is not possible to measure the magnitude of the field distortions; however, a minimum value of two degrees can be established, based on the smallest value of the ratio measured.

References

1) Currie, B. W., P. A. Forsyth and F. E. Vawter: *Radio Reflections from Aurora*, J. Geophys. Research **58** (1953) 179–200.
2) Harang, L. and B. Landmark: *Radio Echoes Observed during Aurorae and Geomagnetic Storms using 35 and 74 Mc/s Waves Simultaneously*, J. Atmospheric and Terr. Phys. **4** (1954) 322–338.
3) Cyce, R. B.: *Auroral Echoes Observed North of the Auroral Zone on 51.9 Mc/s.* J. Geophys. Research **60** (1955) 317–323.
4) Booker, H. G.: *A Theory of Scattering by Non-isotropic Irregularities with Application to Radar Reflections from the Aurora*, J. Atmospheric and Terrest. Phys. **8** (1956) 204–221.
5) Unwin, R. S.: *The Geometry of Auroral Ionization*, J. Geophys. Research **63** (1958) 501–506.
6) Leonard, R. S.: *Distribution of Radar Auroras over Alaska*, Geophys. Institute Scientific Report No. UA6-R116 (1961).
7) Unwin, R. S.: *Studies of the Upper Atmosphere from Invercargill, New Zealand*, Part I, Characteristics of Auroral Radar Echoes at 55 Mc/s, Annales de Geophysique **15** (1959) 377–394.

Discussion

Wright, C. S.: What micropulsation period was found to correspond to the slow period fluctuations of the radar echoes?

Leonard, R.S.: Approximately 10 seconds—however this answer is very preliminary.

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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-2-13. Spiral Distribution of Ionospheric Magnetic Disturbances*

E. I. DOLGOVA**

Some investigations have been made on diurnal variation of basic disturbance phenomena in ionosphere: absorption, the fall of critical frequency of the *F2* layer, sporadic ionization at the *E* layer level, depending on the place of the station to the auroral zone.

A spiral distribution of moments of the most frequent appearance of ionospheric disturbancse was received, which was identical to O. A. Burdo's, A. P. Nikolski's, and Meek's results referring to the disturbances of the earth's magnetic field.

Ionospheric observations for the period of IGY at 48 stations situated beyond 50°N are used in this paper.

Absorption in Ionosphere

Some cases of absolute absence of reflections from ionosphere determined by symbol *B* were taken as characteristic features of absorption. The study was made separately for absorption of the polar cap and of auroral zone-i.e. the absorption of the 3rd and 2nd types.

For investigation of the 3rd type absorption such days were chosen when there was absorption at Resolute Bay, a typical station on the polar cap, and diurnal variation of the reflection absence was determined by those days at all stations. It turned out that the maximum probability of occurrence of the absorption (70–80%) was observed on latitudes 74–83°N; there was no closed band of high absorption values at that time. On

* This paper was read by N. V. Pushkov.
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longitudes 130–180°W and close to the meridian 60°W the probability of appearance of absorption falls to 40–50%. The maximum values of absorption probability at all stations are observed in the morning; at the most stations close to the auroral zone the 2nd maximum is observed about 16 o'clock in local time; the absorption effect seems likely to be felt in the auroral zone of the 2nd type.

To examine the absorption of the 2nd type such days were chosen when there was absorption at the stations on the Dixon, Churchill and College (the days with absorption of polar cap type were eliminated).

It was stated that the maximum probability of absorption appearance is about 40% in the semicircle of 4–7° width situated in the region of longitudes 30°E–90°W. In the Greenland region on longitudes 69°W–0° the probability of absorption appearance falls to 15%. On latitudes farther to the North than 83°N in the eastern hemisphere and 75°N in the western hemisphere the absorption of the 2nd type generally is not observed at all. In the South the zero line goes along 60°N in the eastern hemisphere descending to 45°N in the western hemisphere.

The moments of maximum probability of appearance of absorption depending upon latitude, was considered both for all days and separately for the days with different degrees of magnetic activity.

The marked shifting of the moments with the most frequent appearance of absorption was observed only for equinoctial months. This dependence was shown in Fig. 1 by a continuous line (the geomagnetic time and the distance up to maximum isochasm in degrees were used as coordinates in this figure). For days with strong magnetic disturbance besides the morning spiral there is an evening one of the most frequent absorption appearance.

Sporadic Ionisation in the *E*-Layer Region.

The diurnal variation of probability of appearance of screening E_s layer, with a group retardation typical for the auroral zone, has been studied here. (E_{sr})

The diurnal variation of such E_{sr} layer changes with latitude and has two maxima (Fig. 1 dotted line).

In the auroral zone the E_{sr} layer is observed more often about 1 p.m., and has the most critical frequencies reaching up to 5–7 Mc/s at the period of disturbances. While moving to the North from the zone, an evening maximum shifts to the earlier hours, and the morning one to the later hours. The critical frequency with such phenomena falls to 2–3 Mc/s or even less than that.

Disturbances in the *F2* Layer Region.

As an indicator of disturbance in the *F2* layer negative deviations of Δf_0F2, equal or even more than 20% (in absolute meaning) of critical frequency of the *F2* layer during quiet magnetic days were used. Only summer months were taken into consideration. The received dependence of more frequent disturbance moments in the *F2* layer was plotted by the dotted line in Fig. 1, and has the shape of three spirals, two of which — the evening and the morning ones coincides with the spirals of the most frequent appearance of the E_{sr} layer.

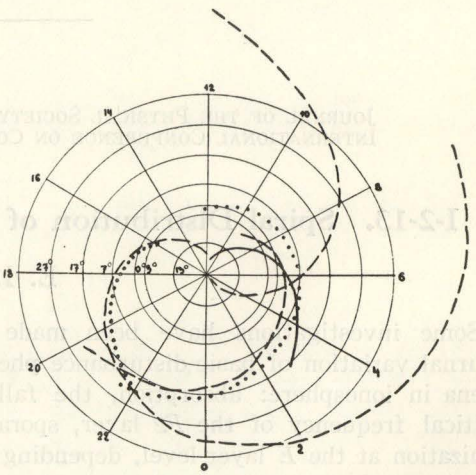

Fig 1.

The greatest probability of disturbances in the *F2* layer in summer months is observed not in the auroral zone, but for some 8–9° more to the North of the zone; that coincides with A.P. Nikolski's conclusion about the increasing of magnetic activity in summer, in the region of so called 2nd magnetic disturbance zone.

The spiral distribution was received for the vast number of geophysical phenomenon. The interpretation of such kind of relation

meets great difficulties. Probably, the most suitable explanation is the one from the point of view of Störmer's theory.

However, one must be careful in the direct identification of Störmer's precipitation line with the observed curves.

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I-2-14. Geographical Distribution of Ionospheric Disturbances in High Latitudes*

R. A. ZEVAKINA**

Disturbance process is considered simultaneously in low and upper ionosphere. With this aim there analysed the synoptical charts Δf_{min}, fE_s and $\Delta foF2$, drawn in polar geomagnetic coordinates by the data of 38 stations of the northern hemisphere (Δf_{min} and $\Delta foF2$ were taken from the medians on quiet days). To present the distribution of the abnormal variations of the ionosphere, depending on season and disturbance intensity, the synoptical charts of Δf_{min}, fEs and $\Delta foF2$ were considered for all the days of July, September and December 1957 for 0, 6, 12, 18 o'clock of the universal time. For the more interesting periods the charts were drawn for each hour. September was very much disturbed, during the month 4 very great disturbances were observed and December was rather quiet–4 small disturbances were observed. 4 disturbances (3 small and 1 very great) were registered in July.

As a characteristic of a disturbed state of ionosphere there adopted: full (B) and increased absorption ($\Delta f_{min} > 40\%$), $fEs > 4$ Mc/s and declination $foF2$ from medians ($\Delta foF2$) more than 20%.

For the period considered 5 very great geomagnetic disturbances with sudden commencement were observed. In all five cases ionospheric disturbances began 1–2 days earlier than magnetic ones.

Figs. 1, 2 and 3 give as an example a number of synoptical charts Δf_{min}, $\Delta foF2$ and fEs during the ionospheric disturbance, observed from 20 to 26 of September, 1957. The magnetic disturbance began at 10^h06^m on Sept. 21, 1957. On the charts the regions of abnormal values of Δf_{min}, $\Delta foF2$ and $foEs$ were contoured. Before the geomagnetic disturbance in the low ionosphere abnormal absorption (Fig. 1a) and the clouds of Es with high fEs (Fig. 3a) were observed. In the region $F2$ a considerable increase of $foF2$ (Fig. 2a and 2b) took place. Before the magnetic disturbance abnormal absorption were observed in small regions. With the beginning and development of geomagnetic disturbance the sizes of the regions with abnormal absorption considerably increase (Fig. 1b). In active periods abnormal absorption spreads along all the space from the pole to the geomagnetic latitudes 50–60°N and sometimes even more to the South. To the end of the disturbance the zone of abnormal absorption gradually reduces (Fig. 1d, 1e, 1f). In this period the regions of abnormal absorption as well as at the first period sometimes resemble spirals (Fig. 1d).

In the $F2$ region with a magnetic disturbance commencement a considerable decrease of $foF2$ takes place, which on the larger part of the territory remains to the disturbance end (Fig. 2 c, d, e). As well as in the low ionosphere, anomalous variations of $foF2$ develop as separate regions, more often they happen to be several (Fig. 2). Its greatest value $\Delta foF2$ reaches in the zone of auroras and somewhat more to the south.

Simultaneously with anomalous variations in absorbing and F regions a considerable increase of fEs is observed on the night side

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