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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part I

I-1-10. Magnetic Bay-Form Disturbances and Their Connection to the Phenomena in the Ionosphere*

M. PUDOVKIN and I. KOROTIN
Polar Institute of the Academy of Sciences of the USSR, U.S.S.R.

Individual magnetic disturbances were investigated to find out the configuration and the height of the currents, causing them, the mechanism of their excitement and their connections with other geophysical disturbances.

As an initial material the data of a number of field magnetic variation stations, working simultaneously on a small territory in the northern part of the western Siberia during the summers of 1953, 1954 and 1957 as well as the data of the Murmansk Geophysical Observatory for the winter of 1959-60 were used.

Separate well developed bays of half-an-hour to two hours duration with the amplitude δH not less than 100γ were chosen for the investigation.

As a result of a number of bays' analysis the following conclusions were drawn:

1. Electrical currents, causing geomagnetic bays, run at 100-150 km height as strips of 200-500 km width.

2. These currents are displaced during a disturbance in a meridional direction with the speed of 60-120 km/sec. This is explained by the fact that the clouds of increased ionization where these currents run, are torn off from the place of corpuscular stream injection and are drawn by the ionospheric wind. The wind speeds, obtained using the magnetic data, are confirmed by the results of ionospheric drift measurements conducted by the space method. At the height of 100-120 km the wind direction appears to coincide with the direction, obtained by the magnetic data, and at the height of 120-150 km is opposite to it.

3. During negative bays the meridional component of wind speed is directed from S to N, and during positive ones from N to S. In the southern hemisphere (Obs. Mirnii) we see the opposite, that is positive bays are connected with the wind directed from S to N, and negative ones from N to S. And at the time when the meridional component of wind speed in its daily variation passes through the zero, the sign of the bays observed changes and SD-variation is equal to zero. Consequently, the intensity of electrical currents in ionosphere is connected with wind speed and geomagnetic field by the relation $\vec{j}=\kappa[\vec{v}, \vec{z}]$. As this dependence fully respond to the demands of dynamo-theory [1] and because it is difficult to explain it from the point of view of other theories, the obtained results show that the main role in excitement of electric currents in ionosphere is played by dynamo action.

4. As the density of electric currents in ionosphere is proportional to the conductivity, that in its turn is proportional to the density of ionization N, one may suggest that (when other factors are constant) $N=\kappa\delta H$, where κ- is a proportion coefficient. The value $\kappa=3\cdot10^3$ cm$^3\gamma$ was determined from the dependence of Sq-variation amplitude of magnetic field H-component on density ionization. Thus, the investigation of H variation allows to judge N-variation in that region of ionosphere, where currents run, that is in E-layer. The analysis of the material obtained showed that the density of ionization in moving clouds at night decreases with the speed, equal to the recombination speed with the coefficient $\alpha=1\cdot10^{-9}$ cm^3/sec. However, the effective recombination coefficient α is not constant and depends on ionization density in such a way that $\alpha=c/N$; $c=(5\sim10)10^{-4}\,\text{sec}^{-1}$. Such a dependence of α on N is probably explained by the fact that recombination takes place primarily due to neutralization of positive and negative ions. And the coefficient of electron sticking to neutral molecules is equal to $(5\sim10)\cdot10^{-16}$, that agrees with the data of other authors [2].

5. The variation of aurora luminescence integral intensity, measured by 180° photometer (δT), is close to δH-curve. And between

δT variation and δH one can observe the following characteristic differences:

a) δH maxima are late compared with δT maxima;

b) after passing the maximum δI rapidly falls to the initial level, while δH returns to the normal level much slower. These facts allow to suggest that between δI and δH there is a functional dependence. The peculiarities mentioned, which differ δH variation from δI variation, indicate the fact that δI is proportional to the speed of ion formation q. δH calculations on δI variation with the account of a wind daily variation for a concrete magnetic storm confirm this suggestion.

Literature

1) N. Fukushima: Journ. Faculty Sci. Tokyo Univ. II, **6** (1953) 293.
2) Alpert, Ginzburg and Feinburg: Radiowave propagation. Moscow (1953).

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I-1-PO. Summary of I-1-1 to I-1-10

E. H. VESTINE (at request of S. CHAPMAN)

Professor Chapman yesterday discussed earth storms in retrospect and prospect. With respect to morphology of storms he could hardly have visualized the prospect of the exciting and rewarding afternoon of papers I wish next to discuss. Following a different order than that of presentation, I begin with the paper by Paghis, on magnetic impulses and sun-earth relations. He considered 817 magnetic impulses of the years 1949–59 and looked for numbers of repetitions of these events at daily intervals in time up to $\Delta t=70$ days. It was found that the 27-day recurrence tendency appeared strongly in the data for a set of years of decreasing sunspot activity, and less distinctly in years of rising solar activity. The events in the years declining sequentially in sunspot number, with several repetitions of disturbances gave rise to several sets of sharply marked repetitions at even shorter intervals, which were noted as a feature of the data. It was pointed out that for this reason great care is necessary in statistical analysis of the data which obviously are not necessarily normally distributed.

There was a paper on solar-terrestrial relationships during the IGY and IGC by H. Maeda, K. Sakurai, T. Ondoh and M. Yamamoto of Kyoto University. They began with events on the sun and looked for related events on the earth. They concluded that almost all ssc geomagnetic storms during the period were associated with solar flares accompanied by great type IV continuous radio bursts and type II outbursts. They also found that total flux density of associated radio outbursts was correlated well with magnetic storm intensity. They also found that the magnitude of ionospheric storms is well correlated with the presence of the nonsymmetrical part of the earth storm *DS*. It was brought out that radio emission near the central meridian and possibly in the northern hemisphere of the sun was most important, but that flares near the east limb seldom gave rise to a storm with strong *Dst*, a matter also discussed in connection with data in a following paper by J. Roosen and L. D. de Feiter. This was the paper: The Relations between Solar Flares and Geomagnetic Storms, dealing especially with solar radio bursts in relation to terrestrial events accompanied by solar flares. They found that a magnetic storm with sudden commencement was accompanied by outbursts over a wide range, from measurements at 200, 550 and 3000 Mc/s. Another finding was that a threshold in average energy flux of relative numerical value 150, 10, and 5 was ordinarily necessary at these respective frequencies.