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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part II

II-1B-2. Investigations of *Pc* and *Pt* Pulsations in Respect of Magnetic Storms*

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The regularities of *pc* and *pt* excitation as well as their amplitude and frequency distribution in the disturbed magnetic field conditions are investigated. The fluxometric and earth current records of the Soviet stations are used. The behaviour of continuous pulsations (*pc*), pulsation trains (*pt*) and short periodic polar disturbances (*pd*) is analysed during different phases of magnetic storms. The tendency of the 27-day recurrence is investigated for different types of pulsations. The cases of intensive world wide *pc* occurring after some magnetic storms are defined and analysed. A preliminary scheme of magnetic storms development in respect of pulsations is given. Special attention is drawn to the microstructure of the Earth's electromagnetic field before and after the storms. The properties of *pt* and *pd* excitation revealed in the course of the investigation of the Arctic and the Antarctic records are used to discuss the peculiarities of corpuscular stream injections in the Earth's atmosphere.

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II-1B-3. Pulsations During Sudden Commencements of Magnetic Storms and Long Period Pulsations in High Latitudes**

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The analysis of the records of the standard magnetographs (with time scale 20 mm per hour) obtained from 1956 to 1960 at the polar observatories of Tikhaya Bay, Cape Chelyuskin, Dixon Island, Cape Wellen, Tixie Bay, and at the middle latitude observatory Voyeikovo has shown that the regular geomagnetic pulsations usually observed on these records are of the following types:

1) *Common giant pulsations* (*Pg*), characterized by comparatively small amplitudes (10–20 γ) and periods in the range of 90–120 sec not depending on geomagnetic latitude Φ.

2) *Long-period giant pulsations* (*Pgl*), of which amplitudes amount to tens and hundreds of gammas and periods range from ~100 to ~600 sec increasing with the increase of Φ.

3) *Pulsations during sudden commencements* (*Psc*), having the form of damping oscillations with the periods 120 to 270 sec also increasing with the increase of Φ.

In the present paper the last two types of pulsations will be discussed.

In Fig. 1a and 1b the examples of *Psc* are shown.

For the determination of the diurnal variation of the *Psc* periods and of their occurence frequency, there was not enough of experimental material, but it has been observed that *Psc* occurring at polar observatories near 01 to 02 h UT have usually much smaller

* No manuscript has been received and the preprint is reprinted. It was read by Troitskaya under the title of "Geomagnetic Pulsation of Various Periods." Discussion is given after II-1B-3.

** This paper was read by V. A. Troitskaya.

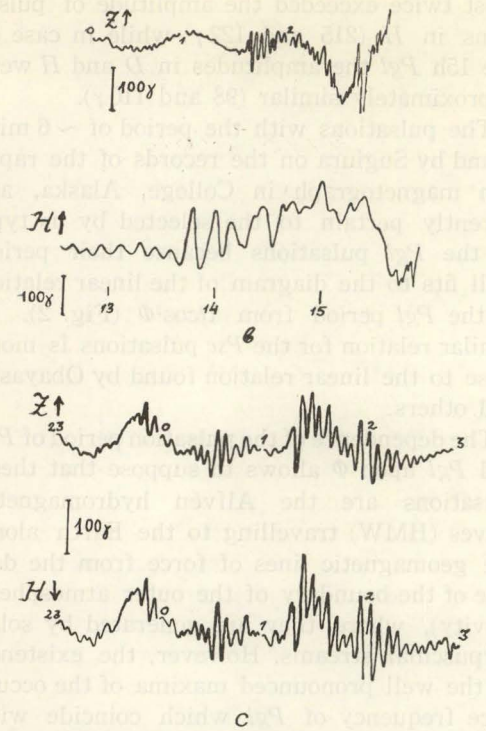

Fig. 1. Examples for *Psc* and *Pgl* on the records of high latitude observatories; a- *Psc* at Tixie during *SSC* 1^h38^m UT April 80, 1956; b- *Psc* at Dixon Is. during *SSC* 13^h44^mUT July 19, 1957; c- *Pgl* at Cape Chelyuskin May 12-13, 1960.

period than *Psc* observed near 13 to 15 h UT.

The maximum of the number of aperiodical sudden commencements and the number of cases without *SSC* at the given observatory at the moment of world-wide *SSC* falls also on the interval 13 to 15 h UT.

In Fig. 2 the mean values of periods for all *Psc* observed at every station are shown. It has been found that the periods of *Psc* observed simultaneously at three and more stations have on an average the values which are close to the values shown in Fig. 2. From this figure it follows that the periods of *Psc* noticeably increase with Φ.

The *Psc* pulsations are displayed best of all in the auroral zone, they are completely absent in the polar cap, for instance, in Tikhaya Bay and they are observed in subauroral latitudes in a comparatively small number.

One characteristic feature of records of high-latitude and subauroral observatories during *SSC* is stressed. Oscillatory regimes

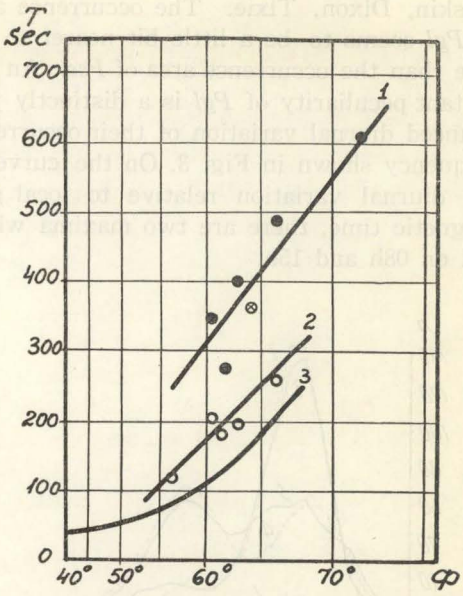

Fig. 2. Dependence of the period of *Pgl* and *Psc* pulsations upon geomagnetic latitude: 1- for *Pgl*, 2- for *Psc*, 3- for pulsations distinguished by Obayashi; ⊗-pulsations found at College by Sugiura.

of the geomagnetic field, as a rule, differ sharply at the time before the *SSC* and after them. Even if after *SSC* the increase of disturbance does not occur at once, the general character of records changes: the amplitudes and quasiperiods of irregular fluctuations of the field change. The changes of the oscillatory regime are also appreciable during such world *SSC* which are not observed at the given station.

For the *Pgl* pulsations the modulated amplitude is characteristic (a typical example of *Pgl* is shown in Fig. 1c).

In their peculiarities *Pgl* are similar in many respects to *Psc*, in particular the mean periods of *Pgl*, as it is seen from Fig. 2, also increase with Φ.

As these pulsations are very local, one failed to carry out the comparison of the periods for the pulsations observed simultaneously at several stations.

The geographical distribution of *Pgl* is characterized with a remarkable concentration of them in the auroral zone; in Tikhaya Bay their number is not great and they are completely absent in Voyeikovo (middle latitude station); the greatest number of them was observed at the auroral zone station: Che-

lyuskin, Dixon, Tixie. The occurrence area of *Pgl* seems to be a little bit nearer to the pole than the occurrence area of *Psc*. An important peculiarity of *Pgl* is a distinctly pronounced diurnal variation of their occurrence frequency shown in Fig. 3. On the curve of the diurnal variation relative to local geomagnetic time, there are two maxima which fall on 08h and 15h.

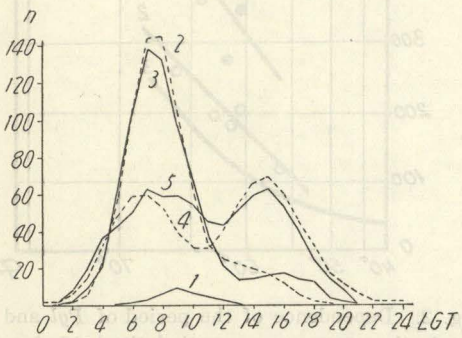

Fig. 3. Diurnal variation of the occurrence frequency of the *Pgl* pulsations (1957-1958) in local geomagnetic time for observatories: 1–Tikhaya Bay, 2–Cape Chelyuskin, 3–Dixon Is., 4–Wellen, 5–Tixie.

The first maximum is expressed best of all on the northern boundary of the auroral zone (Chelyuskin, Dixon) and the second one is on the southern boundary of the zone (Tixie, Wellen). The amplitude and period measurements of *Pgl* at Cape Chelyuskin have shown that the polarization of pulsations pertaining to various maxima is different. In case of the 08h *Pgl* the mean amplitude in *D* is almost twice exceeded the amplitude of pulsations in *H* (215 and 122 γ) while in case of the 15h *Pgl* the amplitudes in *D* and *H* were approximately similar (98 and 110 γ).

The pulsations with the period of ~ 6 min, found by Sugiura on the records of the rapid run magnetograph in College, Alaska, apparently pertain to the selected by us type of the *Pgl* pulsations because their period well fits to the diagram of the linear relation of the *Pgl* period from $1/\cos^2\Phi$ (Fig. 2). A similar relation for the *Psc* pulsations is more close to the linear relation found by Obayashi and others.

The dependence of the pulsation period of *Psc* and *Pgl* upon Φ allows to suppose that these pulsations are the Alfvén hydromagnetic waves (HMW) travelling to the Earth along the geomagnetic lines of force from the day side of the boundary of the outer atmosphere (cavity), where they are generated by solar corpuscular streams. However, the existence of the well pronounced maxima of the occurence frequency of *Pgl* which coincide with the morning and day-time maxima of geomagnetic disturdances, will be explained only in the case if one allows that HMW travel from the hollow boundaries not along the all lines of force but only inside the narrow force tubes involving streams of particles which are responsible for magnetic disturbances observed at 08h and 15h geomagnetic time. Thus, these force tubes may play a role of waveguides for HMW which are responsible for the *Pgl* pulsations observed at the Earth's surface.

Discussion

Parkinson, W. D.: Are *Lpc* the same thing as *Pg* (giant pulsations)?

Troitskaya, V. A.: *Pg* has period 60–120 seconds. It probably has a different morphology to *Lpc*.

Dessler, A. J.: Do you find any correlation between *K* (or *Q*) index during a magnetic storm and pearl activity near 1 c/s?

Troitskaya, V. A.: The pearls near 1 c/s appear at the end of *IPDP* (interval of pulsations diminishing on periods), which take place when *Kp* for the storms reach its maximum value. Besides they can be dispersed during the storms, but usually with slightly greater period (1.5–2.5 sec) in middle latitudes.

Yanagihara, K.: Do you find any difference between initial phase *pc* and main phase *pc*?

Troitskaya, V. A.: We found differences in the magnetic storm fine structure in respect of pulsations for clearly expressed initial and main phases. Our preliminary suggestion is that *pc* are typical for the initial phase of the storm, and the character of pulsations change when the main phase of the storms develops. They are no longer *pc*, but give more irregular form, and interchange of different types of pulsations is characteristic for the main phase.