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Page	Line	Read	For
31	Fig.4	$\overline{(\Sigma K)'}$	$(\Sigma K)'$
	Fig.4	$\overline{\Sigma K}$	ΣK

On the Frequency of Geomagnetic Pulsations Observed in Japan during the IGY (I)

By

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概　　要

IAGA 第10委員会に出している国際報告等にもとずき，毎月の脈動出現頻度，季節変化についてしらべた．pt と pc では頻度分布においてだいぶん異るところがみられる。各観測所どうしも差異が区々である。使用する器械の差異についてもふれ，国際規約の形式えの希望（脈動指数）も併せ述べた。

§ 1. Introduction

According to the form of report of the bureau of the IAGA Committee 10 on "Rapid variations and earth currents" at Ebro, Spain, data of pulsations, pt and pc, are concerned mainly to their times of occurrence, three kinds of class of distinctness of appearance, A, B and C, but not the amplitude, period and other characteristics of the waves, even for the A class pulsations. So, as far as these data are concerned, the first important attempt to deal with the pulsations is to clarify their time frequencies as well as their characteristics of the occurrence and distribution in the scale of the globe or in the regional extent. Along this line of intention, the frequencies of the geomagnetic pulsations observed at the IGY stations in Japan are preliminarily summarized in this note.

§ 2. Equipments for the observations of pulsations used in this note

Memambetsu (C 034)

Geomagnetic coordinates : Lat. 34°.0, Long. 208°.4.

Equipments : Rapid changes with three sensitive variometers and a microfilm recorder, and time variations with three large loops buried in the ground.

Sponsor organization : Kakioka Magnetic Observatory.

Onagawa (C 117)

Geomagnetic coordinates : Lat. 28°.3, Long. 206°.8.

Equipments : Time variations with three induction magnetometers with high magnetic permeability cores.

Sponsor organization : Tōhoku University.

Kakioka (C 147)

Geomagnetic coordinates : Lat. 26°. 0, Long. 206°. 0.

Equipments : Rapid changes with three sesitive variometers and a microfilm recorder. Sponsor organization : Kakioka Magnetic Observatory.

Shimosato (C 214)

Geomagetic coordinates : Lat. 23°. 0, Long. 202°. 4.

Equipments : Time variations with three induction magnetometers with high magnetic permeability cores.

Sponsor organization : Japanese Hydrographic Office, Maritime Safety Board.

Kanoya (C 245)

Geomagnetic coordinates : Lat. 20°. 5, Long. 191°. 1.

Equipments : Time variations with three large loops buried in the ground.

Sponsor organization : Kakioka Magnetic Observatory.

§ 3. Mean frequencies of pt and pc

The monthly frequencies of pt and pc are meant here by the total numbers of occurrence as whole phenomenon every month at each station, and expressed in two groups, (A+B)-group and C-group; the former is of the sum of numbers belonging to A and B classes, while the latter of those belonging to C class. The reason why the (A+B)-group is introduced is merely due to very small numbers in A class at Memambetsu, Kakioka and Kanoya.

The monthly frequencies for (A+B)-group, deduced from the available data at hand in the early January, 1959 at each station, are shown in Fig. 1. And the

Table 1. Mean frequencies per month in 1958.

Station	(A+B)-group			C-group			C-group/(A+B)-group	
	pt	pc	pc/pt	pt	pc	pc/pt	pt	pc
Memambetsu*	4.1	12.2	3.0	9.5	19.0	2.0	2.3	1.6
Onagawa†	(4.6)	(5.6)	(1.2)					
Kakioka*	4.0	5.5	1.4	8.4	15.5	1.8	2.1	2.8
Shimosato	9.3	10.4	1.1	12.8	13.3	1.0	1.4	1.3
Kanoya*	4.8	11.8	2.5	12.5	17.2	1.4	2.6	1.5
Mean of *	4.3	9.8	2.3	10.1	17.2	1.7	2.3	2.0

† A class only.

mean frequencies per month in 1958 are given in Table 1, in which mean values, $\overline{pt}$ and $\overline{pc}$, deduced from the three stations, Memambetsu, Kakioka and Kanoya are shown in the last line.

From these data it may be said that the mean monthly frequencies are approximately equal, as a whole, at all stations in each group, taking both the different instruments used and more or less vague classification of phenomena into consideration. And the mean monthly frequency of pc is about twice that of pt for both groups, while both pt and pc in C-group occur about twice as frequent as those in (A+B)-group.

Concerning further details of frequency distribution in space and of instrumental dependency, if any, the researcher himself should examine of the reproduced original records.

In order to get some reliable image, however, about the space distribution of the monthly frequencies the ratio of their mean values per month, $\overline{pc}/\overline{pt}$, are shown in Fig. 2 in respect to the geomagnetic latitude Φ. It depends fairly well on Φ, its functional form being determined by the similar world-wide data of the IGY.

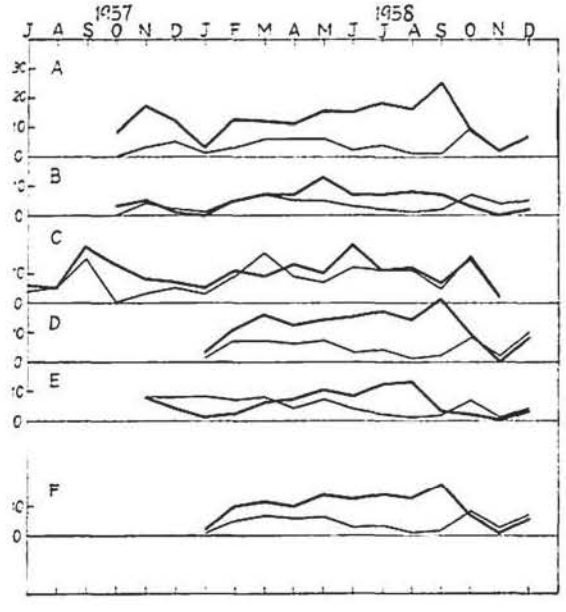

Fig. 1. Monthly frequencies of pt and pc in (A+B)-group.
A : Memambetsu (Loop) ; B : Kakioka (Rapid-run); C : Shimosato(Induction); D : Kanoya (Loop) ; E : Onagawa (Induction), A class only ; F : Means of the three stations, A, B and D.
Thick line : pc and $\overline{pc}$; Thin line : pt and $\overline{pt}$.

§ 4. Seasonal variation of the monthly frequency

In order to discuss rigorously time and spatial changes of frequencies in Fig. 1, it should be taken into consideration that, as shown in § 2, two kinds of instruments are used for the geomagnetic time variations, and at Kakioka the frequency is deduced based on rapid-run recordings. The difference between the frequencies measured by the rapid-run magnetometer and a large loop with no core may be inferred from the results obtained at Memambetsu. It is illustrated in Fig. 3 for both pt and pc in (A+B)-group. As a whole, one can not find any appreciable difference between them for both pulsations. Next, the difference between the

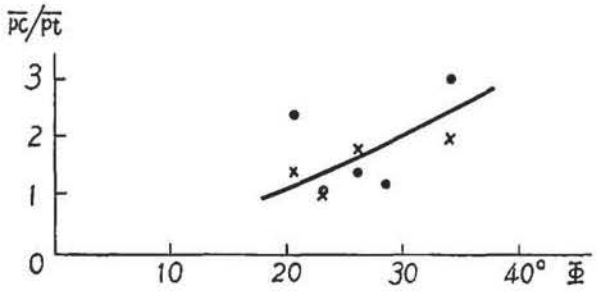

Fig. 2. Distribution of the ratio of mean frequency per month of pc to that of pt in the geomagnetic latitude Φ. (1958) Circles : (A+B)-group ; Cross : C-group.

induction magnetometer method and the loop method is out of examination at present, because there is no station of using both methods in Japan. However, in view of the principle of both methods, it is unlikely to have any apprecible difference of frequencies between them, although the intercomparison of the two kinds of instruments at the same station is substantially needed for the examination of details of character of both pulsations.

The general mode of monthly variation of the frequency for pt in (A+B)-group, which is shown in Fig. 1, is nearly the same at all stations except for a slightly increasing in summer months at Shimosato. It seems to show a seasonal change with maxima in equnox and minima in summer and winter. However, the definite form of the seasonal variation should be confirmed by the more available data in future.

The mean monthly frequencies of the three stations mentioned above are shown for $\overline{pt}$ in Fig. 4, and compared with the monthly means of the daily sum of K-indices, $\overline{\Sigma K}$, at Kakioka. The relation between two curves will be more clearly illustrated by the figure shown at the bottom, which is deduced from $\overline{pt}$–0.95 $(\overline{\Sigma K})'$, where $(\overline{\Sigma K})'$ is the corrected value of $\overline{\Sigma K}$ for its decreasing trend with the assumed rate of change 0.545 per month. The calculated values are thus almost constant throughout the year except three months, April, May and October, during which the coefficient might be increased to 1.25 instead of 0.95, if all the values would remain independently of the month. A similar correlation can be also detectable at Shimosato and Onagawa, though the coefficients of $(\overline{\Sigma K})'$ are different; say, 1.60 at Shimosato.

At any rate the seasonal variation of the frequency of pt in (A+B)-group is surely related to that of the mean geomagnetic activity.

Concerning pc in (A+B)-group, it is specially pointed out that as shown in Fig. 1 the monthly variation of frepuency shows a minimum in winter, and then increases gradually to reveal a maximum in the period from July to September, or becomes to be nearly constant during February to September ; there appears no definite maximum, especially in Spring. This mode of frequency variation is so distingushed from that of pt that further cofirmation by the long period observations is desired, taking the differences between them of the prevailing period,

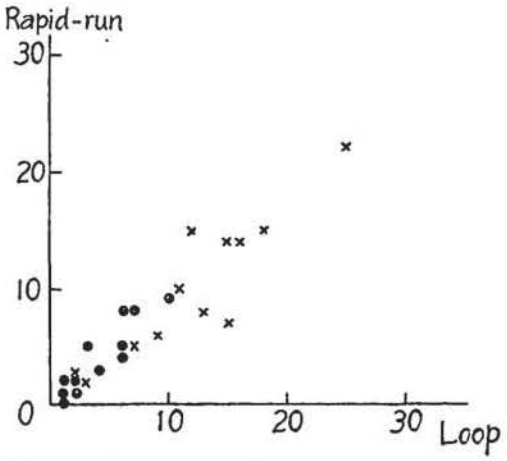

Fig. 3. Comparison between Rapid-run and Loop methods for (A+B)-group at Memambetsu. (1958) Circles : pt; Cross : pc.

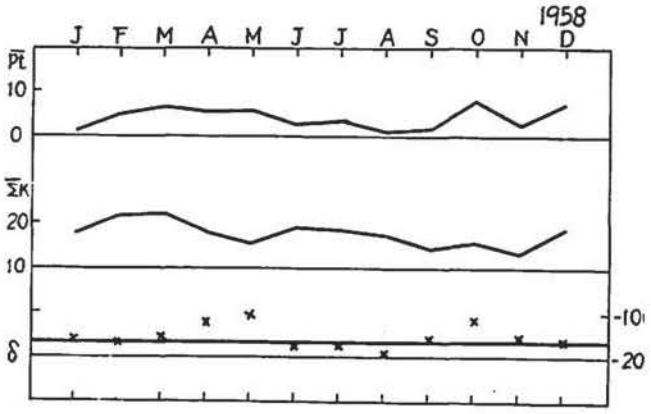

Fig. 4. Monthly frequency of pt in (A+B)-grup and geomagnetic activity. $\overline{pt}$: Mean monthly frequency of pt's at Memambetsu, Kakioka and Kanoya. $\overline{\Sigma K}$: Monthly mean of the daily sum of K-indices at Kakioka. δ : $\overline{pt}$-0.95 $(\overline{\Sigma K})'$; $(\Sigma K)'$: corrected Σ K for its general trend.

wave form, and also possible theoretical views in consideration.

The characteristics of the monthly frequencies of pulsations, pt and pc, in (A+B)-group mentioned above are also observed for those in C-grop.

§ 5. Conclusions and proposals

The first part of this note deals with the monthly frepuencies of pt and pc observed in Japan during the IGY. The monthly frequencies observed at Memambetsu by rapid-run magnetometers and galvanometers with large loops buried in the ground are compared with each other. They show no appreciable differences as a whole, though some of them deviate within fairly wide range from the mean regression line. It is needless to say that it is very important to make necessary comparisons between instruments of different kinds of principle and technique, especiacially in the case of rapid-run changes, of which global observations were begun in the IGY. It is proposed for the purpose to specify an international standard instrument, of which instrumental characteristics are well known and easily reproducible.

The mean frequency of pc in Japan is about twice that of pt regardless of groups and stations.

In order to eliminate personality at each station in some extent, the ratio of mean frequencies per month of pc and pt, $\overline{pc}/\overline{pt}$, is examined to show a fairly well dependency upon the geomagnetic latitude.

The seasonal variation of frequency of pt, which is related to that of the monthly means of the daily sum of K-indices at Kakioka, is so different from that of pc, especially in spring and summer that it is desirable to check whether it is a merely peculiar appearance in 1958 only or not, by the data in other regions of the world.

As far as the frequencies are concerned, they are essentially affected by the exactness of the international scaling standard, and some of their inequalities among the stations may be eliminated at present by specifying the maximum range of amplitude in gammas and prevailing period in seconds, at least for the pulsations in A and B classes. It is further proposed as a final figure to make a kind of index, such as K-index, for the purpose of promoting the international corporation more effectively in this field of science.