STATISTICAL STUDY OF POLAR BLACKOUT*

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南北両極地域における Polar Blackout の統計的特性について*

糟 谷 績**

1. Introduction The temporal and spacial distribution of occurrence of polar blackouts is studied statistically on the basis of the ionospheric data obtained by about 30 stations in the Arctic region and 10 stations in the Antarctic region in 1957 and 1958. This period covers the IGY when the scheme of ionospheric observations was most intensified, and it will be convenient to reveal the whole picture of polar blackouts.

In this study, the characteristics of polar blackouts are not considered in connection with individual geomagnetic disturbances, but the knowledge of average state of abnormal ionization in the lower ionosphere in both polar regions is chiefly aimed at.

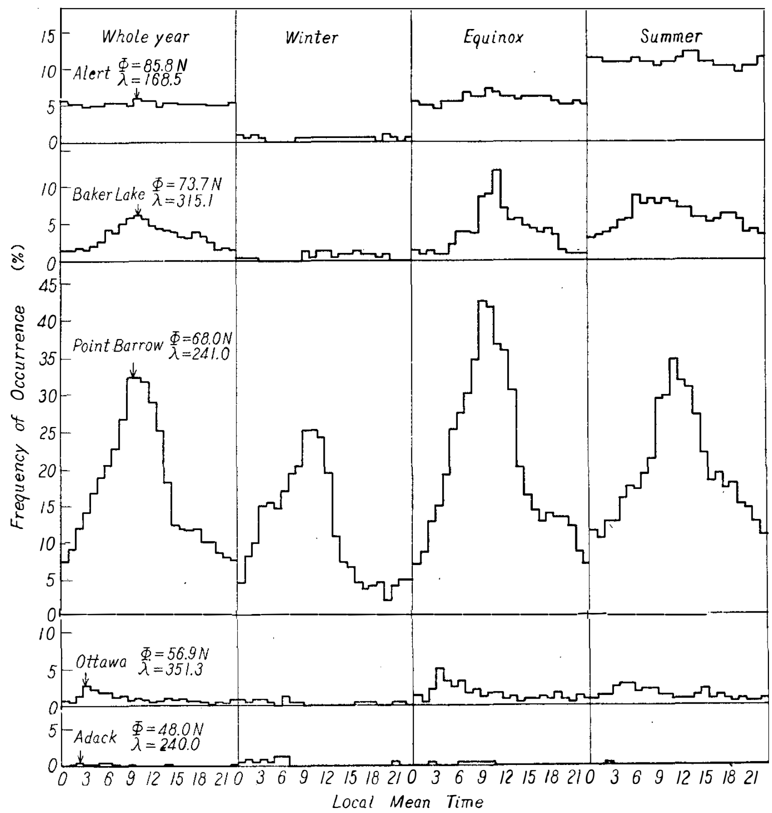

Fig. 1. Examples of diurnal variations of occurrence of polar blackouts with regard to the season and the geomagnetic latitude.

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The diurnal variation of blackouts which corresponds to the so-called S_D variation of geomagnetism is particularly investigated, and a comparison is made between the blackouts observed in the Arctic and the Antarctic.

2. General aspect Fig. 1 shows some typical examples of diurnal variations of occurrence of polar blackouts with regard to the season and the geomagnetic latitude.

The stations illustrated here are chosen as typical of the polar cap region ($\Phi=70°-90°$), the auroral zone ($\Phi=60°-70°$) and below the auroral zone ($\Phi<60°$), respectively. Hereinafter the degrees will indicate the geomagnetic degrees unless otherwise specified. The statistical periods are classified into four groups, the winter, the equinoxes, the summer and the whole year, which mean the whole statistical period without regard to the three seasons. The seasons refer to January, February, November and December as the winter, and May, June, July and August as the summer, and March, April, September and October as the equinoxes.

As may be seen clearly by this figure, there is no remarkable diurnal variation at the polar cap, whereas there is high occurrence with the maximum of diurnal variation in the auroral zone. Below the auroral zone, the occurrence decreases and no blackout appears at less than 50°.

As for the seasonal characteristics of occurrence, blackouts at the polar cap occur mostly in summer, next at the equinoxes, and least in winter, but the blackout in the auroral zone occurs mostly at the equinoxes. This fact may suggest that the type of blackouts observed at the polar cap differs from those in the auroral zone, and the occurrence of blackouts at the polar cap would be mainly controlled by the zenith distance of the sun, while the blackouts in the auroral zone might be associated with the geomagnetic activity.

Further, it can also be noticed in Fig. 1 that the time at which blackouts occur with the maximum frequency seems to shift from early morning to noon as the latitude increases.

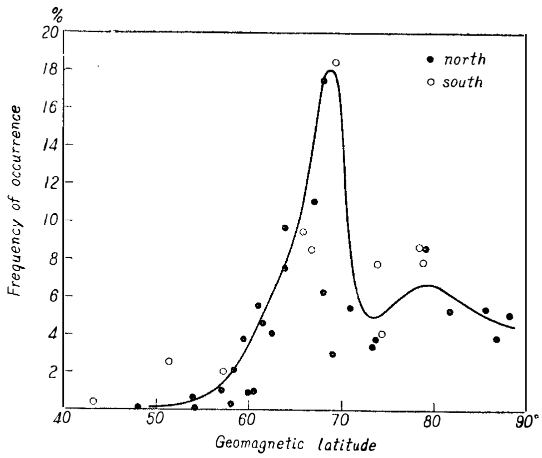


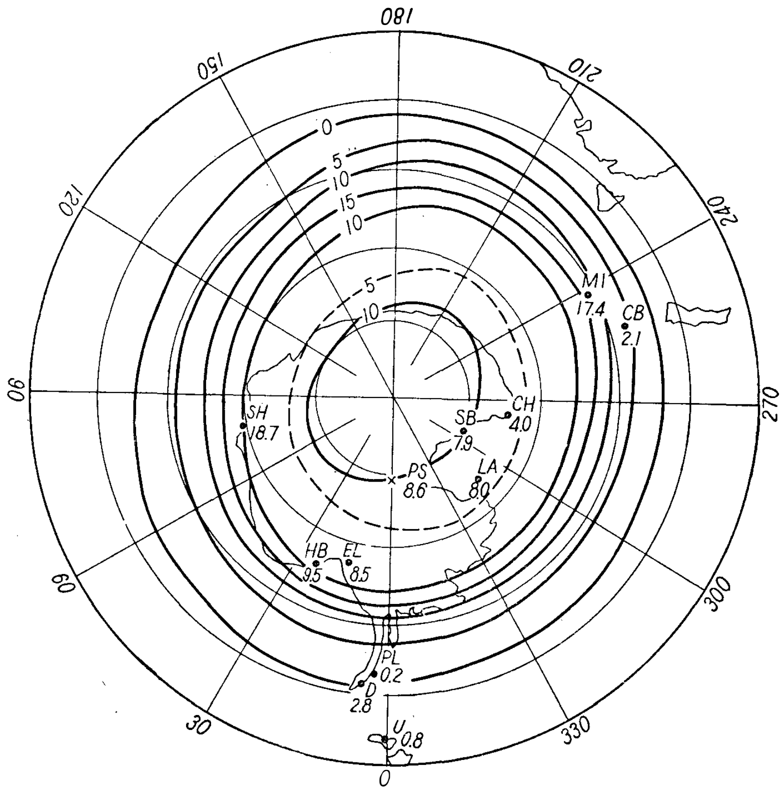
Fig. 2. Percentage hourly frequency of occurrence of blackouts for the whole period plotted against geomagnetic latitude.

3. Various characteristics given by statistical results

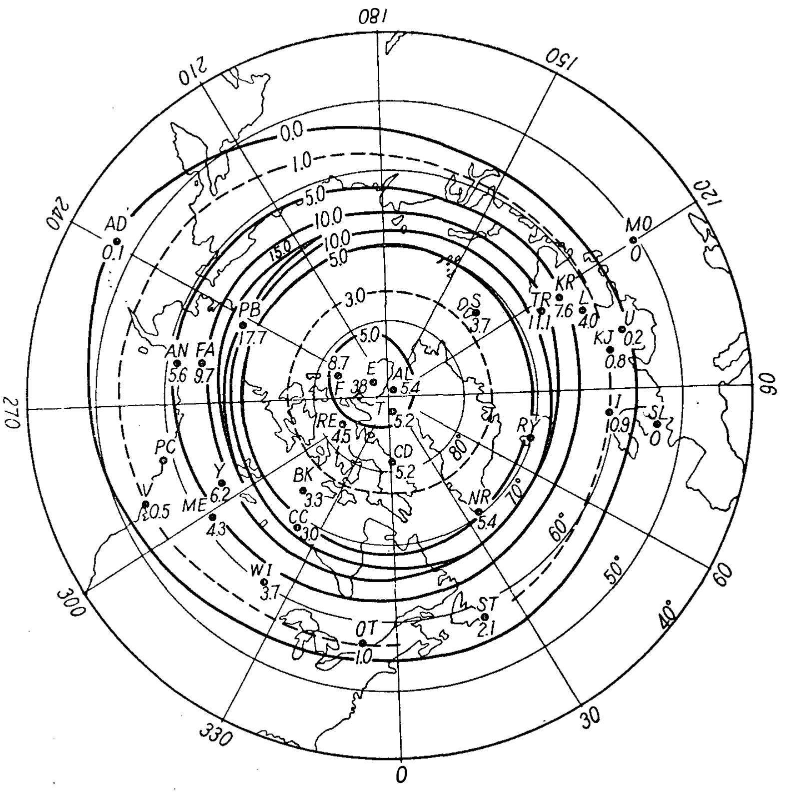
(1) Frequency of occurrence The latitudinal distributions of average occurrence of polar clackouts in both polar regions are plotted in Fig. 2, which shows that blackouts begin to occur at 50° and increase steeply from 60° upward and the maximum lies at some 67°. This region may well coincide with the auroral belt. With an increase in latitude, the minimum lies around 70° and some submaximum seems to exist at 80° or so.

Exactly speaking, however, the occurrence of blackouts is controlled by the geomagnetic latitude and somewhat by the longitude. It would be better, therfore, to show the distribution in terms of the polar geomagnetic coordinates as seen in Fig. 3. On inspection of Fig. 3, it is found that blackouts occur more frequently near Alaskan stations than around other stations than around other stations situated at the same latitude. Although the stations on the Antarctic side are insufficient to draw the contours properly, the distribution of blackouts is not very different from those on the Arctic side.

In addition, Fig. 4 shows the amplitude of diurnal variation in occurrece that is defined



(a)



(b)

Fig. 3. Percentage hourly frequency of occurrence of blackouts for the whole period shown on polar geomagnetic coordinates.

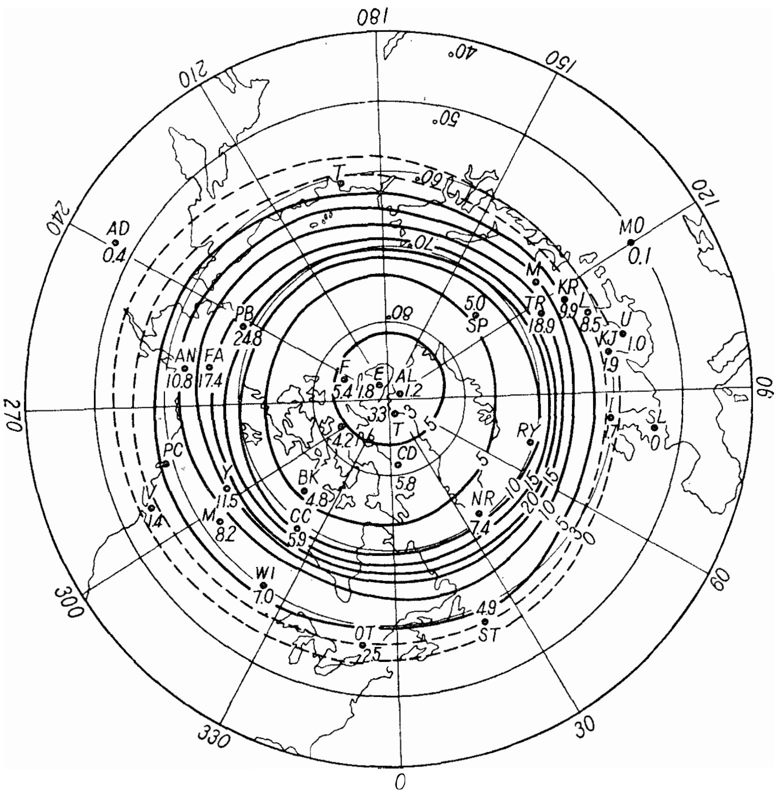


Fig. 4. Amplitude of diurnal variation of frequency of occurrence of blackouts for the whole period shown on polar geomagnetic coordinates.

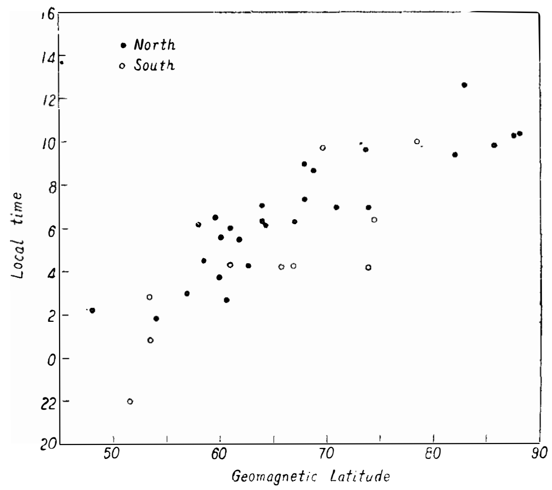


Fig. 5. Local mean time of maximum frequency of occurrence of blackouts for the whole period plotted against geomagnetic latitude.

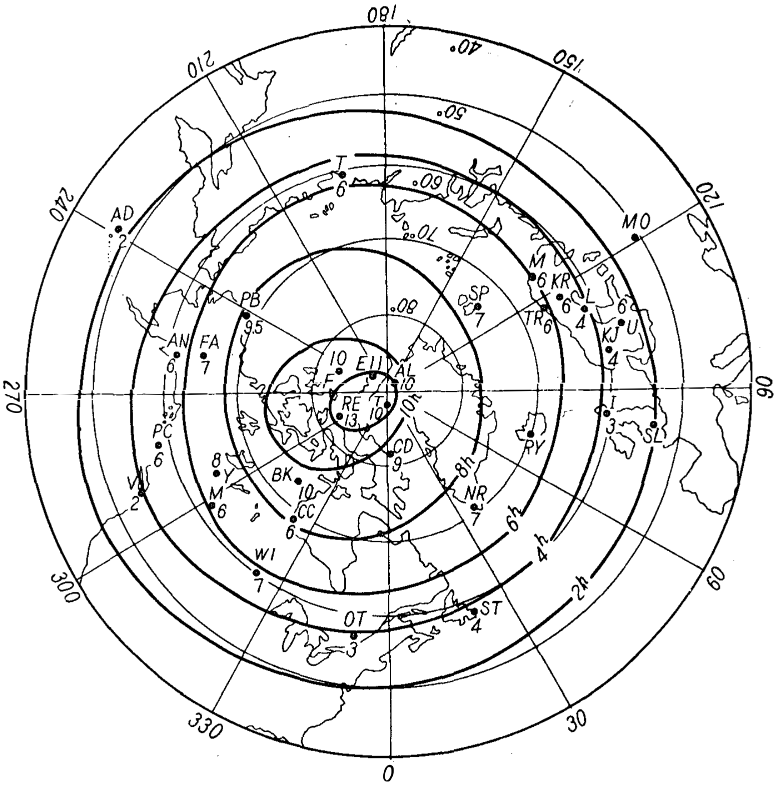


Fig. 6. Isochrons in local time of maximum frequency of occurrence of blackouts for the whole period shown on polar geomagnetic coordinates.

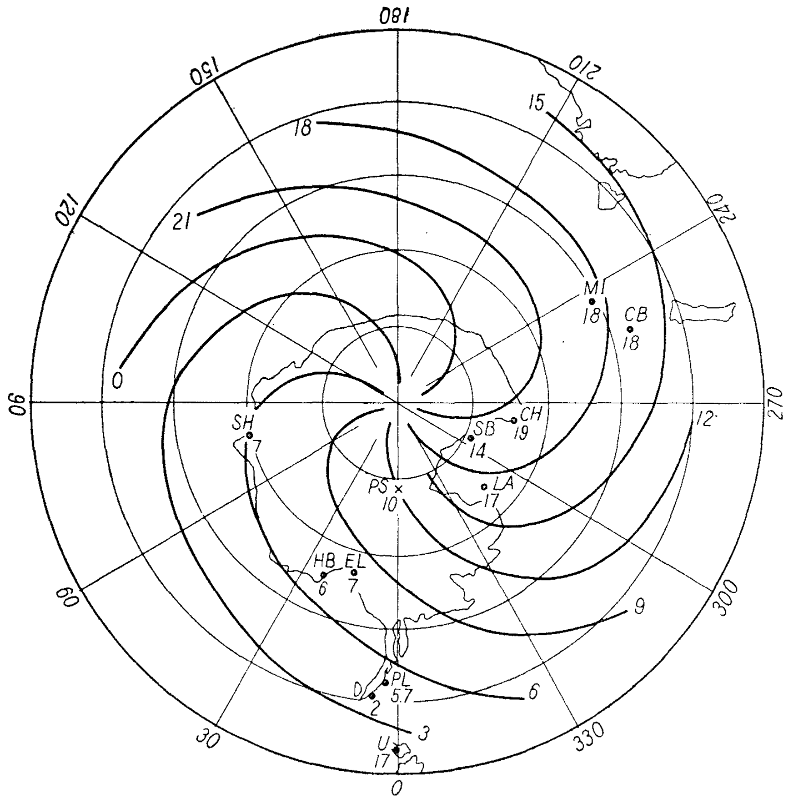
here as the difference between the maximum and minimum of diurnal variation of occurrence. There is no definite diurnal variation at the polar cap, while there is a remarkable variation in the auroral zone.

(2) **Time when polar blackouts occur with the maximum frequency (time of the maximum occurrence)** As will be seen in Fig. 5, one of the most interesting characteristics of blackout is that the times of the maximum occurrence of diurnal variation depend on their observational latitude. Fig. 6 shows isochrons in local time of the maximum occurrence by the geomagnetic polar coordinates.

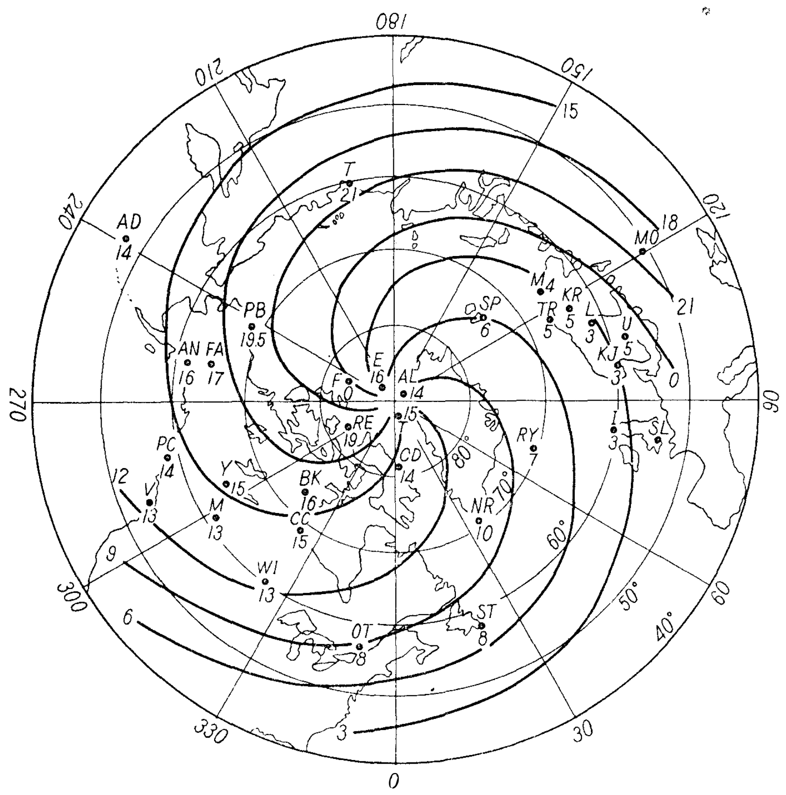
On the other hand, if we draw the isochrons in universal time of the maximum occurrence, the spirals can be given on the polar coordinates in Fig. 7. The widths between the isochrons are not exactly the same. For instance, the width is larger near 12 hr's and is small about 20 hr's. This may be due to some irregularity of geomagnetic distribution. The spiralshaped isochrons may be considered to be the locus of the charged particles that invaded the lower ionosphere at the times referred to.

(3) **Average duration** The plots of the average duration of blackouts at every station against its geomagnetic latitude are shown in Fig. 8. It is evident that the average duration lengthens with the increasing geomagnetic latitude of the stations. The seasonal effect is also considered in Fig. 8(b). The duration is the longest in summer when the day gains in length in higher latitudes. The maximum occurrence exists in the auroral zone, while the duration is not so long in that zone as in higher latitudes.

The phenomenon may be explained by the fact that the charged particles invade frequently to ionize the lower ionosphere in the auroral zone, but recombination is made rapidly, whereas at the polar cap the blackout due to another type of radiation from the sun, which occurred once, lasts for a long time by aid of the sunlight.

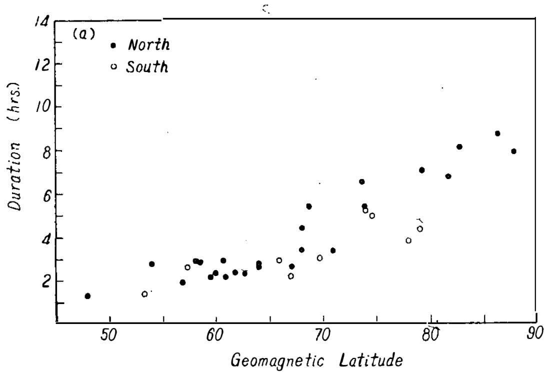


(a)

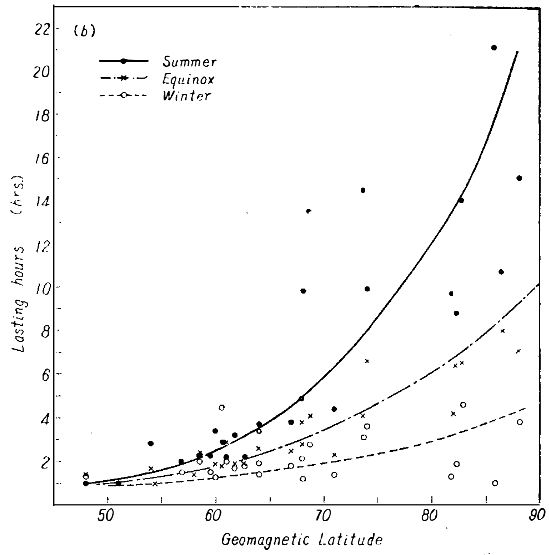


(b)

Fig. 7. Isochrons in universal time of maximum frequency of occurrence of blackouts for the whole period shown on polar geomagnetic coordinates.



(a)



(b)

Fig. 8. Mean duration (lasting hours) for each season plotted against geomagnetic latitude.

DISTRIBUTION OF UNDERGROUND ELECTRICAL RESISTIVITY AROUND SYOWA BASE*

Takashi OGUTI**

昭和基地における Polar Magnetic Storm とその関連現象について*

小　口　　高**

Electrical resistivity of underground rocks around Syowa Base was estimated by using Wonner's configuration for shallow layers and by observation of geomagnetic and geoelectric variations for deep layers. The results obtained may be summarized as follows;

1) **Shallow layers** Observation has shown that there is a thin layer of low resistivity at the surface of the ground which has an axis of minimal resistivity in about E-W direction. Resistivity in this direction is about 4.4×10^4 Ω cm and that in N-S direction is about 5.5×10^4 Ω cm as seen in Fig. 1. The thickness of the surface layer was estimated to be 1.8 m at most. The layer is mostly composed of sand which is accumulated in the bottom of a valley elongated in E-W direction.

Under the sand layer, there exists an other of a little higher resistivity. The axis of minimal resistivity of the layer is about in N-S direction, the value of which is about 6.9×10^5

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