LETTER TO THE EDITOR

Some Characteristics of Geomagnetic Variation Anomaly in Japan

It has often been reported by Rikitake (1959, 1964) and others that change in the vertical component ($\Delta Z$) of the geomagnetic field is anomalously large in Japan at times of bay, ssc and such like. Little attention has been paid, however, to the distribution of the horizontal component ($\Delta H$) because no marked differences have been found in $\Delta H$ amplitude throughout Japan.

It has recently become recognized that $\Delta H$ in the southern part of Japan seems to be slightly larger than that in the central part of Japan. Since the distribution of $\Delta H$ might provide a clue for investigating the cause of the geomagnetic variation anomaly in Japan, the writer undertook close comparisons between $\Delta H$ observed at an observatory to that at Kakioka. Some 100 bay-like events during 1959 were chosen for most of the observatories shown in Fig. 1 although events during different periods were used for observatories for

Fig. 1 The ratios of $\Delta H$ at Japanese observatories to that of Kakioka as calculated for geomagnetic bays and similar changes.
which we had no observations during 1959. $\Delta H$ is defined as the deviation from a straight line connecting the beginning of an event to the end. A $\Delta H$ value is thus defined at the time of the maximum deviation at Kakioka. It is also noticed that there are practically no phase shifts between $\Delta H$'s throughout Japan. The most probable values of the ratio of $\Delta H$ at an observatory to that at Kakioka are calculated and shown on the map in Fig. 1. The probable errors of the ratios are estimated as $\pm 0.01$ or thereabouts.

It is interesting that the ratio is large in the southern part of Japan and small in the north-eastern Japan. Taking the general increase of geomagnetic bay towards the auroral zone into account, it may be said that $\Delta H$ is about 30 per cent larger towards the south-western part of Japan. Comparing the $\Delta H$ anomaly as shown in Fig. 1 to the heat flow map in Japan (Uyeda and Hōrai, 1964), it is suspected that the $\Delta H$ anomaly has something to do with the heat flow distribution, i.e. large $\Delta H$ values are observed in areas where the heat flow is large and small $\Delta H$ values in areas where the heat flow is small. Such a tendency is also confirmed by a spectral analysis of magnetic disturbances in Japan (Sasai, 1965).

It has recently become fashionable to express the local characteristics of geomagnetic variation by an arrow. Parkinson (1959, 1962, 1964) devised a technique by which we can obtain the direction of a plane in which vectors of geomagnetic bays and similar changes are confined. According to his method, the directions of geomagnetic variation tend to fall within a narrow range along a great circle on a polar diagram as can be seen in Fig. 2 which indicates the diagram at Aburatsubo for variations for which $\Delta Z$ changes downwards. In order to indicate such a great circle which specifies the plane in which magnetic vectors are confined, Parkinson introduced a vector of which the direction in the horizontal plane indicates the direction of maximum upward lift of the plane and the length is proportional to the sine of the angle of tilt. On the basis of the data used for obtaining the $\Delta H$

![Fig. 2 Polar diagram for Aburatsubo (Obs. No. 8 in Fig. 3). The great circle indicates the plane in which geomagnetic variations are confined.](image)
anomaly, the Parkinson vectors for the respective observatories are computed by an IBM 7090 computer and shown in Fig. 3.

It is not intended in this short note, however, to discuss the cause of anomaly in detail. Even though the outline of the $\Delta H$ anomaly is brought to light, it still seems difficult to say something definite about the cause of geomagnetic variation anomaly in Japan.

References

Sasai, Y. Personal communication, 1965.