ON RECOVERY PHASE OF GEOMAGNETIC STORMS AND DISSIPATION OF RING CURRENTS

To account for the main phase of geomagnetic storms, theories on geomagnetic storms postulate a ring current formed by charged particles drifting across longitude at several earth radii from the Earth. The dissipation of the ring current is related to the recovery phase of geomagnetic storms, the rate of recovery being the rate at which the ring current is dissipated. It is known, in general, that the recovery time of geomagnetic storms is shorter for intense storms than for moderate or weak ones (Moos 1910, Chapman and Bartels 1940, and Suguira and Chapman 1958). With a view to investigating in detail any systematic relationship between the recovery phase and intensity of geomagnetic storms and the variation through the solar cycle of the dissipation of the ring current, some 122 storms recorded at the Alibag Magnetic Observatory, between the years 1924 to 1959 were examined. The storms taken for study were

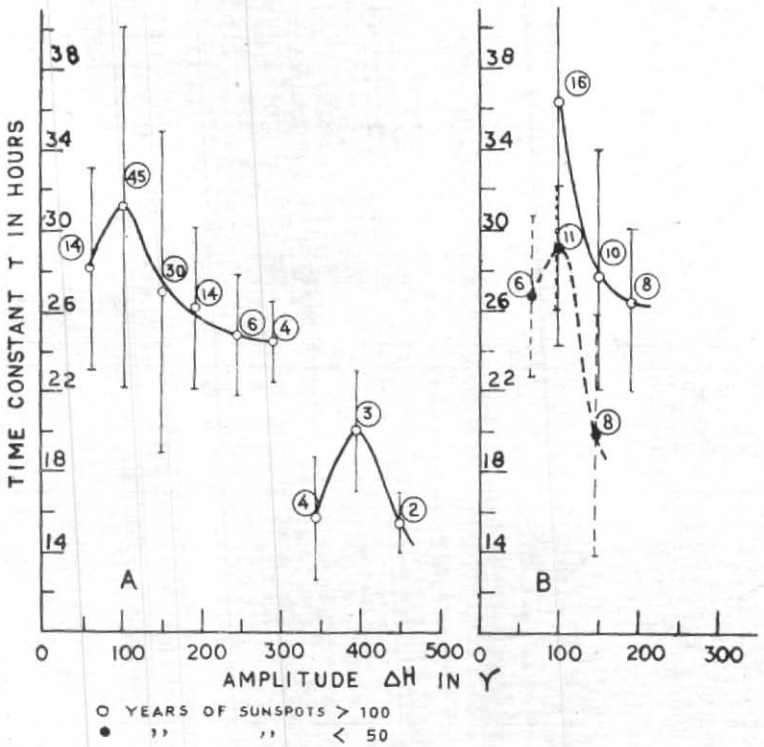

Fig. 1 A—Plot of amplitude $\triangle H$ of the fitted exponential curve and time constant T for the recovery phase of great and very great geomagnetic storms recorded at Alibag between 1924 and 1959

Fig. 1 B—The same plot as in 1A but for a period of high solar activity (sunspot number > 100) and for a period of low solar activity (sunspot number <50). The plot is restricted to only storms of comparatively moderate intensity since during minimum solar epoch storms of high intensity are rare

Figures in circles give the number of storms going into the respective classes of 50 γ intervals of $\triangle H$

of the sporadic type and those classified as Great and Very Great by the observatory.

The method of investigation was to fit an exponential curve to the 36 hourly-values of H from the hour of maximum depression, after subtracting the quiet day hourly values pertaining to the month in which the particular storm occurred. From the fitted curve the amplitude $\triangle H$ of the depression (taken to represent the intensity of the storm) and the time constant T, *i.e.*, the time necessary for $\triangle H$ to recover to $(1/e)\triangle H$ were determined. The amplitudes thus obtained for the 122 storms were grouped into classes of 50γ intervals. For each class the mean amplitude of depression and the corresponding mean time constant were determined and plotted as shown in Fig. 1 (A). Smooth curves best fitting the points were then drawn.

It is seen that the $\triangle H$ *vs* T curve suddenly shifts in the region of $\triangle H = 300$ to 350γ to lower values of T, the two portions of the curve above and below this region being reasonably smooth, with a hump of high values of T appearing in each portion. This discontinuity leads one to speculate that, apart from the general tendency for recovery time decreasing with increasing intensity of storms, there appears to be two preferred regions for the formation of ring currents responsible for the main phase of geomagnetic storms; one region characterised by high values of dissipation time and the other by low values. One is naturally tempted to ask if

the preferred regions are the two Van Allen Radiation Belts ?

For examining the question whether recovery times of geomagnetic storms are shorter for years of high solar activity than for years of low solar activity, as expected by Dessler *et al.* (1961), as a consequence of the geocorona being more dense (with neutral hydron) at sunspot minimum than at sunspot maximum (Johnson 1961), separate H vs T curves were drawn for years of sunspot number less than 50 and for years of sunspot number greater than 100 as shown in Fig. 1 (B). There certainly is a tendency for recovery times to be shorter during years of high sunspot number than during years of low sunspot number. But the difference noticed does not appear to be statistically significant in an unambiguous manner.

Further investigation of the problem is in progress. The full results with attended implications will be sent for publication shortly.

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