The Geomagnetic Effects of the Johnston Island Nuclear Explosion of July 9, 1962 at Quetta

A high altitude nuclear explosion of 1.4 megaton bomb was detonated on July 9, 1962 at 0900 G.M.T at an altitude of about 320 km over Johnston Island (Geogr. Lat. 16.7°N; Long: 169.4°W). The geomagnetic effects of this explosion were observed at many stations all over the world. Marked geomagnetic disturbances and noticeable ionospheric changes recorded Quetta Observatory (Geographic 30.2°N; 67.0°E; Geomagnetic 21.6°N; 139.7°E) at this hour may be attributed to this explosion.

The summary of geomagnetic disturbances recorded on the normal run magnetogram (speed 20 mm./hour) at Quetta is given in Table 1. The magnetogram for the relevant period was traced in Figure 1. The scale value and sense of movement of the traces is represented by the arrow. The accuracy of time measurement on the magnetogram is ±10 seconds.

Table 1 Geomagnetic Field Changes at Quetta due to the Nuclear Explosion of July, 9, 1962.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time of sudden Change G.M.T.</th>
<th>Range of magnetic disturbances</th>
<th>Total duration of disturbances</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 9, 1962</td>
<td>09h 00m</td>
<td>$H$ $D$ $Z$</td>
<td>9 minutes</td>
</tr>
</tbody>
</table>

The onset of the magnetic perturbation in horizontal intensity ‘$H$’ is a sharp initial decrease of 9γ, resembling a ‘sudden impulse.’ The decrease is punctuated by a series of small pulsations extending over a period 2 minutes. The disturbances in declination ‘$D$’ and vertical intensity ‘$Z$’ are of a ‘bay’-type. The maximum amplitude of the change is reached in ‘$H$’ about 1.5 minutes and in ‘$D$’ and in ‘$Z$’ about 2 minutes after the explosion time.

The variation in mean hourly ionospheric characteristics $f_0E$, $f_0F_2$, and $f_{nma}$ between

(161)
the period 06h to 12h G.M.T. is illustrated in Figure 2. The dotted lines show the values on July 9, 1962 the normals for July at Quetta are represented by continuous lines. The only parameter which showed marked change at 0900 hours is the critical frequency of the $F_2$ layer. The general level of all the variation curves on July 9, were lower than the normals. However the marked increase at 0900 hours followed by a steep decrease of the electron density in the $F_2$ region is, under the circumstances, significant.

![Figure 2](image)

**Fig. 2** The variations in $f_{0F2}$, $f_{0E}$ and $f_{min}$ on July 9, 1962 at Quetta.

Since the first geomagnetic effect at Quetta was observed almost simultaneously with the explosion time, the initial onset cannot be explained in terms of simple hydromagnetic wave theory. However, the detonation must have produced substantial hydromagnetic waves which would spread out all round and as it passed through the inner radiation belt, electron trapping would occur resulting in an increase of electron density in the $F_2$ region. The subsequent decrease of the $f_{0F2}$ may be interpreted as due to the gradual electron decay by the process of recombination.

It is most probable that the initial disturbances propagated electromagnetically and the subsequent main field changes at Quetta were caused by the arrival of hydromagnetic waves from the detonation site.

My thanks are due to Mr. S.N. Naqvi, Director, Pakistan Meteorological Service for his kind permission to publish the results of this analysis.

S.A.A. KAZMI  
Pakistan Meteorological Department  
Geophysical Institute, *Quetta, Pakistan*