SHORT COMMUNICATIONS

SWEPT-FREQUENCY RADIO OBSERVATIONS AT THE TIME OF THE NUCLEAR EXPLOSION OVER JOHNSTON ISLAND ON JULY 9, 1962*

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The sudden ionospheric disturbance (SID) which occurred at the moment of detonation of the 1·4 megaton nuclear device 400 km above Johnston Island on July 9, 1962 (New Zealand Journal of Geology and Geophysics 1962, Journal of Geophysical Research 1963) was recorded with the 5–210 Mc/s solar radiospectrograph (Sheridan 1963) at Dapto, N.S.W. (latitude $-34° 28'.3$, longitude $-150° 45'.5$, geomagnetic latitude about 42° 30′ S.). The reported increase in radio noise due to synchrotron emission (Dyce and Horowitz 1963; Ochs, Farley, and Bowles 1963) from high energy electrons generated by the explosion was not observed.

An SID is recorded in the manner shown in Plate 1, which shows two examples induced by X-radiation from solar flares together with the one recorded at the time of the nuclear explosion. At frequencies below about 25 Mc/s a large number of terrestrial communication transmissions are usually present on the record in the form of horizontal lines; most of these signals are from distant transmitters, which are received after reflection from the ionosphere. At times of major flare activity the increased ionization of the *D* region of the ionosphere attenuates these transmissions so that in some instances (as in Plate 1) the signals are not received and their disappearance from the record indicates the start of an SID. Fade-outs of this nature are attributed to the effects of solar X-rays on the *D* region of the ionosphere, the two examples shown in Plate 1 (at these dates observations only extended down to 15 Mc/s) being representative of the class of most severe SID's, induced by flares of class 3+.

During the nuclear explosion recordings were made from 5 to 210 Mc/s but only that portion of the record from 5 to 40 Mc/s is shown in Plate 1, as no effects were observed at higher frequencies. Reception conditions at the time ($21^{h} 00^{m}$ local time) were such that distant transmissions were received only below about 20 Mc/s.

The fade-out caused by the explosion differs from solar-induced fade-outs in two respects. Firstly, the onset is extremely abrupt, as all the ionospheric reflections disappeared within 2 s from the start of the disturbance. (Note that the time scale for the July event in Plate 1 is expanded by a factor of two.) Secondly, the recovery of propagation conditions occurs in two phases. The initial recovery phase is more rapid at higher frequencies (within about 15 s at 15 Mc/s and about 20 s near 6 Mc/s). Considerable attenuation in the propagation paths is evident at the end of the initial recovery phase. The final recovery phase is very slow and occurs in a similar manner

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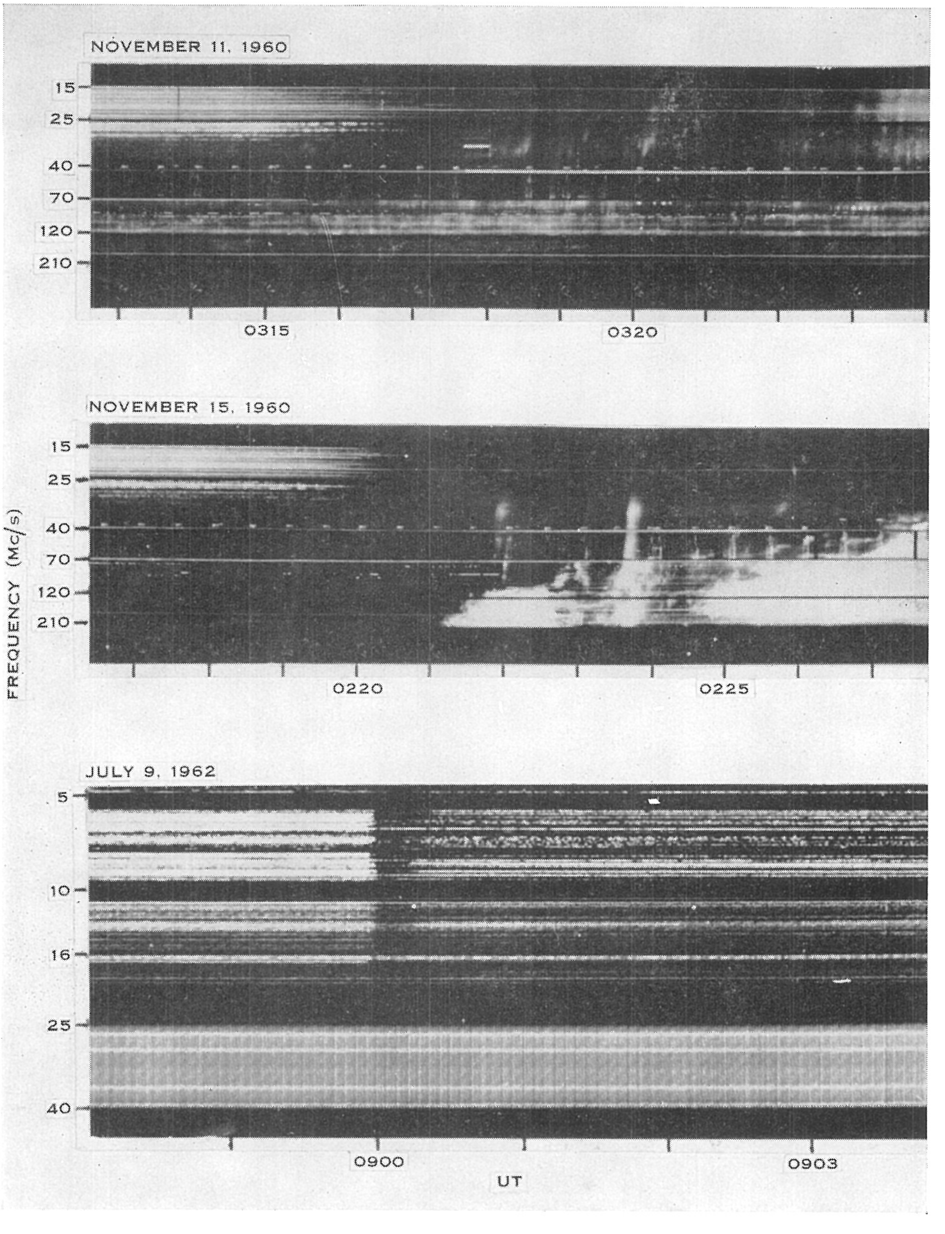
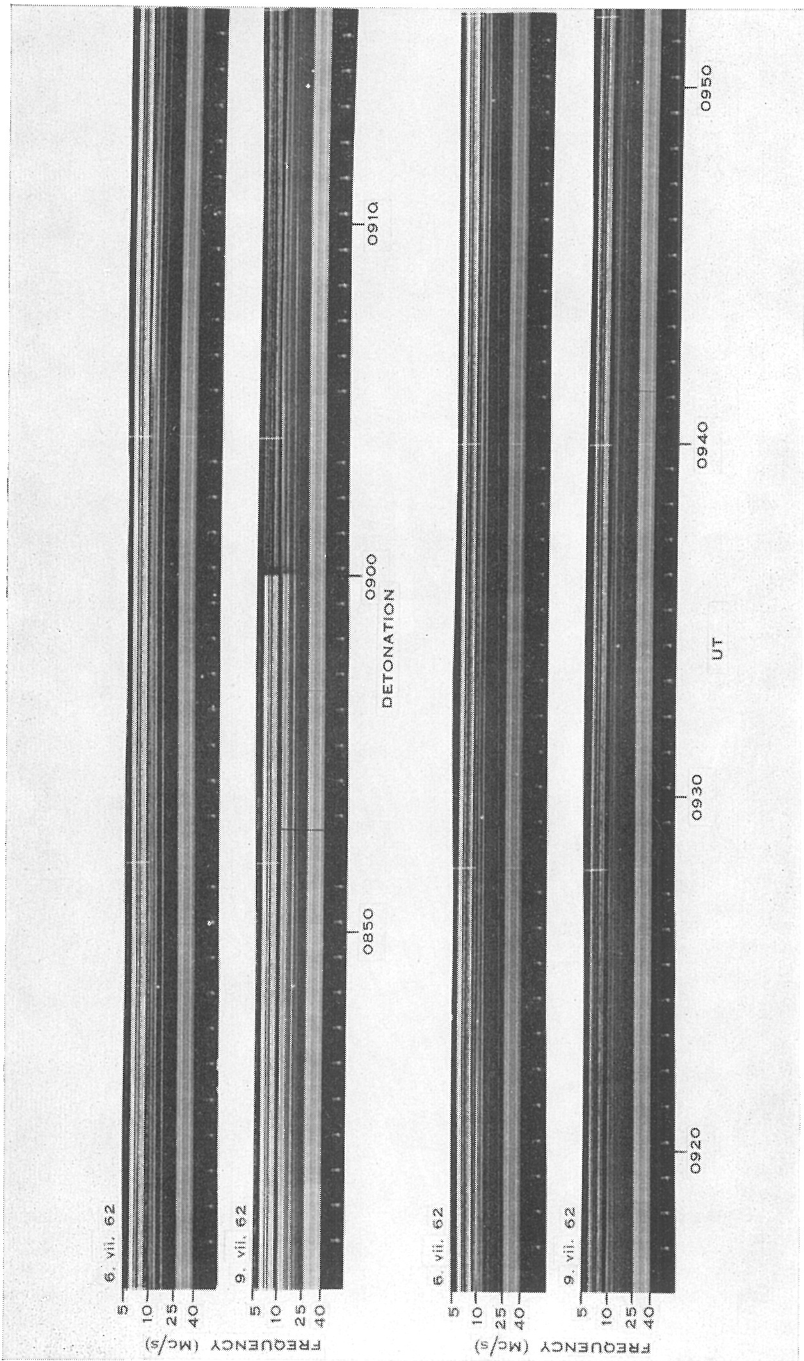
RADIO OBSERVATIONS



Fade-outs produced by solar flares (top and centre) and the nuclear explosion (bottom). Solar radio emission following the fade-out can be seen in the solar records. The horizontal lines in the 25–40 Mc/s range of the July 9 record are caused by interference from local T.V. transmissions not affected by the ionosphere. (A higher gain setting was used on this range.)

RADIO OBSERVATIONS



Reception conditions on July 9 compared with those existing on July 6 (the receiver gain was higher on July 9). The abrupt termination of reception of low frequency signals at the time of detonation on July 9 is clearly seen and the slow recovery of propagation conditions can be followed by comparison with the July 6 record.

to the recovery following solar induced effects. Plate 2 shows how reception conditions prior to, during, and after the detonation compared with those existing 3 days previously (July 6) during the same time period (the gain levels for July 6 were lower than those used for the July 9 event). It can be seen that for the final recovery phase on July 9 propagation conditions had substantially recovered 50 min after the detonation.

The absence on our record of the synchrotron radiation reported from Riometer observations in lower geomagnetic latitudes may be ascribed to the strong latitude dependence of the radiation (see Dyce and Horowitz 1963, Fig. 7) and also the low directivity of our aerials.

If the abrupt onset of the disturbance is closely examined it will be seen that some transmissions persist for slightly longer than others of similar frequency. This is interpreted as a delay in the onset of attenuation of world-wide signals whose paths through the ionization do not pass within the proximity of the explosion zone. The time interval involved, of the order of 2 s, is consistent with the supposition that the increased ionization, at least outside the immediate zone of the explosion, was caused by fast particles ejected from the seat of the explosion, rather than electromagnetic radiation as in the solar case.

When compared with solar-induced fade-outs (Plate 1) it is clear that even the most intense solar flares cannot equal the local disturbance for severity of the onset of the fade-out.

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