LETTERS TO THE EDITORS

PHYSICAL SCIENCES

A New Ionospheric Phenomenon

In recent years, there have been reports[1–4] of sporadic radio-frequency radiation associated usually with auroral activity. However, it has always been difficult to establish an unambiguous identification because similar effects could be caused by man-made noise or interference. The special programme initiated at Jodrell Bank in October 1958 to study these unusual radiations provided a high degree of flexibility by using five separate total-power receivers, all on slightly different frequencies near 80 Mc./s., to monitor continuously various sectors of the sky. At present, two of the aerials are directed at 30° elevation above the northern horizon, one is directed at the zenith, one at 30° above the southern horizon and the other is rotated continuously so that Cassiopeia 23*N*5*A* is always in the beam. Three of the equipments are at Jodrell Bank and the others are on individual sites about 1 km. away. This experimental arrangement allows easy discrimination against localized interference at any one site, and against distant narrow-band radio signals.

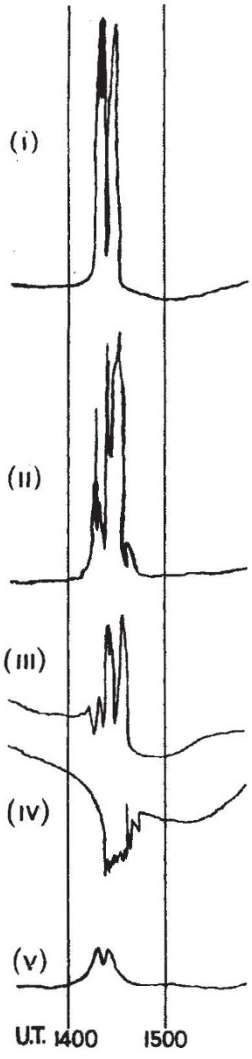

Fig. 1. Records from (I) northerly, (II) northerly (low sensitivity), (III) continuously following Cassiopeia, (IV) zenithal and (V) southerly aerials

Normal records from the equipments show the expected diurnal variation due to the galactic background and, in addition, the southern aerial records radio bursts and noise storms of solar origin. However, during the period January 3–10, 1959, there occurred about ten instances of isolated increases in the noise-level recorded by some of the instruments, together with *simultaneous decreases* in the others[5]. A further very striking isolated event occurred on March 25, 1959, at about 1400 U.T. The records are reproduced in Fig. 1. It can be seen that the northerly channels (i) and (ii) showed very strong enhancements in the signal level. The amplitude of (i) was greater than 150 per cent of the diurnal change in galactic level, and the increase in (ii) was 400 per cent of the diurnal galactic change. The former instrument was driven off-scale while the latter was operating at reduced sensitivity. The apparatus continuously following Cassiopeia (iii) with its aerial directed at this time toward the north-west showed a strong enhancement of approximately 50 per cent of the diurnal galactic range. The zenith instrument (iv) recorded a marked decrease of at least 50 per cent of the diurnal range of galactic intensity, while the south (v) indicated a weak increase of about 25 per cent. Since the back-to-front rejection ratio of the south-looking Yagi aerial is about 1 : 10, it is probable that the apparent southerly increase is spurious in view of the very strong northerly signal. At the time of this event the Sun was actually in the beam of the south aerial, hence one may conclude that direct solar radio-frequency radiation was negligible.

The Jodrell Bank magnetometer revealed a change in the horizontal component of the Earth's field coinciding with these observations. The change of about 50 gammas is the most significant fluctuation in an interval of 4–5 hr. However, the significance, if any, of the magnetic crochet is masked by the presence of other fluctuations of comparable size both earlier and later in the day.

This event, with its simultaneous radio-frequency emission and absorption in different sectors, is more intense than any observed in the January 1959 series. However, it has the same essential characteristics. The suggestion has been made[5] that this phenomenon is caused by passage through the ionosphere of streams of charged particles of very high velocity presumably of solar origin. In the upper ionosphere such particles stimulate the generation of radio-frequency energy while at lower levels the result is a net absorption of the background signal. The absorption mechanism is rather well established, especially in polar regions, and may be attributed to the production of abnormally dense ionization in the lower ionosphere. However, very little is known of processes which can generate radio-frequency noise in our atmosphere. It is believed that the impact of charged particles, both of high velocity and high density, is consistent with the environment for production of Čerenkov-type radiation. Other processes are also being considered.

Events of the type described seem to be rare. It is significant that both the first event of the group in January already reported, and the isolated event of March 25, seemed to be the precursors of a period of intense solar activity with associated terrestrial events such as magnetic storms and auroræ. A preliminary investigation has failed to reveal any unusual solar or other terrestrial effects which may be associated with this phenomenon.

We wish to acknowledge the continued interest and enthusiastic support of Prof. A. C. B. Lovell in this research.

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