PAPER 75

JUPITER AS A RADIO SOURCE

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Records obtained at a declination of about +22° during the first quarter of 1955 with the 22·2 Mc./s. Mills Cross of the Carnegie Institution of Washington occasionally exhibited an interference-like event which was apparently a function of sidereal time. A plot of the right ascensions of beginning and end of each event (duration roughly fifteen minutes) against the date of occurrence revealed a smooth change of Right Ascension corresponding, initially, to a westward motion (Fig. 1). This pre-

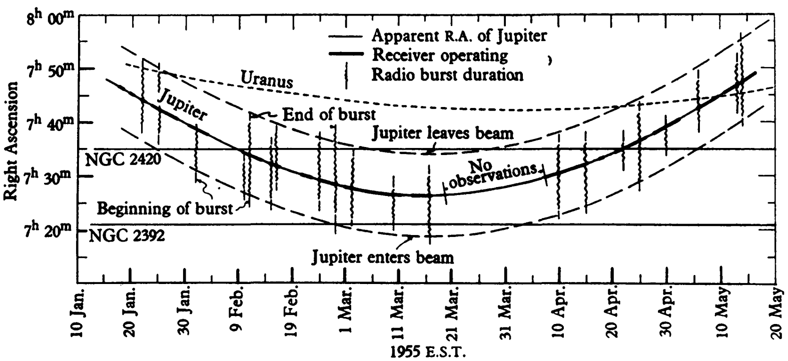

Fig. 1. Apparent positions of variable radio source observed at 22·2 Mc./s.

cluded correlation of the event with passage through the pencil beam of fixed objects like the galactic cluster NGC 2420 and the planetary nebula NGC 2392 which otherwise would have been candidates. The retrograde motion suggested a planet, and a canvass of the solar system uncovered only Jupiter and Uranus as possibilities. Of these, Jupiter exhibited the same position and the same change of position as did the event recorded, while Uranus was well out of the pencil beam much of the time. It was therefore concluded that the source of the radio emission was associated with Jupiter.

The phenomenon itself occurred on twenty out of sixty-eight transits during the observation period, for an average occurrence rate of about one out of three days. The limited material was insufficient to show any trustworthy correlation with central Jovian meridian for either system I or II at the time of observation, (January–May 1955), indicating that there was, apparently, more than one active region, if the events were associated with localized occurrences on the surface of the planet.

The characteristic appearance of each event was that of a succession of intense, sharp bursts, occasionally being completely off the scale of the ecorder. A typical record is shown in Fig. 2. It may be noticed that many

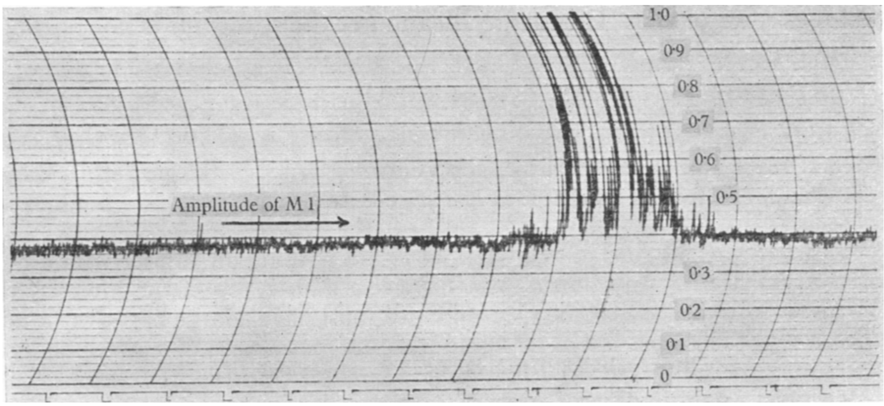

Fig. 2. Typical record of bursts from radio source associated with the planet Jupiter.

of the bursts are more than five times as strong as Taurus A. Extreme events reach or may surpass the intensity of Cygnus A or even Cassiopeia A. Comparisons with the burst intensity of local lightning strokes indicate that the intrinsic radio intensity of the events at Jupiter, assuming an isotropic radiator, are often stronger by a factor of at least 10^9 than terrestrial lightning.

An audio tape-recording was obtained during one of the active transits of Jupiter in April 1955. The individual bursts appear to have a duration of the order of $0^{s}.5$, longer than typical bursts due to local lightning. The Jupiter bursts do not usually have abrupt rises and falls; it is estimated that the rise to maximum intensity may have occupied about one-tenth of the burst duration.

On 6 June 1954, during observations of the solar occultation of Taurus A, a strong 'temporary source' was observed passing through the lobes of a 22·2 Mc./s. interferometer. This source exhibited large, irregular fluctuations in intensity while it was present. Simultaneous records obtained with an interferometer at 38 Mc./s. failed to show any trace of this source. Since the identification of Jupiter as a radio source, a re-examination of the interferometer record showed that Jupiter could account for this 'temporary source'. Recently, equipment operated by H. W. Wells at the Carnegie Institution at 27 Mc./s. exhibited a record which could be correlated with a simultaneous record of Jupiter at 22 Mc./s. C. A. Shain, in Sydney, has records showing Jupiter at 18·3 Mc./s. while F. G. Smith at Cambridge, England, had been unable to observe Jupiter at 81 Mc./s. Thus it is possible to state that this phenomenon is one occurring over the frequency range 18 to 27 Mc./s., but is presently unobservable at 38 Mc./s. and higher. Closer specification of the spectrum is not possible at the present time.

Discussion

Oort: Have you observed Saturn, or Venus?

Burke: Any effect on Saturn is at least five times weaker; we have not looked at Venus.

Smith: In various runs of one week we found nothing on Jupiter with a big aerial at 80 Mc./s. Any bursts must have less than 1/700 of the intensity of Taurus A. This means that the spectral index must have a large negative value, at least $-5\frac{1}{2}$. This does not at all agree with the mechanism of a gas discharge over a long path like terrestrial lightning.

Dewhirst: Analyzing Burke's data of the first half of 1955 we did not find any fixed point rotating with the period of the equatorial regions, but the material was very limited.

https://doi.org/10.1017/S0074180900049500 Published online by Cambridge University Press