10.7-cm SOLAR NOISE BURST OF NOVEMBER 20, 1960

Arthur E. Covington and Gladys A. Harvey
Radio and Electrical Engineering Division, National Research Council, Ottawa, Canada
(Received December 27, 1960)

The occurrence of a flare upon the far side of the sun as described in the previous Letter by Carmichael et al.[1] is an extremely likely event as inferred from analysis of two sets of 10.7-cm solar noise observations taken at the Radio Observatory of the National Research Council, Ottawa, Canada.

The first set of observations was made with a 1.3-meter parabolic reflector and a radiometer which records the solar emission from the whole disk from sunrise to sunset. A tracing of the pertinent portion of the record for November 20, 1960 from 19:00 U.T. to 22:00 U.T., is shown in Fig. 1. The burst is the enhancement above the daily quiet level—shown by the dotted line and estimated from the level on the previous day. The burst features from 20:30 until sunset at 21:20 have been modified by the interference pattern formed by the direct solar ray and the ray reflected from the earth. The times of start of the main burst features are given in Table I. The preliminary listing of flares[2] for this period has been examined and the times of start of the six flares reported in this period are also listed in Table I. The flares occurred in two regions—

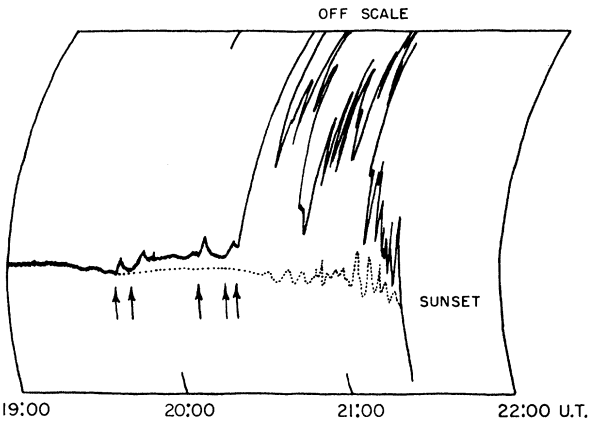

FIG. 1. Record of 10.7-cm solar noise burst, November 20, 1960.

one, the very active region of interest (*HH* 25); the other, a smaller region in the same latitude as *HH* 25 but following it by a few days (*FF* 32).

Comparison of the times of start of the bursts and flares within the time interval customarily used for associating 10-cm bursts and flares show that two of the flares, 20:09 and 20:19,

Table I. Comparison of flare and burst features.

Flare features			Burst features		
Beginning	Importance	Region	Beginning	Flux	Remarks
19:27	1-	*FF* 32			No evidence of flux increase.
			19:39	7	Small rise and fall of flux.
			19:45	7	Small rise in flux to a steady level.
19:55	1-	*FF* 32			No evidence of flux increase.
20:09	1-	*FF* 32	20:09	11	Small rise and fall of flux on steady level.
20:16	1-	*FF* 32			No evidence of flux increase.
20:17	1-	*HH* 25			No evidence of flux increase.
20:19	1	*HH* 25	20:19	7	Small rise in flux; no appreciable fall.
			20:23	400[a]	Large increase in flux; continuing until end of observations.

[a]Peak value obtained from low gain–high speed channel. Not illustrated.

coincide well with burst features. The lesser of these, at 20:09, occurs in the lesser and following region (*FF* 32) which is just inside the limb around which the main region (*HH* 25) is disappearing. The larger flare, at 20:19, occurs in the main region (*HH* 25) which at this time is mostly around the limb. The other small flares are not associated in time with any burst features – which is not unusual, in that this is the case for the majority of the smallest flares. The unusual feature of the burst at 20:23 is that this is a radio event of more than average intensity with a flux of 400×10^{-22} (watt/m^2)/cps and a duration of over 45 minutes, while the only flare listing for approximately this time is of importance 1 and duration 4 minutes. Comparison of 10-cm events and flares over a long period of time has indicated that bursts of this magnitude are almost always associated with flares of importance 2 at least. This supports the suggestion of an intense flare on the far side of the sun occurring in the active region which has largely disappeared around the limb. Possibly the short-duration flare reported is a small fragment on the limb of the much larger hidden flare.

A similar situation was observed previously on June 9, 1959. Analysis[3] showed in this case that the hidden flare occurred in a region which was just about to appear on the eastern limb. In this critical position, a direct line of sight is possible only for the radio emissions which are produced in elevated regions above the flare. It has also been suggested[4] that this event produced x-ray emissions.

The second set of solar noise observations was made with a 185-meter aperture interferometer system with a fan-shaped beam 1′ E.W. by 2° N.S. The daily strip scans of the solar surface are made at 16:30 U.T. and enable the bright radio emissive regions to be accurately located in one dimension. On November 4, a radio emissive region appeared on the eastern limb, crossed the central meridian on November 12, and was last seen on the western limb on November 20. The relation of the trajectory of the radio emissive region with respect to the solar disk indicates that the region was 20° to 30° north of the solar equator. This corresponds to the location of the optical region *HH* 25. In addition, the scan taken during the post-burst increase associated with the November 12 eruption clearly indicates increased emission from this region. Examination of the provisional sunspot positions as reported by the U. S. Naval Observatory showed that the sunspots of this region were first seen near the eastern limb on November 6 and last seen on the western limb on November 18. The longer visibility of the radio region in comparison with the optical manifestations is typical[5] and shows again that the 10-cm radio emission is observed even when the optical center is located on the far side of the limb. This emission is from a hot coronal condensation located some 3% of the solar radius above the photosphere. The surface area of the radio region seems related to bright plages with observed E. W. extents ranging from 1 to 6 minutes of arc.

When the reported sunspot positions are projected to give a value for November 20, it is found that the region extends from 20° to 30° around the far side of the western limb. Since radio emission from the coronal condensation in this position was observed, it is reasonable to assume, in the absence of an intense flare on the visible disk, that a hidden intense flare was responsible for the burst of noise observed at 20:23 U.T.

---

[1]H. Carmichael, J. F. Steljes, D. C. Rose, and B. G. Wilson, preceding Letter [Phys. Rev. Letters 6, 49 (1961)].

[2]Billings, Trotter, and Wetmore, High Altitude Observatory Preliminary Report on Solar Activity, Boulder, Colorado, 1960 (unpublished).

[3]R. J. Coates, A. E. Covington, and S. Edelson, Astron. J. 64, 326 (1959).

[4]J. Kleczek and L. Krivsky, Nature 186, 1035 (1960).

[5]A. E. Covington and G. A. Harvey, Astrophys. J. 132, 435 (1960).