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FILE NO. 15-2-136

NATIONAL RESEARCH COUNCIL
CANADA

ELECTRICAL ENGINEERING
AND RADIO BRANCH

OTTAWA, 8th July, 1947

Mr. Grote Reber,
212 West Seminary Avenue,
WHEATON, Illinois.

Dear Mr. Reber,

Many thanks for the copies of your articles published in NATURE, ASTROPHYSICAL HOURNAL and THE OBSERVATORY.

I have been able to secure measurements on the solar noise nearly every day. Fortunately, I haven't been bothered with set trouble. During May and April we received about thirty-five bursts of solar noise. Most of these are associated with radio fade-outs.

I am enclosing a copy of a letter to NATURE, and some H spectroheliograms taken on the day after the eclipse of 23rd November, 1946; also a copy of the daily solar temperature taken during May and June. The quantity given on the ordinate is the measured temperature of the radiation resistance.

I hope your work is continuing satisfactorily.

Yours sincerely,

A. E. Covington

AEC:HP

A. E. Covington,
Microwave Section

Encls.

NATIONAL RESEARCH COUNCIL

Electrical Engineering
and
Radio Branch

MICROWAVE SOLAR NOISE OBSERVATIONS DURING PARTIAL ECLIPSE NOVEMBER 23RD, 1946

(Letter to "NATURE", 22nd March, 1947)

During the partial eclipse of the sun on November 23rd, 1946, a record of the reduction of radio-frequency energy emitted from the sun in the 2800-megacycle band was obtained at Ottawa, Canada. At this station, the eclipse commenced at 10:45:5 E.S.T., reached a maximum at 12:18, and ended at 13:51. At noon the sun was at an altitude of 23°, with its axis of rotation 19° East of North. The clear sky permitted the taking of photographs of the sun at the Dominion Observatory. Data from these are shown in Figure 1.

The sun's radiation, contained in two 5-megacycle bands centered about 2800 megacycles, was received continuously by a parabolic reflector, astronomically mounted and driven to follow the sun. Once every hour the drive was manually corrected to compensate for errors in following. The dipole antenna placed at the focus of the mirror was oriented so that its axis was parallel to the sun's axis of rotation; thus the plane of polarization of the received energy was fixed with respect to the sun's axis. The beamwidth, 6° to the half-power points, allowed the total radiation from the sun and surrounding space to be received. The receiver, constructed after the manner of Dicke[1], measured over a short period of time the relative changes of energy, to within 1%. For a longer period of time, the sensitivity showed a gradual change. Calibration with a thermal load before and after the eclipse showed that the receiver sensitivity had decreased by 12%. In allowing for this drift, it was assumed that the change was linear with time. At times shown by breaks in the record (Figure 2), the antenna was moved from the sun in order to obtain the background as a reference point. The receiver output was used to drive a recording milliammeter.

Curve a, Figure 2, shows the percentage antenna temperature smoothed to eliminate receiver noise and corrected for changes in sensitivity; curve b, shows the percentage eclipsed area of the sun's photosphere. The observational results are:

(1) A 15% rise in the sun's temperature after the end of the eclipse.

(2) Small temperature fluctuations of about 7% before the eclipse.

(3) (a) A definite drop 3.0 minutes before the moon made its first visible contact. At this instant the moon's edge was 1.05 times the sun's radius from the centre of the sun. Details of change are shown in the table below:

Minutes before contact	% reduction
3	0
2	4.8
1	6.5
0	8.0
-1	9.5
-2	9.5

(b) A gradual return during the last part of the eclipse.

(4) A decrease occurring at 11:39 and an increase at 12:57 E.S.T.

Since the discovery of solar noise by Southworth[2] and Reber[3], and the subsequent discovery by Pawsey, Payne-Scott and

McCready[4] that the sun spot areas are particularly active noise generators in a lower frequency region (about 200 megacycles), records obtained during the solar eclipse will give information regarding the noise distribution over the sun's surface. In the microwave region, (24,000 megacycles) reference should be made to the results of Dicke and Beringer[5] obtained during the eclipse of 1945. Fortunately, during the present eclipse, a large group of spots was obscured by the moon at 11:39 and uncovered at 12:57. It is believed that this is the interpretation of the sudden change of energy (25%) during the middle of the eclipse, marked by the fall and rise at the indicated times. The noise generating region, totalling 2.2% of the sun's projected surface, and containing the sun spot group, is outlined by the four lunar shadows shown in Figure 7. With the present data, this area has an equivalent temperature of 1.5×10^{6}°K in excess of the average surface temperature of 5.6×10^{4}°K. This average is obtained for the eclipsed portion of the sun disregarding the spot area.

Before the first contact, the substantial reduction in energy might indicate that the source is in the space surrounding the sun, either from the corona, or from a prominence. Calculation of the equivalent temperature of the crescent-shaped area swept out by the moon during the three minutes before contact, gives 3×10^{6}°K. From the rate at which the temperature fall, most of the energy is produced in a region just off the visible limb. Photographic evidence for such a local disturbance has not yet been obtained.

No obvious correlation has been obtained between the disappearance of the isolated spot in the north-east quadrant of the sun, and any sudden drops in radiation. The large group south of the equator was not eclipsed, although an active region surrounding this spot could have been partially eclipsed for a short time.

The writer appreciates the assistance given by members of the Dominion Observatory.

A. E. Covington

OTTAWA, Canada
16th December, 1946

HP

R E F E R E N C E S

(1) R. H. Dicke, Rev. Sci. Inst. 17, 268 (1946)

(2) G. C. Southworth, J. Frank. Inst. 239, 285 (1945)

(3) G. Reber, Astrophys. J. 100, 279 (Nov. 1944)

(4) J. L. Pawsey, R. Payne-Scott, L. L. McCready, Nature, 157, 158 (1946)

(5) R. H. Dicke and R. Beringer, Astrophys. J. 103, 375 (May 1946)

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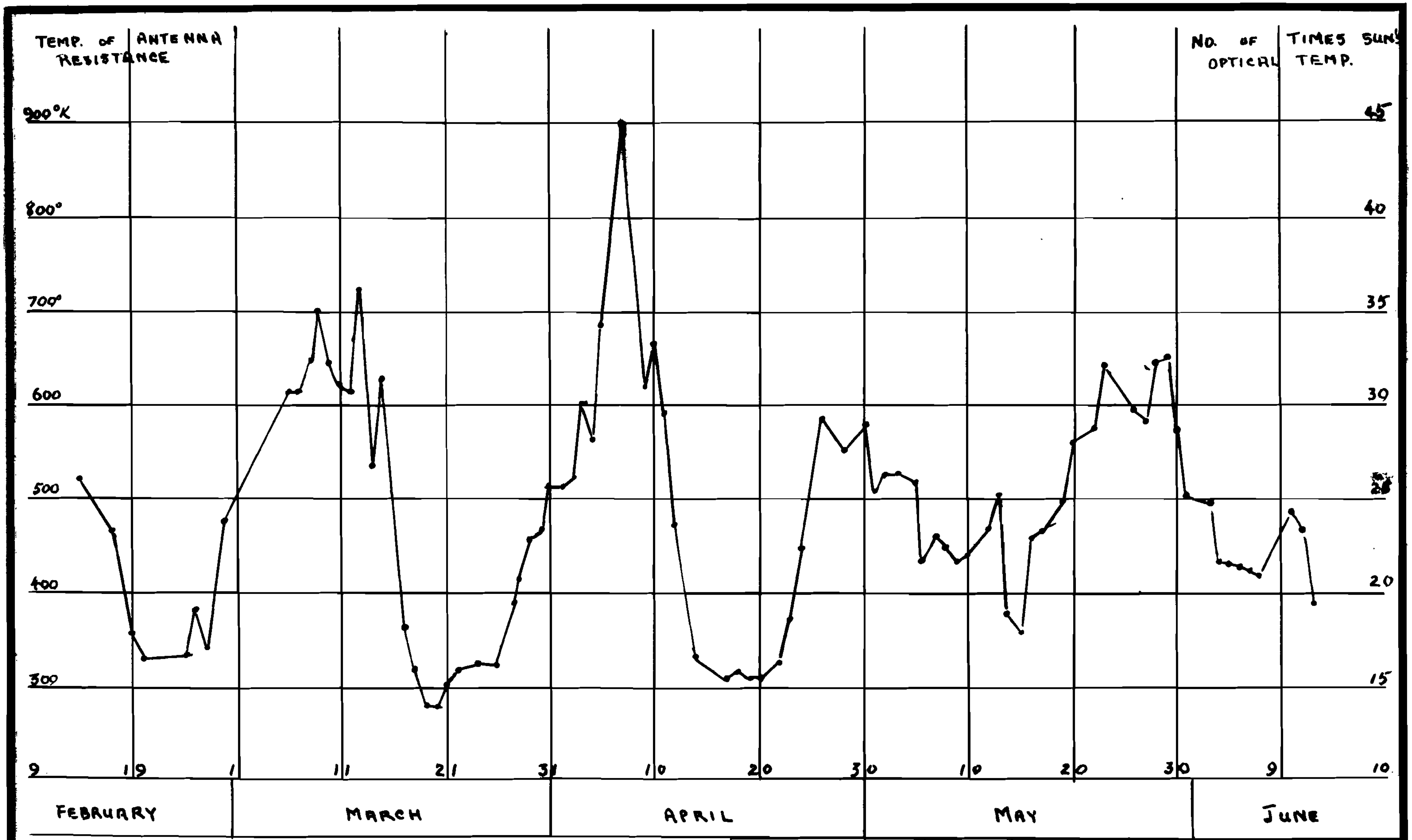

1947

10.7 cm Solar Radio Noise

Daily Ave.

ϕ = solid angle of sun

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DRAWN BY	DATE	SUPERSEDES
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NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

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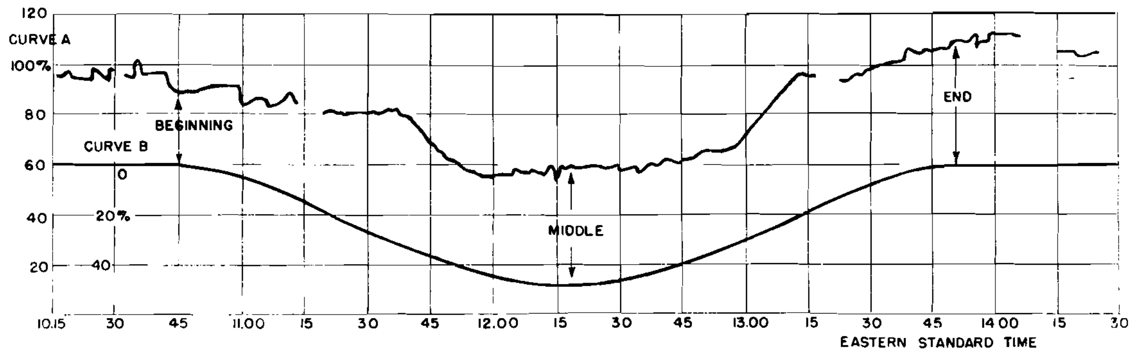

CURVE A - VARIATION OF SOLAR NOISE DURING ECLIPSE NOV. 23RD. 1946

CURVE B - ECLIPSED AREA OF SUN

Fig. 2

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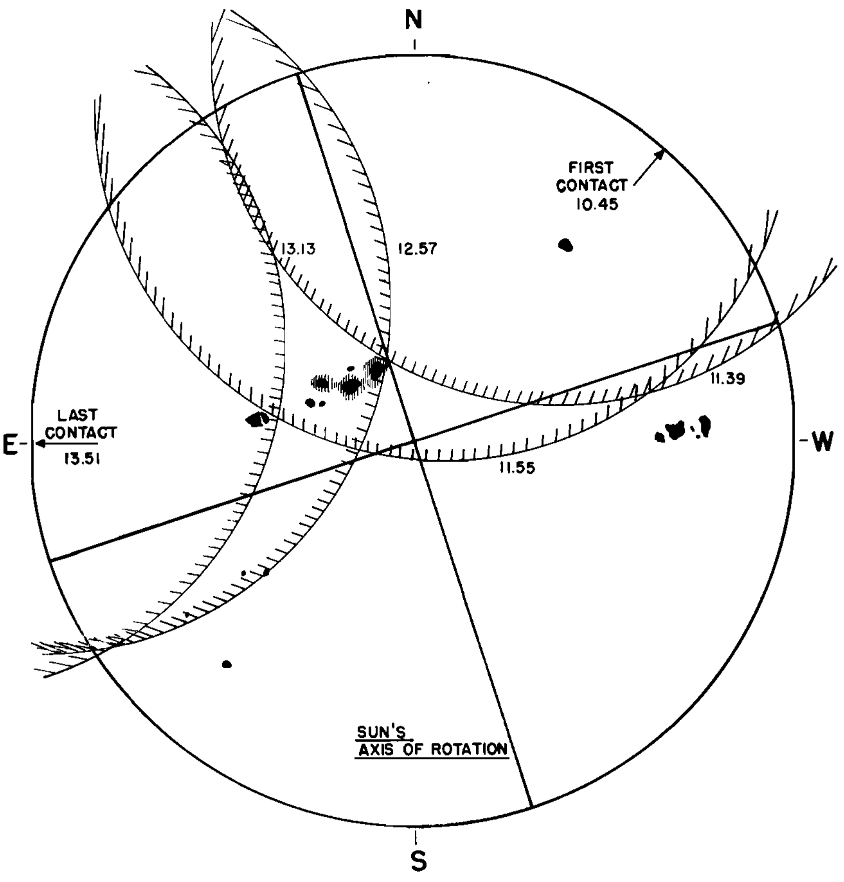

LUNAR SHADOW POSITIONS OUTLINING ACTIVE REGION
DATA TAKEN FROM DOMINION OBSERVATORY PHOTOGRAPHS

FIG. 1

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