Among the possibilities for the interpretation of these long-delay echoes are: (a) ionospheric focusing of E reflexions, (b) oblique reflexions from distant ion clouds in the E -region, (c) large delays due to lateral deviation^{6,7}, and (d) reflexions from the 'fourth reflexion condition', above the maximum of the F_2 -layer. Ionospheric focusing is immediately ruled out by the fact that the echo polarization is radically different from that of the E hops. Other records containing a definite focusing phenomenon do not show the reversed mode that is observed on the long-delay echoes. Oblique reflexions of detectable amplitudes would require an oblique surface of such proportions as to make this explanation extremely unlikely. No calculations have been made on possible time-delays due to lateral deviation; but it does not, at present, seem likely that this could account for the amplitudes and the time-delays of the orders observed.

We believe there is a strong possibility that these long-delay echoes are reflexions from above the maximum of ionization density in the F_2 -region, and that the reflexion mechanism corresponds to the 'fourth condition for reflexion'. It is hoped that future observations will add further evidence regarding this possibility.

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J. J. GIBBONS
R. L. SCHRAG
A. H. WAYNICK

Ionosphere Research Laboratory,
Pennsylvania State College, Pa.
Dec. 20.

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A Method of Analysis of the Directivity of Solar Radio Emission from Sunspots

It has been reported previously that the daily values of intensity of solar radio emission are approximately proportional to the whole disk Wolf's sunspot relative number or sunspot area^{1,2}. On the other hand, there is a tendency for the intense radiation to be observed when active sunspots are near the central meridian, especially in the metre wavelength region. If the solar radio emission has such a tendency, the daily values of solar radio emission will show better correlation with the sunspot relative number, $nA_1 + A_2$, than the whole disk sunspot relative number, $A_1 + A_2$, where A_1 , A_2 indicate Wolf's relative sunspot number in the central-circle zone (half-diameter circle) and in the outer zone respectively, and n is a parameter which indicates the importance of the sunspots located in the central-circle zone compared with those in the outer zone. To investigate the directivity of solar radio emission from the sunspots quantitatively, the value of n

Correlation coefficient r between solar radio emission and sunspot number versus n , which indicates the importance of the sunspots located in the central circle zone compared with the sunspots in the outer zone. —, May to August 1951; ---, January to June 1951

to give a maximum correlation coefficient was determined.

In the accompanying graph the correlation coefficient r , between solar radio emission at 3,260 Mc/s. observed at our observatory and the sunspot relative number, is plotted against n , and this is compared with the radio emission at 200 Mc/s. observed at Tokyo Astronomical Observatory in Japan, and 600 Mc/s. and 1,200 Mc/s. observed at Pott's Hill, Sydney; the solid lines are for observations from May to August 1951, dotted lines for those from January to June 1951. The sunspot number is taken from the Tokyo Astronomical Observatory Report.

As shown in the graph, the correlation coefficients between solar radio emission and sunspot relative number have the following maxima:

$n = 1.0$	at 3,260 Mc/s. and $r_{\max.} = 0.86 \pm 0.02$	(May-August 1951)
$n = 2.0$	" 1,200 " " " " " " " " " " " "	" " " " " " " " " " " "
$n = 1.5$	" 600 " " " " " " " " " " " "	" " " " " " " " " " " "
$n = 2.0$	" 200 " " " " " " " " " " " "	" " " " " " " " " " " "

Unfortunately, the standard errors are large at 200, 600 and 1,200 Mc/s. compared with the variations of $r_n/r(n=1)$ shown in the graph, so the results obtained at these frequencies by this method are almost meaningless. The directivities at these frequencies are therefore being investigated using another method of analysis; but it also shows a tendency to result in similar directivities.

It may be concluded that the solar radio emission at 3,260 Mc/s. from sunspots can be observed on the earth at almost equal intensity whatever the location of the sunspots; but at present the directivities are not clear quantitatively at other frequencies.

It is also doubtful if these directivities may be applied to the radio emission at bursts or outbursts.

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T. TAKAKURA

Osaka City University,
Ohgimachi, Osaka.

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