

# BELL TELEPHONE LABORATORIES

INCORPORATED

463 WEST STREET NEW YORK

May 13, 1937

CHELSEA 3-1000

IN REPLY REFER TO

KGJ-326-AB

REPLYING TO

MR. GROTE REBER

212 W. Seminary Avenue

Wheaton, Illinois

Dear Mr. Reber:

In the following I will attempt to answer briefly the questions contained in your letter of April 26. Where the answers are long or involved I will refer you to existing literature on the subject.

Since the array used was made up of  $\lambda/4$  vertical elements, the vertical directional characteristic is equal to that of a  $\lambda/4$  vertical antenna multiplied by the factor  $\frac{1 - \cos(\pi/2(1 + \cos \delta))}{2}$  where  $\delta$  is the angle above the horizontal. This factor must be applied to take into account the effect of the rear curtain of the array.

The characteristic of a  $\lambda/4$  vertical antenna depends upon the constants of the ground and is discussed in "The Optical Behavior of the Ground" by C. B. Feldman, Proc. I.R.E., Vol. 21, pp. 764-801, June 1933 and in "The Determination of the Direction of Arrival of Short Radio Waves" by H. T. Friis, C. B. Feldman and W. M. Sharpless, Proc. I.R.E., Vol. 22, p. 47, January 1934.

For a vertically polarized signal arriving from a direction coincident with that of maximum receptivity, the array has a gain of about 12 db over a  $\lambda/2$  vertical antenna, the effective height of which is discussed in the above two papers.

By question three, I assume that what you wish to know is the intensity of the radiation in question. Knowing the answers to your two previous questions, it is possible to calculate the incident field strength. Applying the equation for Poynting's radiation vector gives the energy flow across a unit area perpendicular to the direction of propagation.

Assuming that one has made these calculations, however, and has allowed for the probability that the radiations in question are of random polarization and that they come from widely separated sources of varying intensities, the results are of questionable value for calculations such as you wish to make because, at present, it seems impossible to estimate the effect of the ionosphere on these radiations. There is no doubt that some of the energy incident on the earth's atmosphere is refracted away from the earth and some is absorbed before it reaches the receiver, but just how much is not known.

The answers to questions four and five will be given in a paper which I am now preparing for publication, a copy of which I will mail to you as soon as I have extra copies available.

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If after reading the above papers you have further questions, I will be glad to hear from you and will give you whatever additional information I can.

Very sincerely yours,

*Karl G. Jansky*  
*abj*

KARL G. JANSKY