DISCUSSION ON PORTABLE RECEIVING SETS FOR MEASURING FIELD STRENGTHS AT BROADCASTING FREQUENCIES, BY AXEL G. JENSEN*

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Mr. Jensen has so fully covered the technical features of these new measuring sets that I think it would be impossible for me to add anything of importance to that phase of the subject except to emphasize, as Mr. Jensen failed to do through modesty, just how great an advancement the replacing of the method of balancing voltages impressed on the grid of the first detector with one involving the balancing of the voltages induced in the loop represents in the art of measuring field strengths at broadcast frequencies. Advancement both in the sustained accuracies obtainable in field work and even more in their ruggedness and convenience in the field. We have found that on the average we can accomplish nearly twice as much work with these new sets as we could with the old type which they replace. Also, it may be of interest to you to see how these sets are being used in the field in actual field strength measuring work, and to review both the uses to which they have been put as well as the ones to which they may be put and for which they are peculiarly well adapted.

Originally our field work was done with sets which we carried on the back seat of an ordinary touring car, relying on the cushion effect of the seats themselves to protect them from severe road shock. This involved lifting them up on a small platform every time a measurement was to be made, and attempts were made to develop a spring mounting which would satisfactorily protect them from road shock and at the same time carry them in position ready for instant use. Figure 1 will show our solution of this problem with the sets closed and the loop mounted on the running board of the car ready to go.

*Received by the Editor, May 19, 1926.

The mounting for the sets consists of a heavy wooden box supported on an equally heavy angle iron frame, this box being lined on the bottom, sides, and back with heavy automobile type cushions, and the sets are carried in a felt lined light wooden frame upon these cushions. Since it is necessary to reach the front and top of the sets during operation, it was impossible to surround them entirely by cushions, and instead the sets were clamped into the light frame, and this box frame is held against

FIGURE 1

the cushions by four heavy steel coil springs located at the bottom and top rear corners of the mounting. This cushion mounting has been very successful in protecting the sets from injury by road shock as well as convenient in operation. We also thought it looked quite handsome until the proprietor of an electrical shop where we stopped to get some batteries asked us, "What kind of a washing machine is that?"

Figure 2 shows the sets with the loop inserted in its socket and the set in operation. When a measurement is to be made, all that is necessary is for the driver to remove the loop from the spring clips in which it is held, insert it in the socket on the top of the set, and plug in his receivers. The batteries are turned on by the insertion of the receiver plug. The condenser dials are fitted with clamps so that the set remains in tune. This makes

it a very convenient arrangement and we have found it possible to make as many as nine separate measurements in an hour at points spaced one mile apart.

FIGURE 2

Examples of the first work done in the field with measuring sets involved a small survey around New York City and another around Washington, D. C. The results of these surveys are shown in Figures 3 and 4. The form of the contour lines show clearly for the first time the very wide departure of field strength distribution from the ideal, especially in congested areas filled with absorbing metallic structures. In the case of New York City, the shadow cast by the 42nd Street district north over the Central Park area, and another cast by the downtown skyscrapers over Governors Island and lower Brooklyn are clearly shown by the marked dents in the contour lines. These data were included in a paper by Mr. Bown and myself presented before this Institute in 1924.

Shortly after these surveys were made, field strength measuring sets of the early type were used to make a quantitative comparison of the transmission from a transmitting station located at 24 Walker Street and a transmitting station located only one mile away at 463 West Street, both in New York City. The results of these comparative measurements rather surprised us

by showing a difference, at certain points in the lower tip of Connecticut, of over 100 to 1 in power efficiency of transmission between these two stations, only a mile apart.

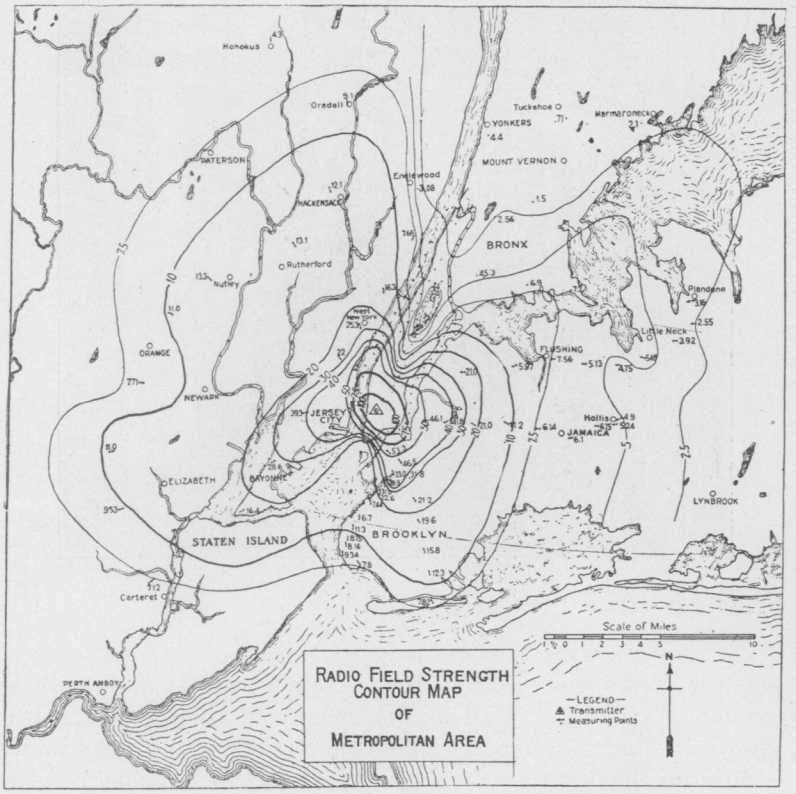

FIGURE 3—Radio Field Strength Contour Map of Metropolitan Area
(Field Strenghts in Millivolts per Meter)

In an attempt to get some explanation of the possible causes of such a condition, a complete detailed survey was made of Westchester County and the lower tip of Connecticut, which resulted in the field strength contour map shown in Figure 5. The contours on this map show that there is a series of long nearly parallel hills and valleys of field strength. There has occurred to us, as an explanation, that this hitherto uncharted form of field strength distribution is a gigantic wave interference pattern. This interference pattern probably results from the extremely heavy absorption of the high building area around the 42nd Street district with its resulting shadow and the feeding in

from each side of this shadow as the waves progress out over Westchester.

This same shadow effect has been definitely located by means of these measuring sets in connection with the use of a portable transmitter, shooting at this 42nd Street district from different directions. In Figure 6 is shown the location of the portable transmitter at these different points with a large enough fragment of the resulting contour map to show the shadowing effect. The intersections of the lines drawn from the shadows to the transmitter fall at approximately 38th Street in the vicinity of

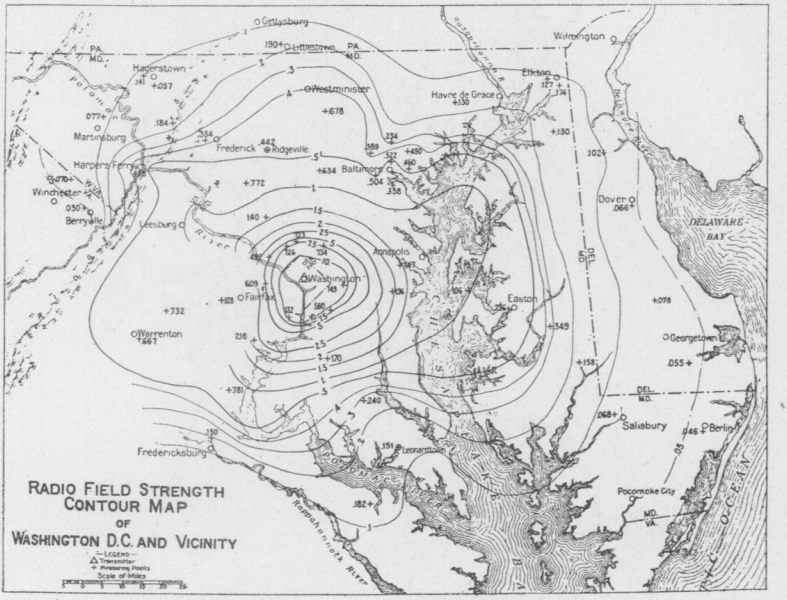

FIGURE 4—Radio Field Strength Contour Map of Washington, District of Columbia and vicinity

Sixth Avenue, definitely locating the center of gravity at least of the area of abnormally heavy absorption. The interference pattern given above and our conclusions as to the nature of the effect of the building area on the interference pattern were first described in a paper presented before this Institute last fall, "Some Studies in Radio Broadcast Transmission," by Messrs. Bown, Martin and Potter.

Finally, I should like to point out that such sets as these are the only means available at the present time for making accurate and complete field strength surveys of a broadcasting station. By the use of a portable transmitter, in connection with surveys

made in this way, it is possible to evaluate accurately in advance of any costly construction, the relative merits of different sites for the location of a new broadcasting station, and thus avoid the chance of unsatisfactory performance which has been experienced by so many stations located in dense metropolitan areas.

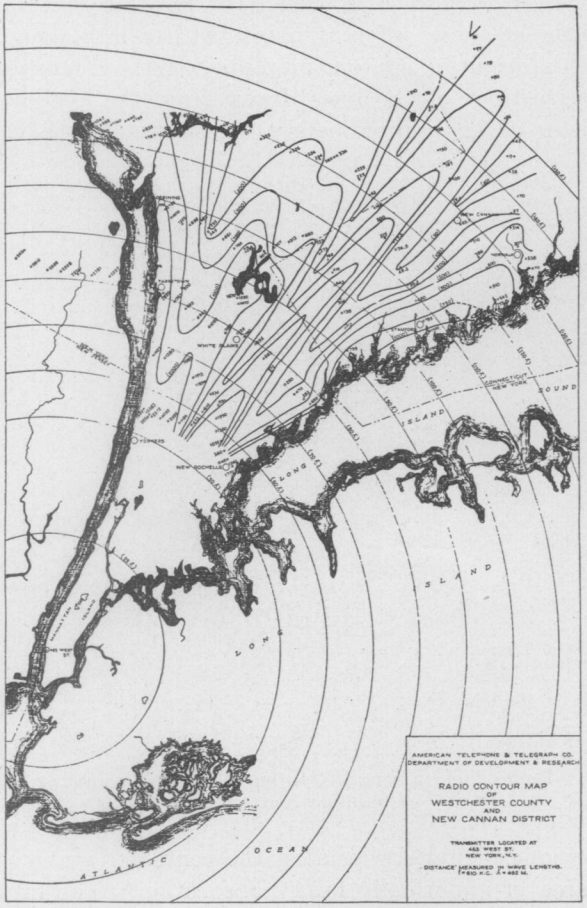

FIGURE 5—Radio Contour Map Showing Wave Interference Pattern

These sets also are peculiarly well adapted for the location of noise or interference of any sort. Heretofore, it was necessary to have a carrier from some transmitting station in order to bring the noise or interference in as sideband and thus raise it to an audible level in the receiver comparable to ordinary receiving conditions. But due to the directional characteristic of the carrier it was impossible to use a directional receiver to determine

the bearing of the source of the noise. With these sets it is possible, from the local signal input oscillator, to supply a carrier of any known or desired value and frequency without a directional characteristic, and to use this carrier to sensitize the receiver so that the loop's directional characteristic may be used to locate the bearing of the incoming noise and thus to trace down the source of noise.

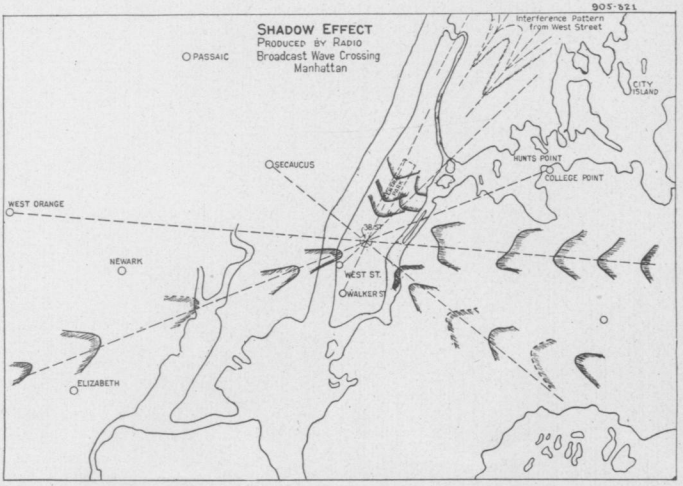

FIGURE 6—Map Showing Location of Radio Obstruction on Manhattan Island as Determined by the Intersection of Lines Between Various Transmitting Points and Their Corresponding Shadows

In conclusion, perhaps the best indication of the value of these sets in research work is given by the fact that we have thought it worth while to carry sets of these types over 15,000 miles in the last three years in the making of field measurements and have made a total of about three thousand separate measurements.