LETTERS TO THE EDITORS

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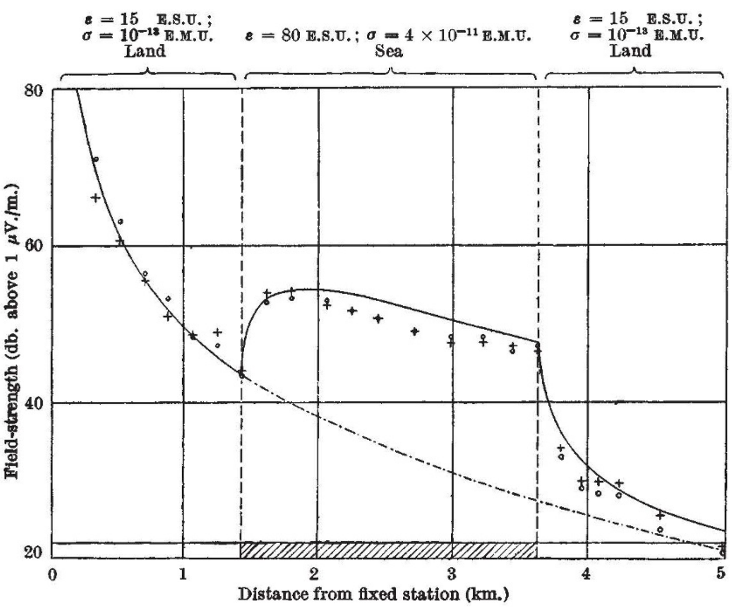
Ground-Wave Propagation Across a Land/Sea Boundary

In a paper to be published shortly[1], I have discussed the problem of ground-wave transmission across a land/sea boundary, and have predicted that under some conditions there should be a marked recovery in field-strength. On medium wave-lengths this recovery should extend to a considerable distance over sea, though, so far as I am aware, no conclusive evidence of this phenomenon has yet been published. The theory shows that the effect should not be confined to the diffraction region; but that on sufficiently short wave-lengths it should occur at distances where the Sommerfeld flat-earth analysis is valid.



———, Theoretical curve, land and sea; — · — · —, theoretical curve, land only; +, measurements at fixed station; o, measurements at mobile station. λ = 3·9 m.; P = 10 watts; vertical polarization, $h_T = h_R = 0$

For vertical polarization on a wave-length of 4 metres, the recovery should be well developed when the land/sea boundary is only a kilometre from the transmitter, and the maximum increase in field-strength when both aerials are on the ground should then be of the order of 12 db. and occur at about 0·5 km. beyond the boundary. Experimentally, these conditions are favourable for the finding of a suitable site free from irregularities of terrain comparable with the wave-length, and for obtaining adequate field-strengths at the required distances with a portable transmitter. The expected increase is also greatly in excess of any likely instrumental or site errors.

Fortunately the Marconi crystal-controlled transmitter-receiver *H*.16 working on 77·575 Mc./s. ($\lambda \approx$ 3·9 m.) is ideally suited for the purpose, giving a radiation of 10 watts from a vertical half-wave dipole and permitting two-way transmission and reception with telephonic communication. An experiment has been carried out using one such set as a fixed station on the Mundon Marshes south of the Blackwater, Essex, while another was moved from it along a straight line to the shore 1·4 km. away, and then across the sea path of 2·2 km. in a motor-boat. Field-strength readings were taken at high tide at each station at intervals along the land- and sea-paths, and at a number of points on the land on the farther side.

The results are shown in the accompanying graph. On this wave-length the propagation over land is controlled mainly by the permittivity, and a value of 15 E.S.U. deduced from the shape of the initial land curve has been taken in computing the theoretical curve. The assumption that the propagation is unmodified before a boundary is effectively fulfilled, and the test confirms the prediction as regards both the extent and the position of the recovery. It also affords an interesting check of the reciprocity condition over such a composite path.

The measurements over sea were conditioned by the necessity of stopping the engine of the boat while taking a reading and the consequent drift off course. The low values may be accounted for by obstructions on the modified land path, in particular a section of sea wall lying along the path. To overcome this difficulty, a continuous recording was made at the fixed station of the signal from the mobile transmitter while the boat kept on its course at uniform speed, and the curve so obtained agrees closely with the theoretical curve over the whole of the sea path, including the initial rapid rise of field-strength.

The terrain on the farther side was less favourable for unobstructed transmission, involving the choosing of measuring sites considerably off course; but the values confirm the correspondingly rapid drop in field-strength that occurs on crossing a sea/land boundary. On this wave-length the theoretical curve would eventually settle down to the all overland curve if the sea section were somewhat farther from the transmitter.

The theory is admittedly approximate, but this confirmation at a short wave-length strongly supports the explanation I have given of these effects in terms of a redistribution of energy above the ground, whereby the height-gain relation on one side of the boundary changes to that characteristic of the section on the other side, and strengthens one's confidence in the use of the theory on medium and long waves, where the results can be of profound practical importance.

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[1] *J. Inst. Elect. Eng.* (in the press).