ON A NEW MIXED PROBLEM OF THE PARTIAL DIFFERENTIAL EQUATION OF TELEGRAPHY.

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DURING the last twenty years the question of the propagation of electric waves in wire lines or cables has been the subject of a very great number of researches, on the one hand on account of its practical importance in connection with telephony, rapid telegraphy, wireless telegraphy, and the transmission of energy by means of alternating currents, and on the other on account of its purely mathematical interest and of the great increase in our knowledge of partial differential equations of the hyperbolic type. In all these researches the point of view has been very different in the different cases and may be roughly classified as follows. The electrical engineer, whether interested in transmission, telephony, or wireless, has been mainly concerned with phenomena depending upon simple harmonic functions of the time, that is, with standing wave phenomena after the steady state of oscillation has been established. For these the methods of trigonometric series suffice perfectly, and with them we are not here concerned. In these cases the line is of finite length, and we deal with series of functions. On the other hand the mathematician has been interested in problems connected with propagation in a line of infinite length, especially as depending on the data of the initial state of the line. For this case instead of infinite series we should use definite integrals of Fourier, but the method of Riemann has furnished a more powerful and interesting method of attack, which should interest the physicist on account of the clearness with which the results may be interpreted. It would be impossible to cite all the important memoirs that have appeared on this subject, but it would be equally impossible to omit the names of Heaviside, Picard, Poincaré, Boussinesq, Goursat, Brillouin, and Hadamard.

The first appearance of the so-called telegraphist's equation is in a paper by Kirchhoff,* which is remarkable in that it

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* Kirchhoff, "Ueber die Bewegung der Elektricität in Drähten," *Pogg. Ann.*, vol. 100 (1857); Ges. Abh., p. 131.