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THE OUTSTANDING PROBLEMS OF RELATIVITY[1]

IT was in January, 1914, that Einstein[2] made his great departure from the Newtonian doctrine of gravitation by abandoning the idea that the gravitational potential is scalar. The thirteen eventful years which have passed since then have seen the rapid development of the new theory, which is called general relativity, and the confirmation by astronomers and astrophysicists of its predictions regarding the bending of light rays by the sun and the displacement of spectral lines. At the same time a number of new problems have arisen in connection with it; and perhaps the time has now come to review the whole situation and to indicate where there is need for further investigation.

Speaking from this chair I may perhaps be permitted to recall that my first experience of the British Association was as one of the secretaries of Section A nearly thirty years ago; and that my secretarial duties brought me the privilege of an introduction to the distinguished mathematical physicist, Professor G. F. FitzGerald, of Dublin, who was a regular and prominent member of the section until his death in 1901. FitzGerald had long held an opinion which he expressed in 1894 in the words "Gravity is probably due to a change of structure of the ether, produced by the presence of matter."[3] Perhaps this is the best description of Einstein's theory that can be given in a single sentence in the language of the older physics: at any rate it indicates the three salient principles, firstly, that gravity is not a force acting at a distance, but an effect due to the modification of space (or, as FitzGerald would say, of the ether) in the immediate neighborhood of the body acted on; secondly, that this modification is propagated from point to point of space, being ultimately connected in a definite way with the presence of material bodies; and thirdly, that the modification is not necessarily of a scalar character. The mention of the ether would be criticized by many people to-day as something out of date and explicable only by the circumstance that FitzGerald was writing thirty-three years ago; but even this criticism will not be universal; for Wiechert and his fol-

[1] Address before Section A—Mathematical and Physical Sciences—the British Association for the Advancement of Science, Leeds, 1927.

[2] *Zeits. f. Math. u. Phys.* 63 (1914), p. 215.

[3] FitzGerald's *Scientific Writings*, p. 313.