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THE SIZE OF THE UNIVERSE[1]

THE century in which we live promises to make an incalculable advance in man's power of exact measurement. "Nearly all the grandest discoveries of science," says Lord Kelvin, "have been but the rewards of accurate measurement and patient, long-continued labor in the minute sifting of numerical results." The opening decades of the century have witnessed the emergence of a number of fundamental natural phenomena, the explanation of which defies all the mighty power of Newtonian mechanics. The Newtonian laws have hitherto been found adequate to explain large-scale phenomena; but there seems convincing reason for grave doubt as to their applicability to small-scale phenomena. "The old laws," as Jeans observes, "are not, so to speak, fine-grained enough to supply the whole truth with regard to small-scale phenomena." Nor are they exact enough to explain very minute changes in large-scale phenomena. Conspicuous among contemporary theories which throw grave doubt upon the universal applicability of the Newtonian mechanics are the electron theory of Lorentz, the quantum theory of Planck and the relativity theory of Einstein. The Lorentz transformation, basic in the electron theory, belies Newton's ideas of absolute space and time. Crucial in the quantum theory is the phenomenon that "the total radiant energy per unit volume of ether in temperature-equilibrium with matter is finite"; and to explain the facts of radiation according to Planck's law the Newtonian mechanics are inadequate. The remarkable explanation of the observed discrepancy in the advance of the perihelion of Mercury, and the phenomenal accord of observation with theory in the matter of the light-ray deflection announced by W. W. Campbell a few weeks ago, thitherto unexplained by the Newtonian mechanics, constitute supreme triumphs for Einstein's relativity theory.

To-day are going forward profound investigations, at each end of the scale of magnitudes—towards the infinitesimal and towards the infinite. Methods of almost incredible refinement are being devised for determining the scale of the atom and the scale of the universe. The investigations of Rutherford have virtually set it beyond doubt that the atom consists of a central nucleus of almost infinitesimal dimensions, and of electrons revolving in planetary manner

[1] Presidential address before the North Carolina Academy of Science, Greensboro, N. C., May 5, 1923.