

BOOK REVIEW

LORD (ERIC A) : Tensors Relativity and Cosmology. Pp. 216, Tata-McGraw-Hill Publishing Co., Ltd., New Delhi, 1976. Price Rs. 19.50.

The general theory of relativity, formulated by Einstein in 1915, has occupied a very special position in physics. Theoretical physicists have been fascinated by its aesthetic beauty and logic, experimental physicists have despaired at the magnitude of the effects and laymen have been perplexed by its statement about the curvature of the four-dimensional spacetime. The developments in cosmology have revived the interest in the theory and the present book is a timely one.

A part of the subject matter, namely, tensors, is taught to M.Sc. students of Mathematics and Physics in a limited way. The author has started from this point, viz., the algebra of tensors, to go into the elements of differential geometry including Riemannian geometry. This first part of the book is a short mathematical prelude to the second and the third parts of the book, dealing respectively with the special and the general theories of relativity. While the special theory, Einstein's brainchild of 1905, could be taught without the full apparatus of tensor analysis, the author has gone ahead into matters like the Lorentz group, spinors and the Lagrangean formulation. In these matters the compactness and the utility of the tensor analysis becomes clear in a dramatic way. The Lagrangean formulation is carefully done with simple discussions of the Yang-Mills field and the Noether's theorem.

In the third part of the book, occupying more than half of the book, the Einstein's gravitational field equations are first derived and the post-Newtonian approximations are discussed. The author then goes on to various cosmological models of the universe. From here the developments going beyond the Einstein field equations are taken up, especially the steady state cosmologies, the unified field theories and the scalar-tensor theories of gravitation. The author has skilfully prepared the ground for these developments, so that the plausibility of the theories is easily brought out. Admittedly in a book of this size one cannot go into the details of the recent speculations but enough is presented to enable an intelligent reader to follow the recent literature in this area without too much of difficulty.

In balance, what can one say about the book? It is a compact book prepared to train young students of mathematical physics to appreciate the current problems in relativistic cosmology. Indeed the book is based on a set of lectures given to the Ph.D. students in theoretical astrophysics and cosmology. In this task the book is fairly successful, although the student must put in a very substantial effort. The author has a terse style, which would not be inappropriate in a set of lectures where the students can ask for the details to fill the gaps. In a written book this brings some problems in following the text. Secondly each person has his own bias in the choice of material. The reviewer would have liked to see a discussion of gravitational waves, a matter of cosmological significance and also an area of current interest in laboratory-based experiments, thanks to the efforts of Weber, to test the general theory of relativity and the cosmological ideas regarding the structure of our galaxy. Another item, the reviewer would have liked to see, is the gravitational precession of dipoles, again a possible candidate for a laboratory-based test of relativistic gravitation. This effect was calculated first by Lens and Thirring in 1920 and more completely by Schiff in 1961. The effect goes beyond the point mass test particles and concerns the influence of space-time curvature on dipole test particles. One would have liked a mention of this effect, particularly since the work of Kibble and Sciama on the gravitational interaction with spinning particles is mentioned in the book.

The book has been moderately priced at Rs. 19.50, as a result of the support from the National Book Trust. Though the M.Sc. students will find it beyond their reach, the book would be welcomed by research workers.

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