view of our knowledge of those aspects of the fission process that affect the kinetic behavior of a reactor; and the second half a textbook of reactor dynamics. Of the two parts, I preferred the first. Here the author speaks with an impressive authority, and he has done a commendable service for the community of reactor physicists in bringing together so much data that is needed to predict the kinetics of reactors.

As for the second half of the book, though it outlines much of the theory that has been done in the American laboratories, particularly at Los Alamos, its tone is more descriptive than explanatory. For example, the most fundamental theorem in the noise analysis of a reactor—that the noise spectrum is proportional to the square of the amplitude of the reactor transfer function—is quoted rather than proved. Nor does Keepin cover many of the experiments on reactor transients—experiments described by such code words as "Borax" and "Spert," which illuminate various aspects of the theory. But here, and throughout, Keepin directs the reader to sources where details of derivations or of experiments can be found. One hopes that these sources display the same degree of scholarship and responsibility toward the reader that Keepin displays in the first half of his useful book.

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Unified field theory

LES THEORIES UNITAIRES DE L'ELECTROMAGNETISME ET DE LA GRAVITATION. By Marie-Antoinette Tonnelat. 522 pp. Gauthier-Villars, Paris, 1965. Paper $30.00

by R. B. Lindsay

One of the aims of physics as a science and indeed probably the chief one is the search for points of view that can subsume the largest possible domain of physical experience. This was exemplified, indeed, by the ancient Greek philosophers in their attempts to understand the world, though we do not consider their efforts very plausible or successful. The nineteenth century produced Faraday, who devoted many years to trying to find essential connections between apparently diverse phenomena. It also witnessed the accomplishments of the thermodynamicists who succeeded in establishing the concept of energy as a unifying principle. One of the great challenges of twentieth-century physics is the unification of the relativity theory of gravitation with electromagnetic theory and the quantum theory so as to produce a unified field theory that will encompass both gravitation and electromagnetism.

In the public mind the notion of a unified field theory is associated almost entirely with the name of Einstein, and indeed the celebrated author of the theory of relativity spent his later years in the valiant effort to produce a satisfactory synthesis of this kind. It is not generally realized that a host of other theorists have tried their hands at this problem. What may be called with considerable accuracy the whole story is set forth in the volume under review by Madame Tonnelat, professor in the University of Paris, and a well known authority in the field of which she writes.

The main part of the book is prefaced by a 13-page introduction, which provides an interesting and informative historical summary of the whole subject. This can be read with profit even by the nonspecialist, who may well find the body of the work rather formidable. The volume is divided into three parts dealing respectively with: (1) the basic theories of relativity and electromagnetism (150 pages); (2) the classical unitary theories (220 pages); and (3) attempts at quantification of gravitational fields. The first part is essentially a review of material that has been a part of the literature of physics for a long time. It is however presented with great clarity and even includes a review of the necessary mathematical background of vector and tensor analysis, the differential geometry of Riemann spaces, etc. The second part discusses in some detail the principal efforts at unified field theory in what may be called the classical or geometrical (nonquantum) domain. It is prefaced by an instructive chart relating the various theories of this kind from that of Weyl in 1919 to that of Schrödinger of 1943 and including of course the famous Einstein papers of the 'thirties and 'forties. The attempt is made to summarize all the principal theoretical points of view and to compare them by introducing so far as possible a uniform notation. Even the less successful attempts have been included for the light they may shed on future developments.

Part three of the volume is devoted to a review of the more highly speculative attempts that have been made to introduce a connection between gravitation and quantum theory, in other words to quantify the gravitational field. Here there is much mention of gravitons, and both linear and nonlinear field theories are discussed. In comparing the various points of view that have appeared in some profusion in the past twenty years the impartial nonspecialist observer is apt to conclude that the problem is one of estimating the likely future success of theories that so far have enjoyed only a dubious reception. The lack of clear-cut experimental verification is of course a drawback in the assessment of such theories. Nevertheless it is imperative to encourage speculation, for only by this route can ultimate success be achieved.

The author's style is clear but terse, and only the person well acquainted with the general background will be able to grasp the details. For the expert one of the chief merits of the book is the extensive bibliography of 429 items. Unfortunately its usefulness as a reference is much diminished by the lack of an index.

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A great American physical chemist

THE QUINTESSENCE OF IRVING LANGMUIR. By Albert Rosenfeld. 369 pp. Pergamon Press, New York, 1966. Paper, $2.95

by R. B. Lindsay

Since science is the creation of scientists, the lives of those who have made outstanding contributions to its development will always be of interest and value to both the scientific community and the general public. Hence the writing of scientific biography is an important business. Unfortunately it must be admitted that it is an extremely difficult task. His fellow scientists want to know what the man really did to justify his fame, but, though they are willing to accept a certain amount of technical detail, wish to have it explained in sufficiently simple language so as to be understandable by the competent nonspecialist. A certain amount of human-interest element is desirable, but it must not be overdone. To meet these demands is sufficiently difficult for the biographer, but his task is made even harder when he has to produce a readable and comprehensible picture of the scientist for the general reader. The latter type of biography is all too likely to reduce to a collection of anecdotes.

The author of the life of Irving Langmuir, here under review, has in general steered fairly skillfully between the two extremes of a purely technical account of the subject's scientific work and a popular story of his personality and nonscientific activities. The book was first written as volume 12 of the series of *The Collected Works of Irving Langmuir,* published in 1961 by the Pergamon Press. It now appears as a paperback, intended for a wider audience, in the series Selected Readings in Physics in the Commonwealth and International Library. D. ter Haar, the general editor of the series, contributes a foreword. The series is intended in general to be anthological in character, but will eventually provide estimates of the achievements of famous physicists with reprints of their principal papers. This biography by Albert Rosenfeld, the science editor of *Life* magazine, takes a somewhat different slant, but its publication in the series was nevertheless felt to meet a real need.

Irving Langmuir was without doubt one of the great American physical chemists and physicists of the first half of the twentieth century. With insatiable curiosity and fertile imagination he penetrated into a host of problems on the borderline of chemistry and physics. His name will forever be associated with the physics and chemistry of surfaces. He had more than