Life and times of a unique theorist

Paul Ehrenfest, Vol. 1.
By Martin J. Klein
330 pp. American Elsevier (North-Holland), New York, 1970. $9.50

Reviewed by H. B. G. Casimir

This book, the first part of a study of the life and work of Paul Ehrenfest, is both a fascinating biography and an important contribution to the history of modern physics. Paul Ehrenfest was born in Vienna during 1880, studied theoretical physics at Vienna and at Göttingen and obtained his doctor's degree at Vienna in 1904. In that year he married a fellow student, the Russian-born mathematician Tatyana Alexyevna Afanassjewa, and from 1907 to 1912 the Ehrenfests lived in St Petersburg. In 1912, Ehrenfest was called to Leyden as a successor to Hendrik A. Lorentz, who was moving from Leyden to Haarlem where a special position had been created for him at Teyler's foundation. From 1912 to his death in 1933 Ehrenfest was professor of theoretical physics—and the only full professor of theoretical physics—at Leyden University.

Physicists interested in the logical foundations of statistical mechanics will still study the article of P. and T. Ehrenfest in the *Encyklopädie der Mathematishen Wissenschaften* which was published in 1911. The notion of adiabatic invariants, first introduced by Paul Ehrenfest in 1913, played an important role in the formulation of the quantization rules of the preliminary versions of quantum mechanics. He also published numerous papers elucidating specific points of thermodynamics, statistical mechanics, quantum theory and the theory of relativity. All this work is now easily accessible in *Ehrenfest's Collected Scientific Papers* (M. J. Klein, ed., North-Holland 1959).

But the influence of Ehrenfest has been far greater than one might expect from his published work. He was a magnificent lecturer and was unrivalled as a leader of discussions. He had a unique ability to formulate the essential ideas of a theory and to invent simple models to illustrate them. He was forever fighting lack of clarity and could become a merciless and scathing critic when he suspected humbug or dishonesty but he was generous and unselfish in his appreciation of what he considered valuable. These characteristics, together with his wholehearted dedication to the cause of science, made him into a much more central figure among his contemporaries than a present generation of physicists might suspect. His biography provides interesting sidelights on Lorentz, Einstein and many others with whom he was on close terms of friendship.

Martin Klein tells us in the preface to his new book how he looked up some work of Ehrenfest's in 1953. "I was struck by Ehrenfest's unique style: the man himself seemed to be present in some of his scientific papers, a most unusual situation. When I also read Einstein's moving and personal memorial notice of his friend Ehrenfest I decided that I wanted to know more about this extraordinary physicist."

The result, after a quest of many years, is what I consider an extraordinary and almost unique example of a scientist's biography. Writing a book of this kind requires a rare combination of talents and abilities. The author must be a competent scientist, and it is obvious that Klein meets this requirement. Throughout the book he shows his mastery of the subject and his impressive erudition does not prevent him from tracing the main lines of development of physical theory in clear perspective. I should like to mention in particular a lucid chapter on "The Essential Nature of the Quantum Hypothesis" (chapter 10) and a penetrating analysis of the Encyclopedia article (chapter 6). Klein explains, for instance, Ehrenfest's attitude towards Willard Gibb's *Elementary Principles in Statistical Mechanics*. Ehrenfest felt that Gibbs had not really made a contribution towards solving the difficulties that Boltzmann had been confronting in his statistical explanation of

Paul Ehrenfest lectures at a University of Michigan summer symposium on theoretical physics, 1930. (Photo courtesy Niels Bohr Library, George Uhlenbeck collection.)

irreversibility. But as a consequence he failed to appreciate the importance of the canonical ensemble (and the grand ensemble) as a description of equilibrium and as a total for calculating thermodynamic functions. "The great power of the canonical ensemble as a method of calculation had no special appeal for Ehrenfest, since he rarely carried out such calculations" (page 134). This ties in with a remark at the end of chapter 4 on Ehrenfest's thesis (page 74) —"Also characteristic of Ehrenfest is the fact that his thesis is not a calculation. He does not solve a problem in the usual sense of applying a well formulated theory to a new situation. There are plenty of equations, of course, but the goal of the investigation is not a single formula. In this respect the thesis is typical of Ehrenfest's work, but in this as in other respects, he was a very atypical theoretical physicist."

Next, the author should be willing and able to devote much time to careful scholarship. Klein has made a thorough study not only of all available sources of printed material, but also of diaries and correspondence: It is fortunate that so many of Ehrenfest's note books and letters were preserved. And he has contacted many of Ehrenfest's former students and colleagues who provided him with documents and personal reminiscences. The whole book bears witness to Klein's accuracy and diligence.

But above all a biographer should be an artist. He should be more than an outside observer. He should have the gift of empathy, of sharing the feelings of his subject and he should have the ability to communicate these feelings to his readers. In this respect Klein is outstanding. He does not resort to dramatic exaggeration or to fictitious dialogue and he keeps to the facts he took such pains to collect. And yet, his clear and easy flowing prose recreates the atmosphere of Vienna, St Petersburg, Göttingen and Leyden and conveys a moving and convincing picture of an unusually gifted and sensitive man, devoted to science and to teaching, but harassed by a sense of his own inadequacy.

This book should be read by everyone interested in the history of the development of modern physics. Students not yet particularly interested in history will find some chapters extremely useful as an introduction to their subject. But I should like to see it also in the hands of many nonphysicists. They will have to skip quite a few pages, but there remains an arresting story that will provide a better understanding of the life and work of a scientist and of the sociology of science than the often sadly distorted pictures presented in newspapers and magazines, in popular works of fiction and even in the writings of famous novelists.

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The reviewer, who studied under Paul Ehrenfest in 1926–32, has contributed to theoretical physics, applied mathematics and low temperature physics. He is currently associated with Philips Industries in Eindhoven, the Netherlands.

Space Physics

By R. Stephen White

318 pp. Gordon and Breach, New York, 1970. $24.50 reference, 12.50 professional

As one of the team of researchers who first measured the energy spectrum of the penetrating protons in the Van Allen radiation belt more than a decade ago, R. Stephen White is well qualified to write a book on space physics. He is now professor of physics and associate director of the Institute of Geophysics and Planetary Physics at the University of California's Riverside campus.

The book has chapters on the earth's atmosphere, ionosphere and magnetosphere, interplanetary space and the sun, with the first chapter devoted to White's own field, the radiation belts. The author states that he has attempted to satisfy the needs of three classes of readers: the student for a textbook, the engineer for a description of space experiments, and the space scientist for reference work outside his own special field. I feel that he has come close to success in only the last of the three cases. As a textbook, the work can not stand alone. Frequently, theoretical developments are not presented in enough detail to be fully understood by the uninitiate. Details of experiments, spacecraft and their subsystems are actually relatively few and mostly of old apparatus. The book also suffers, of course, from the knowledge explosion in the field of space physics, and the delays that seem to be inherent in book publishing: with only a few exceptions, the more than 250 references are to papers published in 1967 or earlier.

Despite these negative comments, White's book is a good job and will be useful to all his intended readers. Especially nice are the historical introductions to each chapter, in which the sometimes-forgotten work of early pioneers is described. These are the people who in many cases really stuck their scientific necks out in interpreting totally new phenomena, and all classes of White's readers should be glad to know about them.

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Spark Chambers

By O. C. Allkofer

247 pp. Verlag Karl Thiemig KG, Munich, Germany, 1969. $15.00

In the last decade, spark chambers have emerged as one of the primary instruments of particle-physics research. Their development has been and continues to be rapid, causing any book on the subject to be necessarily both timely and obsolescent.

O. C. Allkofer's treatment of his subject is not appropriate for the casual reader interested in obtaining an overview of spark-chamber technology. It seems to be intended instead for the experimentalist who is currently developing a spark-chamber system. The first portion of the book deals in a coherent but detailed manner with the mechanisms of spark formation by various gas mixtures. The construction and performance of spark chambers with their dependence on gas composition, delay and memory times, and other factors, are thoroughly dealt with next. Finally, the book ends by describing some typical applications of spark chambers.

The strong point of this presentation is completeness. The text is unstintingly detailed and its numerous graphs, photographs and schematic diagrams make apparent the care with which it has been prepared. The numerous references to the original literature that it contains is exhaustive.

This presentation is, however, badly flawed by a literary style that is always graceless, at times unintelligible and never lucid. The translator (who goes nameless) failed to supply the skill required of his profession. The editors have failed their literary responsibilities.

Because of these shortcomings I cannot recommend purchase of it by individuals. However, library acquisition is appropriate.

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Directory of Selected Scientific Institutions in Mainland China

***Prepared by* Surveys and Research Corporation**

469 pp. Hoover Institution Press, Stanford, Calif., 1970. $19.50

This Directory was prepared by Surveys and Research Corporation for the National Science Foundation, under the direction of Ralph J. Watkins who was