History of Electrodynamics

Under the general editorship of D. ter Haar of Oxford, Pergamon Press has begun the publication of a series entitled Selected Readings in Physics, intended for use in undergraduate courses in physics. The general idea behind the series is an excellent one. Students can and should learn their physics in historical context, for only in this way can they properly appreciate the contributions made by earlier workers to the development of physics. In this series the historical context is provided in two ways. First, the core of each volume consists of lengthy extracts or entire reprints of the classical papers on the subject being considered. Second, a lengthy introduction or commentary is included to help the student comprehend what is going on. Such introductions are an important adjunct to a collection of readings, because oftentimes the problems which the original author is attacking have been so changed by more modern work that the reader doesn't really understand what the whole point of the paper is. Nothing would be more fruitless in such cases than throwing a number of old physics papers at undergraduates and expecting them to get anything out of them. For papers considerably removed from us in time, the introductions must be based on sound historical investigation.

One of the first group of volumes in Pergamon's series, **Early Electrodynamics: The First Law of Circulation** (Pergamon, New York, 1965. 227 pp., illus. Paper, $2.95) by R. A. R. Tricker, contains the fundamental papers by Oersted, Biot and Savart, Ampère, and Grassmann upon which classical electrodynamics was erected. The translations are generally good and the material chosen does indeed treat of the foundations of electrodynamics. It is good to have these selections in English so that the undergraduate, either in a course in the history of science or in physics, may consult them.

The papers are preceded by an extended commentary which occupies almost half the book. Here the reader is less well served. There will undoubtedly be two schools of thought on the value of Tricker's contribution. There can be no doubt that he introduces with great lucidity the physical problems with which Oersted, Ampère, and others wrestled. Using modern notation, he carefully dissects the major contributions of his authors and shows how the results can be derived from the experiments described, but this modernization is done only after the essential lines of the argument have been traced out in the original notation. Thus the student will be able first to see how the problem appeared, say, to Ampère and the means at Ampère's disposal for solving it. Then, the same results are translated into modern notation to enable the student to use them in modern problems. This seems to me to be an excellent pedagogical device; so often the works of historical figures in science are presented in such modern guise that the student has trouble in understanding why a "great" scientist deserves the adjective. Thus the way is opened to a successful solution to that perennial problem of how to "humanize" the teaching of science and also teach the fundamentals of the science. If I were a teacher of physics, I should warmly recommend this volume.

I am, however, a historian of science, and I found myself wincing on almost every page which dealt with the history of electrodynamics. One example must suffice here, but it is a significant one, for it represents the most common fault of those who, as scientists, write the history of science. It is that they wish to see the history of science as a straight line leading directly and logically from the past to the present. Thus, Ampère was "right" because his mathematical theory correctly described electrodynamic phenomena. If the mathematics is right, then the physics must be right. But, in point of fact, the physics is wrong. Ampère believed in a two-fluid theory of electricity and stated his belief explicitly many times. He specifically defined an electric current as a flow of the positive electric fluid in one direction and the flow of the negative fluid in the opposite direction. He also clearly announced his belief in the combination of the two electric fluids to form the luminiferous ether. His electrodynamic molecule consisted of streams of both electricities around the molecule. The origins of these currents he left shrouded in silence. The reader will never find these things out from Tricker's account. Instead, he will be impressed with the "modernity" of Ampère's concepts, for they are described as being "almost precisely the same as that suggested by Heaviside for his 'rational current element' towards the end of the century." The difference between a "rational current element" and a molecular model of matter which Ampère intended to be taken seriously as *physically* true is too obvious to require comment. Why cannot Ampère be shown to us, warts and all? Does it make him any less a hero if he was wrong on certain points? In short, if the commentary is intended to place the papers in their historical context, should its author not have the same respect for historical accuracy as for physical truth?

L. PEARCE WILLIAMS
Department of History, Cornell University, Ithaca, New York

Physical Chemistry

Ionic Equilibria (Pergamon, New York, 1966. 129 pp., illus. $5.50) by J. E. Prue is one of the hundred volumes planned for the International Encyclopedia of Physical Chemistry and Chemical Physics. A brief historical introduction puts the book in perspective. The author has steered a middle course between the electrolyte-solution chemists who are interested in precise data on dilute solutions and the complex-ion chemists interested in complex equilibria. Ionic equilibria influence most physical properties of electrolytes. Such equilibria masquerade as activity coefficients which are misleadingly simple expressions hiding a great deal of complexity.

Prue has produced a readable book which treats optical adsorption, Raman and nuclear magnetic resonance spectroscopy, conductance, electrochemical cells, solubility, physical properties, reaction rates, relaxation spectroscopy, acidity, stability constants, and solvent effects. The treatment is necessarily one of picking and choosing and so reflects the author's interests. The material is cast in modern thermodynamic terminology, with statistical mechanics and quantum mechanics left severely alone. In the treatment of reaction rates the emphasis is on measurement of the rate constants and their qualitative relation to structure. The author omits the formulation of even the simplest quantitative theories of equilibrium constants and of reaction rates.

The last chapter on solvent effects brings into sharp relief the difference between dielectric constants in promoting ionization and solvent-ion compound formation.

The book is a useful brief survey that