

periods. Writers have tended to concentrate on one area or figure of physics; for example, John Heilbron wrote *Electricity in the 17th and 18th Centuries* and L. Pierce Williams, *Michael Faraday*; other authors have published recent books on the concepts of ether, energy and atomism. The absence of attempts to provide any broader picture is regrettable, however. Studies focusing on only one area, even a rather broad one, are unlikely to present larger guiding ideas spanning many such areas.

And now, with the basis for such a broad overview laid in the vast number of detailed studies made since World War II, Peter Harman has attempted to provide such a broader perspective. A historian of nineteenth-century physical sciences, he draws on an enormous body of research to produce a solidly based synthetic portrait of nineteenth-century developments. He shows that the physics of the nineteenth century, in both its ideals and its substance, departed significantly from earlier physics; it was far from being a mere slavish working out of the consequences of Newtonian physics. The ideals of nineteenth-century physics, introduced by Laplacean physics, were clearly formulated by 1850: "mathematization, quantitative experimentation, and a unified physical world view, together with the postulation of models of physical reality amenable to experimental test and mathematical formulation" (page 19). Harman traces how field theory, energy physics, and molecular mechanics were developed, guided by these ideals. In passing, he also discusses relevant aspects of chemistry, astronomy and geology during the period: The book is concerned with the physical sciences and not restricted to physics in a narrower sense. He presents the interactions of ideas in all these areas. For example, he shows the concept of energy to have been of central importance not just in thermodynamics, but throughout physics in the second half of the nineteenth century. He provides an excellent treatment of the gradual emergence of problems in the various areas of physical science and shows briefly how those problems provided much of the rationale for the development of special relativity and the early quantum theory. Harman refuses to treat developments "whiggishly," as merely steps in an inexorable march toward our present views. Rather, he presents them within the context of their own physics, as leading to the formulation of Hendrick A. Lorentz's "electromagnetic" view of nature and of Wilhelm Ostwald's "energeticism." He also investigates the relative explanatory roles of mathematical equations and physical models. An especially valu-

able feature of the book is its excellent 20-page bibliographical essay, giving guidance through the huge volume of literature on which the book is based. Another is the author's remarkable use of diagrams.

In spite of the many virtues of the book, however, there are some serious shortcomings. One could cavil about various omissions or overemphases or about the often obscure treatment of the role of models in relation to equations. Perhaps the author should have made more explicit the continuities with seventeenth-century approaches as well as departures therefrom. After all, René Descartes and Isaac Newton, too, sought a unified physics on the basis of mechanical explanation, and surely Newton, among others, made a practice of quantitative experimentation. But there are more serious problems with the book. Presumably in an attempt to reach a broad audience, Harman avoids mathematics that the physicist would find illuminating. Even so, his discussion is very often beyond the lay reader, for example, in the case of Joseph Lagrange's analytical methods, which play a central role in the book. The problem is exacerbated by the book's extreme brevity: All too often Harman gives only conclusions, not supporting arguments, and these conclusions will only be fully intelligible to someone who already knows a considerable amount about the subject. The author makes this problem still worse by repeating a point several times in slightly different words, without adding much in the way of explanation. But while a fully successful overview of nineteenth-century physics still needs to be written, this book remains a valuable contribution. Historians and philosophers of science will value it for its synthesis of the mass of details they have already learned; readers of *PHYSICS TODAY* will find in it insights into the background of their science.

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