Ogston effect in sedimentation velocity, for example, is particularly clear and informative. Students of thermodynamics will be pleased to note that the treatment of sedimentation equilibrium is in terms of the Helmholtz free energy.

The concept of rapidly attained equilibrium and its influence on the transport processes are discussed first in terms of the weak-electrolyte moving-boundary theory. The results are relevant both to moving-boundary electrophoresis (a technique now used by only a small minority of laboratories) and to sedimentation velocity. As an example in the latter field, Cann cites the work of Schachman *et al.* on aspartate transcarbamylase to illustrate the experimental approach made possible by ultraviolet scanning optics.

Great progress in the understanding of reversibly associating macromolecular systems has come from analytical solutions of the simplified conservation equations, in which diffusion is neglected. In this area, Gilbert's work is of the first importance, and Cann describes it in satisfactory detail. The examples chosen to demonstrate the conclusions of the Gilbert-Jenkins theory are an antigen-antibody reaction and a Michaelis-Menten complex, salutary reminders of the very general application of this rather recondite theory. In passing, one notes a very clear exposition of the concept of entropy-driven *association* reactions in solution.

More recently, the computer has been harnessed to provide numerical solutions of the exact differential equations of transport, retaining the diffusion term. The whole range of variation in the shapes of distribution curves may thus be explored, and Cann provides a comprehensive account of these investigations. This work is of importance, for example, in illustrating the precautions that are necessary before the results of moving-boundary and zone electrophoresis can be taken at face value.

Pressure effects in sedimentation velocity experiments on reversibly reacting systems are now recognized to be significant; these effects are analyzed in some detail, with continuing reference to the fascinating example of myosin.

The numerical methods described in chapter 5 (of which W. B. Goad is the author) will be of interest chiefly to those who are concerned with programming: this section includes a Fortran program for the calculation of equilibrium constants for a generalized macromolecular aggregation.

The emphasis throughout the book is on mass transport phenomena, and the possibilities inherent in sedimentation equilibrium are given perhaps less than their due weight. In a second edition attention will no doubt be given to recent progress in this field; such an occasion would also allow the correction of a series of trivial but distracting misprints ("Svedburg," "Faxin," "Picten," for example) confined largely to the first chapter.

To sum up, this book provides a clear and up-to-date account of a complex subject; the practicing biochemist will find it of great value in interpreting the many macromolecular systems that fall within its scope.

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Terminal Ballistics

High-Velocity Impact Phenomena. RAY KINSLOW, Ed. Academic Press, New York, 1970. xii, 580 pp., illus. $25.

This book attempts to collect, bring up to date, and summarize our knowledge concerning the very complicated subject indicated by its title. This goal is fully realized in the nine chapters, all of which are written by authorities in the special fields. The variety of technological fields to which high velocity impact is relevant is wide and is well covered in this book. The subjects treated extend from experimental methods of causing projectiles to attain high velocity, through theoretical analyses of the behavior of materials under high rates of strain and experimental observations, to engineering design. Although progress in this field was beginning about 1940, motivated by military considerations, the development of space travel in recent years has excited and demanded greatly accelerated research on the subject because of the hazard of meteoroidal collision. Some of the treatments are highly technical and mathematical, yet there is much that the general science reader can learn from the book. The specialist will find the book very useful in that it gathers together the many threads of the problem.

The theory of elastic waves in solids is given as a foundation for the more difficult nonlinear theory, and considerable space is devoted to codes useful in numerical solutions of specific impact problems. In such a difficult exercise, experiment and empirical observation play an important role, and these subjects are given extensive treatment in this book. One chapter is devoted to the equation of state for solids, centered chiefly on the beautiful work accomplished in Los Alamos over the last 20 years. The role of metallurgical and mechanical properties of materials in crater formation is discussed. And finally, as is discussed in the last chapter, the engineer is faced with the problem of designing hardware on the basis of incomplete theory and limited data.

One of the valuable features of the book is the very extensive bibliographies included at the end of each chapter. The serious worker will find these references invaluable, but the history of the subject is such that a great many of the citations are to reports of limited circulation.

The statement is made in the preface that terminal ballistics has been the subject of formal study for more than two centuries. No attempt is made, however, to review this history. Such a review would have revealed that almost nothing was learned about the subject before 1940. In fact the very words "terminal ballistics" did not to my knowledge occur in the English language before they were introduced by R. A. Beth in 1941. Perhaps the omission of any history is excusable, as so little was accomplished until recently, particularly in the very high velocity range.

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Mach's Views

Ernst Mach. Physicist and Philosopher. Based on an AAAS symposium, Washington, D.C., Dec. 1966. ROBERT S. COHEN and RAYMOND J. SEEGER, Eds. Reidel, Dordrecht, and Humanities Press, New York, 1970. viii, 298 pp., + plates. $11.50. Boston Studies in the Philosophy of Science, vol. 6. Synthese Library.

The rich contents of this collection of essays by 12 authors deal historically, biographically, systematically, and critically with the multifaceted work of one of the truly great and influential thinkers of the 19th century. I hesitate to single out those essays that fascinated me most. As is well known, Mach's ideas greatly influenced the young Einstein. But Einstein dissociated himself soon after from the radi-

cal empiricism (phenomenalism, antiatomism) of Mach. This is clearly brought out in the remarkable essays by R. S. Cohen, Erwin N. Hiebert, and especially Gerald J. Holton. Mach, whom his contemporary William James considered an intellectual star of the very first magnitude, still looms large as an experimental physicist and as a philosopher of science. Essays by R. J. Seeger and W. F. Merzkirch deal with Mach's important contributions to gas dynamics and the physics of shockwaves. Philosophically significant discussions of the implications of Mach's views on various subjects (including psychophysiology, gravitation and inertia, relativity, geometry, and functional relations) are presented by Floyd Ratliff, Peter G. Bergmann, Karl Menger, and Hubert Goenner. There are also helpful biographical and bibliographical articles by Otto Blüh and Merzkirch. In the appendixes two very valuable essays by Philipp Frank and one by Richard von Mises (all three on Mach's philosophy of science) are republished.

Although Mach is currently (of course!) regarded as mistaken in his opposition to the atomic theory and to the theory of relativity, it is most interesting here to obtain more detailed information than is usually available on the development and motivation of his ideas regarding these matters. The controversial "Mach principle" (relevant for cosmology) is discussed in several articles. The only omission I noted is the absence of even a reference to Clifford Truesdell's views regarding the history of mechanics, which differ sharply from those of Mach. This (minor) shortcoming notwithstanding, the editors of this book are to be congratulated on their success in assembling an excellent set of essays.

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