or even criticizing it, and by their care some of the confusion such writers as BOLTZMANN succeeded in eliminating has been reintroduced for the help of students." On page 65: "BOLTZMANN, whose writing was no clearer than his mathematics." On page 74: "Despite two centuries of study, the integrals of general dynamical systems remain covered with darkness." On page 82: "I should like to be able to say that statistical mechanics is unnecessary, that the name 'statistical mechanics' is a misnomer for 'asymptotic mechanics,' as far as equilibrium is concerned. This is almost true, but not quite so." On page 85: "These 'leaders' interpret mathematics as a dead language and regard the problem of expressing nature in mathematics terms like that of writing a poem in classical Latin, where the subject must be chosen or wrested so as to fit an ancient vocabulary. Nature is expected to adjust its comportment to the mathematics learnt in their school days by the members of some senior international committee for mutual congratulation and worldwide sightseeing." Page 87: "When a student I heard lectures by an elderly faker who enjoyed, and perhaps still posthumously enjoys, a big name as a historian and philosopher of mathematics. He often said that 'pure' mathematics had developed because in the nineteenth century the mathematicians had solved physical problems faster than physicists could pose them, or they turned to a new source of study within themselves. With no wish to estimate anyone's motives, I remark that the fact asserted is more than ordinarily untrue." One more from page 107: "Research has been overdone. By social command turning every science teacher into a science-making machine, we forget the reason why research is done in the first place. Research is not, in itself, a state of beatitude; research aims to discover something worth knowing. With admirable Liberalism, the social university has declared that every question any employee might ask is by definition a fit object of academic research."

I would like to end this long series of quotations from the book with an autobiographical note found on page 83: "In 1946 I was employed as an adjunct to a large captured wind tunnel, where my interest was directed to rarefied gases. The gaseous chief, more dense than rare, was unable to place my efforts in any pigeonhole. With professional certainty of a former assistant professor of physics at a minor degree mill, he knew that what I did was not physics. While his senior aerodynamicist assured him it was the purest of pure mathematics, an aging refugee estimator of 'eigenvalues' begged to be relieved from evaluating my work on the ground that he himself was a mathematician. Indeed, several mathematician friends told me that any paper in which the words 'stress' or 'vorticity' appeared was clearly engineering or physics. Those few engineers I ran across were too polite to damn my area of study completely, but they did say that engineering application for it lay at least 200 years in the future."

The book is highly polemical. It is characteristic that in the whole volume there are only two papers quoted, and these quotations are both articles by the author himself. No references are given to the other papers or larger works that are attacked, and sometimes quite sharply.

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Electron microscopy

ELECTRON MICROSCOPY OF THIN CRYSTALS. By P. B. Hirsch, A. Howie, R. B. Nicholson, D. W. Pashley and M. J. Whelan. Butterworths, Washington, D.C., 1965. $29.50.

by L. Marton

In the preceding review, I quoted extensively from the opinions of Professor Truesdell over many areas of physics. He happens to have also some comments on dislocations: "not long ago was born a new branch of continuum mechanics called the 'theory of dislocations'. Since this theory has grown up mainly in laboratories of solid-state physics, it has been presented in a language of its own in which clarity and logic take a poor second place to physical intuition. . . . Molecular hypotheses have come and gone, but a sound continuum theory is a monument forever, exempt from fashion. . . . The dislocation experts, with boundless thirst for finding complications within complications until all hope of ever proving anything is lost before the terrifying complexity of their orgies of formalism, think that the stress should not be symmetric; nay more, now they begin to see bodies filled with multiform dislocations and the corresponding multipolar stresses of all orders."

The present book, Truesdell's opinion notwithstanding, is a monument to the success of dislocation theory. While it is limited to the electron-microscopical aspects of the investigation of thin crystals, it contains so much proof for the soundness of the basic concepts that I am unable to agree with the opinions expressed by Truesdell.

The book is a result of a summer school held in Cambridge in July 1963 with the five authors as lecturers. It consisted of a series of ten lectures backed up by "examples, classes and demonstrations of the electron microscope."

It would be tedious to list all the titles of its eighteen chapters, but it suffices to say that the first few chapters give a good introduction into electron microscopy of thin films, followed by the theory of electron diffraction and of image contrast. Later chapters present the dynamical theory of contrast, both in its wave-optical and in its wave-mechanical formulation. One important chapter deals with the matrix formulation of electron diffraction theory and of treatment of many-beam effects. Later chapters are devoted to some very special fields, such as dark-field, stereomicroscopy and trace analysis, two-phase materials, periodic and ordered structures, Lorentz microscopy, and similar things.

The book is an extremely useful mixture of the theoretical and of the practical. One of its many desirable features is its appendixes. These appendixes start with specimen preparation techniques, with the rules of matrix algebra, and finish with typical problems in electron microscopy with solutions to these problems. These

problems are very judiciously chosen and cover a very wide area of applications. I do not know of any other example of extensive choice of problems in electron-microscopy practice.

While the price is somewhat high, I would like to recommend this book without any reservations. Its contents are so excellent and the book is so well presented that close to thirty dollars is not too high a price.

Gas flows

INTRODUCTION TO PHYSICAL GAS DYNAMICS. By Walter G. Vincenti and Charles H. Kruger Jr. 538 pp. Wiley, New York, 1965.

by T. Teichmann

Although the classical equations of gas dynamics are the direct consequence of the underlying atomic and molecular interactions and their statistical combination, it is only in recent years that this relation has come to have more than academic and conceptual interest. The practical importance of high-speed, high-temperature and low-density gas flows has impelled consideration both of the physical significance of the quantities occurring in these classical equations, and in the degree of approximation to reality. Kinetic phenomena and transport processes of all types have thus begun to play an important role in expositions of modern gas dynamical situations.

In this book, the authors, who are members of the Aeronautics and Mechanical Engineering Departments at Stanford University, have set out to describe the foundation of high-temperature and nonstationary gas flows with particular reference to the underlying physical phenomena. Most of the contents are therefore devoted to questions of kinetic theory and statistical mechanics, equilibrium and nonequilibrium reactions, and radiative transfer. Interspersed with these are discussions of gas flows, in which the main emphasis is on the deviations (if any) from the classical picture due to the underlying physical phenomena. There is a particularly extensive treatment of nonequilibrium kinetic theory and its application to flows with translational nonequilibrium.

The work is thus designed not so much to facilitate the analytical solution of a variety of problems, but rather to indicate the important physical phenomena, and the way in which they limit the idealized problem formulation in a variety of situations. These are, of course, illustrated by reference to the most important "standard" examples: plane shocks, nozzle flows, Prandtl-Meyer expansions plane acoustic waves, Couette flow, and the wavy-wall problem. The approach is by no means formal and overly academic, and is always aimed at physical situations. It is nevertheless amusing to note that in a book written by engineers and presumably for engineers (among others) very few of the hallowed nondimensional numbers of fluid mechanics are mentioned, and even the Reynolds number appears only as an aside in an example for the reader! Despite this minor caveat, the book can be well recommended, not only as a complement to more standard fluid-dynamical treatises, but also as a clear exposition of modern kinetic theory.

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For users of photography

THE THEORY OF THE PHOTOGRAPHIC PROCESS. (3rd ed.) T. H. James, ed. 591 pp. (Collier-Macmillan, London) Macmillan, New York, 1966. $25.00.

by M. F. McCarthy, S.J.

The publication of the revised, enlarged and extended third edition of the classic: *The Theory of the Photographic Process* will be welcomed by all whose work involves serious attention to the problems of photometry and photography. This is the first revision to appear after the death of C. E. Kenneth Mees, who edited the earlier volumes of 1942 and 1954; the present edition is a most worthy successor to these and will, together with them and the recently inaugurated Mees Observatory in Rochester, honor the memory of this pioneer of the photographic process.

The reviewer agrees with the new editor, T. H. James of the Eastman Kodak Research Laboratories, that the title implies a more comprehensive coverage of the topic than could actually be realized. When the time comes for planning the next edition, the editor will have to decide whether to include a proportionate treatment of those processes which employ materials other than silver halides or simply to change the title to "The Theory of Silver Processes in Photography."

The present edition gives us an excellent treatment of a most difficult subject and synthesizes the latest information from several branches of physics and chemistry in a thorough survey of the principles, practice and problems of the photographic process. One notes especially the extensive contributions from crystal physics. In an effort to keep the book within reasonable limits (22 cm × 30 cm, 591 pages, $25.00) the editor has condensed certain topics now chiefly of historical importance and quite properly makes frequent references to the earlier editions. This allows him more opportunity to accommodate the many important advances in this field since 1954. However, no one who owns one of the earlier editions will want to part with it; the third edition adds many treasures to the already rich trove of the earlier editions.

The book begins with a description of the properties of the silver halides both as crystals and as grains. There follows a discussion of gelatins and emulsions. It may be noteworthy that not all of the details concerning emulsion making have been revealed. The relations of density and exposure are discussed and the very clear exposition of reciprocity, intermittency and low temperature exposure effects is of special value. The theory of the latent image and its various effects are treated completely. A "textbook" rather than a "handbook" approach to these topics is most commendable. Especially in the chapters devoted to sensitivity, sensitizing dyes and the mechanism of sensitization one notes a certain modest reluctance of the authors to appear to be endorsing the local products. In any case most of those who read this volume will already be well supplied with the Kodak Technical Data Books and do not require