

a course in experimental nuclear physics for many years, intends the book to be an aid for the beginner in a nuclear-physics laboratory. About three-quarters of the volume are devoted to the detection of radiation, the remainder to dosimetry, shielding, electromagnetic lenses, and accelerators. The principles of operation of radiation detectors, and the theory of pulse amplification and of coincidence measurements are presented well. Actual counting and analyzing circuits are not included. Most valuable are many tables, graphs, and formulas, which should be useful both to the beginner and the specialist.

Unfortunately the book does not give a realistic picture of the methods

used in contemporary nuclear research laboratories. For example, the only accelerator described in any detail is the betatron, nowadays probably the least useful type of accelerator for nuclear research. Geiger counters, which are treated in detail, have become as rare in research laboratories as cloud chambers (which are not discussed); ionization chambers and photographic emulsions (which are described) are being displaced in the laboratories by detectors that permit faster counting. The author refers the reader for more complete information to extensive lists of references, but only two references in the entire book are to articles published since 1959.

This volume is an excellent intro-

duction for the student who wants to familiarize himself with radiation detectors that have been used so widely in many applications (assuming he can read German). Nevertheless there remains a need for an updated version to acquaint the nuclear physics research student with the experimental methods in current use, such as modern detection circuits, data-handling methods, magnetic spectrograph time-of-flight equipment, to name a few examples not included in the present book.

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Pungent natural philosophy

SIX LECTURES ON MODERN NATURAL PHILOSOPHY. By C. Truesdell. Springer-Verlag, New York, 1966. \$4.50.

by L. Marton

In a slim volume (only 117 pages) Professor Truesdell presents the text of six lectures in which he defines his concept of Natural Philosophy. Let me quote from the first lecture: "For two hundred years, the fields of scientific research were wilfully shrunk and sharpened to pin-point size, and appropriate microscopes were developed so that organized micro-thought could

split them into forklets of micro-science, now budgeted at rates in megabucks per kilohour."

On page 22 our author tells us, "These lectures are intended for beginners. I have adopted a conservative position. There are times when generality is needed, and others when it is all too easy."

Now that we have been warned, let's examine briefly the areas covered by the six lectures. The first lecture is on the "Rational Mechanics of Materials," followed by "Polar and Oriented Media." The third is on "Thermodynamics of Viscoelasticity," the fourth is on "Electrified Materials," the fifth is "The Ergodic Problem in Classical Statistical Mechanics," and the sixth is "Method and Taste in Natural Philosophy." At the end of the volume, an appendix is added containing the text of the Chairman's Introduction to the Colloquium on the Foundations of Mechanics and Thermodynamics held at the National Bureau of Standards in 1959.

In spite of the author's remark that the lectures are for beginners, the reading is not always quite easy. The treatment of the different subjects is on a very sophisticated level and often an equation may appear without much introduction, a procedure that makes the reading easy only for the specialist. What makes the whole volume

very entertaining reading is the author's pungent style. This review would be incomplete without giving at least a few examples of this style, showing the author's attitude toward a certain number of problems and to all the men who worked on them prior to him. On page 35 our author writes: "Thermostatics, which even now is usually called thermodynamics, has an unfortunate history and a cancerous tradition. It arose on a chaos of metaphysical and indeed irrational controversy, the traces of which drip their poison even today. As compared with the older science of mechanics and the younger science of electromagnetism, its mathematical structure is meager. Though claims for its breadth of application are often extravagant, the examples from which its principles usually are inferred are most special, and extensive mathematical developments based on fundamental equations, such as typify mechanics and electromagnetism are wanting. . . . "The early studies of thermodynamics abound in nonsensical wording, some of which the wars among the creators of the subject served to clear away, but they left much policing for later generations to do. As the area receded, from the frontier of physical thought, however, it fell into the hands of text compilers, always eager to water and 'explain' what is generally accepted without re-creating



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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 multi-form 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