

namic, radiative transfer, stellar rotation, and eclipsing binaries.

For many years to come this book will be one that eager apprentices in astrophysics will want to master and know thoroughly. It will also provide her research colleagues of today with a rich background for checking their own studies and for planning future investigations. Its wide coverage of topics and techniques, its frank posing of problems and critical evaluation of proposed solutions, its clarity of presentation and excellence of style all commend Miss Underhill's book.

Many of her colleagues will wish to take exception to one or two of her judgements on controversial issues. Examples are her treatment of the luminosity calibration of the early type stars (she appears not to appreciate the fact that Petrie's and Bertiau's distance determination for the Scorpio-Centaurus group agree within the limits of their respective probable errors), her discussion of the reddening law valid for different portions of the galaxy and her interpretation of the variations of the Beta Canis Majoris stars.

The book is well printed throughout; the reproduction of stellar spectra deserves special credit for excellence. Tables and line drawings are clearly presented. Full references and indexes complete a well planned book.

* * *

The reviewer, an astrophysicist and Jesuit, is with the Vatican Observatory in Rome, Italy.

Nuclear data

NUCLEAR TABLES, PART 2: NUCLEAR REACTIONS, VOL. 2: THE ELEMENTS FROM ALUMINUM TO SULFUR. By Wunibald Kunz, Josef Schintlmeister. 272 pp. Pergamon Press, Oxford, 1967. \$45.00

by H. H. Barschall

The information explosion in nuclear physics has increased the dependence of the nuclear physicist on data compilations. Those interested in light nuclei, for example, use the classic energy-level compilation of Ajzenberg and Lauritsen, for heavier nuclei Kay Way's Nuclear Data Sheets are available, and those concerned with neutron cross sections rely on the barn books prepared at Brookhaven. Less

well known to US physicists are the monumental *Nuclear Tables* by W. Kunz of Vienna and J. Schintlmeister of Dresden. These authors started their effort while in the Soviet civil service and continued it after their repatriation in 1955. The books are beautifully printed in East Germany in a format reminiscent of Landolt-Börnstein. The latter (published in West Germany), by the way, also contains nuclear energy-level tables.

The publication of *Nuclear Tables* began in 1958 with a two-volume, 1100-page, nuclear energy-level compilation, followed in 1965 by *Nuclear Reactions* for the elements up to magnesium, and this year by *Nuclear Reactions* in aluminum to sulfur. This year's publication covering just four elements led to the present review. Each of the two volumes on nuclear reactions consists of a bound part and a box containing loose folded energy-level charts, typically 0.5 m² in area. For Al²⁷, for instance, 280 levels and transitions between them are shown on six such charts covering over 3 m² when put together. In the text volume measured reaction cross sections are given in tables and diagrams. In addition, reaction energies and properties of energy levels are tabulated. Following each element references (typically 500) are listed; unfortunately many references are to other compilations. Explanations, except for the introduction, are in German, but the amount of text is small enough that a knowledge of German is not necessary for the use of the tables. A critical evaluation of the data is generally not attempted, and contradictory data are shown.

In the fast-moving field of nuclear physics a compilation which is several years old has limited usefulness. The sheer magnitude of *Nuclear Tables* makes it virtually impossible to keep them updated. The volume on the lightest elements includes only data published before July 1962, and a part of it has been made obsolete by the most recent Ajzenberg-Lauritsen compilation although the latter does not contain cross-section tables. The loose and large energy-level charts are awkward and will not survive frequent use; even their elegant containers were received broken by the reviewer. Nevertheless, *Nuclear Tables* should

be a useful source of information for data which are not covered in more recent compilations. The user will wonder how long it will take the authors to complete the herculean task they have set for themselves and when they will be able to update their earlier volumes.

* * *

The reviewer is a professor of physics at the University of Wisconsin's Madison campus. His research interests are in experimental nuclear physics.

It's a gas

RAREFIED GAS DYNAMICS. (Advances in Applied Mechanics, Suppl. 4) Conf. proc. (Oxford, July 1966) C. L. Brundin, ed. 1731 pp. in two volumes. Academic Press, New York, 1967. \$18.50 each

by Lawrence Talbot

The scope of the 103 contributions to this symposium is indicated by their division into four main categories: (a) gas-surface interactions (19 papers), (b) kinetic theory (35 papers), (c) transition flow (29 papers), (d) ionospheric aerodynamics (10 papers), plus an additional group of 10 papers on experimental methods. The contributed papers in each group are introduced by invited survey articles that summarize the state of knowledge and indicate the directions of current research in the field. These four survey articles are all of excellent quality and are quite instructive for those workers who are conversant with the general field of rarefied gas dynamics but not specialists in the particular areas covered by these articles.

The first group of papers on gas-surface interactions (survey by F. C. Hurlbut) contains both theoretical and experimental contributions. On the theoretical side, the main effort has been in predicting the energy exchange between molecules and surfaces, using both classical and quantum-mechanical models. Considerable progress has been made here in the two years since the previous 4th symposium though a satisfactory theory is still lacking. The new experimental results reported on energy accommodation, momentum exchange and distribution of scattered particles are indica-

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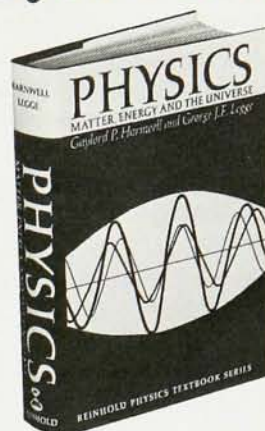
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Designed for use in a full-year college physics course, this book introduces the quantitative concepts and procedural definitions of physics as a basis for understanding present descriptions of physical phenomena in terms of the properties of the elementary particles composing the world of which they are a part. Totally modern in approach, it presents classical concepts wherever appropriate.

The authors begin with a summary of the requirements for a suitable description of physical phenomena, and proceed from the intuitive to the quantitative, introducing ideas of space, time and motion, followed by the concepts of mass, force, momentum, and energy. The physical processes of these concepts are formulated in terms of simple symmetries and the conservation laws relating to them. This work is unique in that it (1) uses the basic atomic concepts and elementary statistics to provide the foundation for a description of the properties of matter in bulk, and (2) extends the account to recent advances in nuclear and high-energy physics. The book takes a mathematical approach to physics, and introduces early in the text the mathematical concepts necessary for a full understanding of the areas of physics dealt with later in the book.

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tive of the increasing precision and variety of measurement techniques in this area.

A wide variety of topics are represented in the group of papers on kinetic theory and the Boltzmann equation (survey by J. P. Guiraud). The familiar friends (or antagonists, depending on one's state of mind) are still with us: sound propagation, Couette flow, shock-wave structure, slip conditions, internal flows, free expansions and so on. The techniques of analysis employed to embrace (or assault) these problems are varied: Among them are Monte-Carlo methods, the use of kinetic model equations (the Bhatnagar-Gross-Krook model of the Boltzmann equation), moment equations, a variational method and a few others. Other papers deal with properties of the Boltzmann and model equations and with extensions of kinetic models to binary gas mixtures and polyatomic gases. A great deal of effort is represented by the contributions in this group of papers, and some significant advances have been made. If I had to single out the area where progress has been greatest, I would say it is in the use of kinetic models that, for a few simple problems, have yielded solutions over the entire Knudsen number range.

The third group of papers on transition flow (survey by J. Leith Potter) is comprised predominantly of experimental investigations of aerodynamic and heat-transfer problems in the intermediate regime between the extremes of collisionless (free-molecule) and collision-dominated (continuum) flow, of the production of "aerodynamically intensified" molecular beams and of low-density flows in jets and through orifices. The structure of the flow region near the sharp leading edges of flat plates, wedges and cones is still a vexing problem, as is the shock-layer problem for a blunt body. Viscous, hypersonic, flow theory is capable of predicting some of the experimental observation in the near-continuum regime, but a unified theory spanning the entire domain between the collisionless and collision-dominated limits for flows about bodies is nonexistent. The situation is considerably better for freely expanding jets, where theory and experiment are reasonably well developed and in sub-

stantial agreement. In this connection, one of the most important recent experimental developments is the observation of optical radiation produced by electron-beam excitation of the flow. With this technique one can determine local gas density and temperature, and even the distribution function itself, point by point within a nonuniform flow field.

In the fourth group of papers on ionospheric aerodynamics (survey by J. H. de Leeuw) the main emphasis is on the interaction between moving charged bodies and a plasma environment although there are several papers dealing with more basic plasma phenomena. Only one contribution in this group is of an experimental nature.

Finally in the group collected under the heading of experimental methods, there are papers dealing with molecular-beam production and detection with electron beam, chemiluminescent and laser techniques and with various flow probes.

Taken as a whole these symposium proceedings represent an up-to-date account of the field of rarefied gas dynamics, both theoretical and experimental, that will be of immense use to others in the field. Not all of the papers are completed works. Some are only brief reports on work that was in progress at the time of the symposium. The advantage of including these progress reports in the proceedings is that a complete record is thus afforded of all presentations, but at the cost of occasional reader frustration on finding instead of results, sometimes like "work is now in progress and will be reported at a future date." Fortunately the percentage of papers that fall in this category is small.

Production of the volumes was accomplished by photographic means from typewritten copy supplied by the authors, with the result that the time involved in printing was indeed quite short for a work of this size. Although many different type styles are in evidence, the volumes are quite readable throughout. One unfortunate error was made in the choice of format, however. All the pages bear the same heading, "Rarefied Gas Dynamics," rather than author names or article titles that could just as easily have been typed in. Consequently one

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cannot identify an individual paper except by leafing back to its title page, a feature that I find rather annoying.

* * *

The reviewer is professor of aeronautical sciences at the University of California, Berkeley and director of the rarefied gas dynamics laboratory there. He edited the proceedings of the 2nd symposium held at Berkeley in 1962.

Gruel-less concepts

THE ELEMENTS OF CONTINUUM MECHANICS. By C. Truesdell. 279 pp. Springer-Verlag, New York, 1966. Paper \$5.40

by Ellis H. Dill

The author is professor of rational mechanics at the Johns Hopkins University. This book is a collection of 30 lectures, forming a graduate course on the continuum theory of materials, that he has given as a visitor at other institutions. Most of the topics have been presented in more detail in "The Non-linear Field Theories of Mechanics" (Handbuch der Physik, Vol. III/3) by Truesdell and W. Noll. This volume is, however, the only reasonably complete presentation of the exact theory that is available at a modest price.

The pages are spiced with the criticisms for which the author is famous: "... many engineering schools are now disguising by the name 'continuum mechanics' a loose gruel of bits of classical elasticity floating at random in classical fluids wastes." Such sharp statements, perhaps appropriate for the sleepy audience of the lecture room, may cause foaming at the mouth of current practitioners of the honorable academic profession.

Truesdell is a champion of mechanics as an "expanding framework for theories and experiments on the behavior of different sorts of materials." He follows that scheme here. The emphasis is on the conceptual aspects of the subject rather than the computational. I strongly recommend this book to those who wish to understand modern developments in classical mechanics.

* * *

The reviewer is a professor of aeronautical engineering at the University of Washington, Seattle.

Distributions throughout

MATHEMATICS FOR THE PHYSICAL SCIENCES. By Laurent Schwartz. 358 pp. Addison-Wesley, Reading, Mass. 1966. \$14.00

by Dagmar Henney

The author is a recent recipient of the Field Medal—the equivalent of the Nobel Prize in mathematics. He received the award for his outstanding accomplishments in the theory of distributions. *Mathematics for the Physical Sciences* is a revised and expanded edition of the French original, *Methodes Mathematiques pour les Sciences Physiques*, published by Hermann, the French publisher of the Bourbaki series.

The treatment and elegance of the material presented herein rivals the author's *Distribution of Functions*. Mathematical concepts are discussed with care and precision, and various applications are chosen from the physical sciences. The theory of distributions is introduced at an early stage and used throughout the text. According to the author, the reader need have only a first-year university course (European university course, that is) augmented with some ideas from linear algebra and functions of a complex variable. This requirement means that the author intended his book not only for the mathematician but also for the physicist or engineer.

Fourier series and transforms as well as the Laplace transform are discussed concisely and thoroughly. The latter part of the volume treats wave and heat-conduction equations; gamma and Bessel functions conclude this excellent text.

* * *

Dagmar Henney is an associate professor of mathematics at the George Washington University.

The new spectroscopy

SECOND QUANTIZATION AND ATOMIC SPECTROSCOPY. By Brian R. Judd. 61 pp. Johns Hopkins Press, Baltimore, 1967. \$5.95

by Harold Mendlowitz

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