servations. In fact, Kepler *did* make observations, also in 1610, with a telescope made by Galileo and lent to him by Elector Ernest of Cologne; thus he was able to show that Jupiter's moons obey recently deduced planetary laws.

The bibliography is disappointingly confined. Obvious works are cited, but, surprisingly, Koestler's readable *Sleepwalkers* is not included nor are any references to journals. There have been numerous articles, for example in *Sky and Telescope* and in the *American Journal of Physics*, that could have been included. One might also have wished to find a few references to associated workers—Brahe, Kepler, Newton—for additional reading.

As regards the extracts themselves, a good cross section is presented: mechanics, hydrostatics, machines, kinematics, astronomy. These extracts give a vivid picture of the range of Galileo's interests and styles. Chapter 6, though, from the *New Sciences*, starts at a poorly chosen place. The original has a preceding diagram without which the quoted section is almost meaningless. Chapter 9, "Apparent Lightness" (by far the longest section), is from "On Motion and Mechanics," as is Chapter 13, "The Screw as a Machine." For the latter, it would have been worthwhile to include some of the footnotes of Drabkin and Drake, who prepared the translation. Chapter 16 draws together extracts from several sections of the *New Sciences* and then presents them as a single portion, but the resulting discontinuities could have been indicated for clarity. The extracts starting on pages 207 and 236 should show that the speaker is Salviati. Chapter 18 also runs together some sections not originally contiguous but fails to mention that they are taken from *Siderius Nuncius* (the reference quoted covers many other works in addition).

Despite these detailed criticisms, this should still be a most useful volume. It makes more accessible such gems as Galileo's description of accurate weighing with a fine wire wound round a balance arm for measurement of the pan position: "Since the wires are very fine, as is needed for precision, it is not possible to count them visually, because the eye is dazzled by such small spaces. To count them easily, therefore, take a most sharp stiletto and pass it slowly over said wires. Thus, partly through our hearing, partly through our hand feeling an obstacle at each turn of wire, we shall easily count said turns."

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Stat mech and thermo: integrated

FUNDAMENTALS OF STATISTICAL AND THERMAL PHYSICS. By Frederick Reif. 651 pp. McGraw-Hill, New York, 1965. $12.50

by Stuart A. Rice

It is often said that one cannot fully understand the implications of thermodynamics until one has studied statistical mechanics. Despite the wide currency given this statement, few elementary treatments of these subjects attempt an integration and synthesis. At first sight it might appear that the complications of statistical-molecular theory are such as to defy presentation at an elementary level. Moreover, integration of thermodynamics and statistical mechanics raises important pedagogical questions with respect to division of emphasis between study of general theorems and specific molecular models. That both of these difficulties can be overcome is triumphantly demonstrated by Reif in *Fundamentals of Statistical and Thermal Physics*, a text designed for third-year undergraduate physics students.

The text begins with the nature of the statistical description of systems of particles, including a careful discussion of the nature of ensembles and constraints. It is at this stage that the fundamental postulate of equal a priori probabilities is introduced. The thermal and mechanical interactions between two systems are studied from the point of view of changes in the occupation and structure of the energy-level spectrum, and entropy is first introduced in a study of the properties of the distribution of energy between two interacting systems. Included in the general presentation are incisive descriptions of properties of the absolute temperature scale, heat reservoirs, fluctuations and stability conditions, and the limiting behavior of the entropy as absolute zero is approached. Chapter four, which deals with the macroscopic definitions of heat, work, etc., is in my opinion weaker than the preceding chapters. Reif uses a logically satisfactory method of constructing an internal-energy function, but mars the generality of the treatment by referring to the previous statistical definition of heat. Similarly, the importance of the second law of thermodynamics in defining the absolute temperature scale is not emphasized. I wish to emphasize that these comments refer only to matters of preference and are not intended to imply that there are errors in the text.

Chapters five through eleven are concerned with various applications of thermodynamics and statistical mechanics to systems of interest, for example, ideal gases (5,9), black body radiation (9), conduction electrons (9), solids (10), classical nonideal gases (10), magnetism (10,11). Interspersed with numerous digressions on subjects of interest in chapters five, six, seven and eight, is a considerable amount of general material dealing with thermodynamic relationships in homogeneous substances, properties of the canonical ensemble and canonical partition function, a brief description of the grand canonical ensemble, a discussion of the Gibbs paradox and the equipartition theorem, elementary kinetic theory of gases, phase equilibrium and chemical equilibrium in gases.

Chapters twelve through fifteen are concerned with transport phenomena: An elementary treatment is given in chapter twelve, a somewhat more sophisticated relaxation-time theory in chapter thirteen, and a description based on the full Boltzmann equation in chapter fourteen. Chapter fifteen discusses linear response theory and several examples of irreversible processes, for example, Brownian motion.

One of the most satisfactory features of Reif's book is the use of interspersed interpretive remarks and worked examples. These are set apart in the text by background boxes col-

ored gray. They catch the eye and admirably supplement the main text. As might be expected, there are also numerous problems at the end of each chapter.

It is my opinion that *Fundamentals of Statistical and Thermal Physics* by F. Reif is an outstanding text. As is characteristic of such a text, the authors presentation provides insights to both students and instructors. Although there are several aspects of the general presentation with which I am not in complete agreement (some examples were cited above—another case concerns the author's description of the exchange of energy and matter between systems in an ensemble and its connection with invariants of the motion and the constraints that define the ensemble) in every case the disagreement is basically a matter of preference. The good features of the text so overwhelm any such matters of taste that I have no hesitation in recommending this book to all instructors, both physicists and chemists, who teach courses in the general area of statistical and thermal physics.

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Experiments, observations and their interpretation

ADVANCES IN MATERIALS RESEARCH, VOL. 1: EXPERIMENTAL METHODS OF MATERIALS RESEARCH. Herbert Herman, ed. 316 pp. Interscience, New York, 1967. $14.95

by Henry M. Otte

It is becoming the rule, rather than the exception, that each new technical book published is one of a continuing series. No doubt the fact is well established that this will lead to the purchase of unwanted books in order to maintain the "continuing series" complete and current. The merits of each volume thus tend to be displaced to a secondary consideration, and criticism of any lack of completeness is eschewed on the grounds that omissions can be corrected in future volumes. Such a plea is entered for the book under review, which is the first in a new series entitled *Advances in Materials Research*. The editor of this series, H. Herman (University of Pennsylvania), is also the editor of the first volume. Opposite the title page we may survey an impressive list of fourteen people who form an international editorial advisory board. On the basis of this we should be entitled to expect high-quality technical presentations, and indeed volume 1 does come up to expectation.

Ten articles have been assembled under the title *Experimental Methods of Materials Research;* they were originally presented as lectures during the 1964-65 academic year at the University of Pennsylvania, and sponsored by the School of Metallurgical Engineering and the Laboratory for Research on the Structure of Matter. The goal of the lecture series was to have critical evaluations of significant experimental techniques of materials science presented by men who were themselves prominent contributors to the development of these techniques. A glance at the names of the ten lecturers suggests that this goal was achieved successfully. Lack of completeness in the subject matter covered by them hopefully will be "corrected," as already noted, in future volumes of the series.

The first six articles deal with techniques based on the interaction of radiation with matter: "X-Ray Diffraction" by C. S. Barrett, "Neutron Diffraction" by C. G. Shull, "Electron Microscopy" by V. A. Phillips, "Field-Emission Microscopy" by A. J. Melmed, "Electron-Probe Microanalysis" by K. F. J. Heinrich and "Applications of the Mossbauer Effect to Problems in Materials Science" by P. A. Flinn. Three articles are related to techniques for studying deformation: "Anelastic Techniques: Iron, A Case History" by D. N. Beshers, "Low-Temperature Deformation Techniques" by R. J. Arsenault and "Determination of the Stored Energy of Deformation of Metals and Alloys" by R. O. Williams. The last article is by C. T. Tomizuka on "Some Experimental Aspects of Diffusion in Metals."

Barrett singles out the very interesting x-ray topography methods for