position of the moon is dealt with in a very cursory way, and the atmosphere of the moon, or rather, its exosphere, is discussed much too briefly. The problem is quite complicated but of real importance as it bears on whether or not the moon could ever have had an atmosphere or hydrosphere. Kopal categorically denies that any visible features of the moon could ever have been modified by running water, or by freezing or melting water. Unfortunately the evidence from the Orbiter pictures suggests the opposite. (From theory I would conclude that it is indeed possible for the moon to have had an atmosphere and hydrosphere for a short period of time. The problem would have been to create an atmosphere and hydrosphere rapidly enough to preclude equally rapid escape. This problem is still under detailed investigation.) The next chapters deal with the lunar surface. On the basis of quite difficult observations, Kopal concludes that the lunar globe is deformed by about 2 to 3 km, but not along the line of a principal moment of inertia. This forces the conclusion that the moon is not homogeneous; yet the position of the principal axes is unaffected! Next there is a description of mapping, a descriptive survey of lunar surface features and a discussion of the origin of the lunar surface features. Kopal points out that the evidence favors both external impacts and internal processes.

The fourth and concluding portion of the volume is devoted to radiations from the lunar surface and, therefore, necessarily to the microstructure of the surface. The photometry of the moon is discussed first. It becomes clear that the photometric properties are determined by the shadow phenomena produced by surface irregularities, and that the microrelief is more important than the exact form of the diffuse-reflection law. Thermal emission from the lunar surface is discussed in a classical manner. The surface of the moon cannot be solid rock but must be covered by loosely-packed dust, in order to give the correct value of the parameter. (Heat conductivity $\times$ density $\times$ heat capacity)$^{1/2}$. At what point below the surface of the moon does the temperature become constant during the course of a lunation (one month)? The answer turns out to be about 30 cms and the temperature is 240 $\pm$ 6 K. In the text, it is claimed that the results from numerical integrations of equation 20.9 and 20.10 are shown, however, I was unable to discover the corresponding figure.

The origin of the maria is still beset by uncertainties. Kopal takes a strong stand against the dust reservoir explanation; he also presents arguments against an origin by impacts of large planetesimals and suggests that the maria may be the scars of a disruption that occurred when the moon came within the Roche limit of Earth during the capture phase. On the other hand Kopal denies that the moon might have melted at some time between its formation and the present. His contention might be true if only radioactive heating were the cause: however, if the moon is captured, then certainly the frictional heating of the tidal forces will be sufficient to induce melting.

Perhaps this inconsistency will be removed in a forthcoming new edition; perhaps new observations will suggest a different solution. Keeping up with an explosively expanding subject certainly presents a problem; nevertheless this book contains so much basic subject matter that will stand the test of time that the volume can be strongly recommended to beginning graduate students as well as to the active researcher.

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The reviewer has recently been concerned with the dynamics and evolution of the Earth–moon system. He is the Deputy Assistant Secretary for Scientific Programs with the Department of the Interior.

Statistics kept simple

EQUILIBRIUM STATISTICAL MECHANICS. By E. Atlee Jackson. 241 pp. Prentice-Hall, Englewood Cliffs, N. J., 1968 $7.75

by GARRISON SPOSITO

This book offers a concise and simple introduction to statistical physics; the book's eminently teachable structure reflects the fact that the author has based it upon his course at the University of Illinois. There are four chapters; three, of modest length, are on probability, the concept of energy and the foundations of statistical mechanics, and the fourth is a lengthy chapter on applications. The first three chapters are embellished by a summary page entitled "Essential Points" and all four feature their important equations in boxes. The language is at all times simple, both mathematically and physically, and presumes only an acquaintance with integral calculus, elementary mechanics and thermodynamics.

The chapter on probability is worth more than a passing comment, as it very successfully conveys its subject in a context of set theory without being mathematically pedantic and, therefore, pedagogically unpleasant. The last section of this chapter is especially successful in creating Boltzmann's H out of a most plausible argument founded in applied information theory.

The discussion, in the third chapter, of the foundations of statistical mechanics does not fare so well as its predecessors. The problem is largely one of clarity and logical precision. For example the idea that one does not prescribe the classical state variables, position and velocity, any more definitely than to restrict them to infinitesimal ranges is stressed. Yet, the "Basic Assumption of Statistical Mechanics" resides gloriously and unverifiably in its box throne in the form, "All microstates of a system that have the same energy are assumed to be equally probable" – as if one could know the energy precisely even though the state variables upon which it depends are known but imprecisely. Again, in the discussion of the canonical ensemble, one is told that the probability distribution function cannot be simply proportional to the energy because the normalization integral would then cease to exist. The immediate reply that the astute student will fire back is that the infinity catastrophe is obliterated if one does not impose the rather unphysical infinite upper and lower limits upon the velocity integral. Because of this difficulty and the antediluvian manner of presenting the canonical distribution (equivalent to Gibbs's original method but without its straightforward character), the whole discussion of the canonical ensemble comes off rather weakly.

Equilibrium Statistical Mechanics is suggested by its author as a textbook for upper-level undergraduates. This it can be, although one might suggest it as well for an alternative to F. Reif's *Statistical Physics* in the lower-division sequence of introductory physics courses. If it were to be used in a curriculum at the level of the Berkeley

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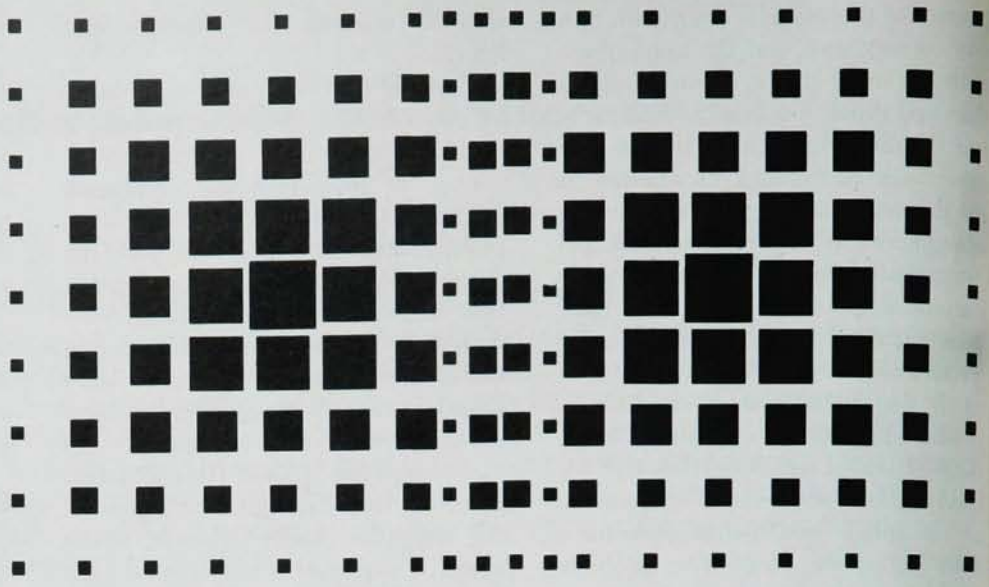

DATA REDUCTION AND ERROR ANALYSIS FOR THE PHYSICAL SCIENCES
Philip R. Bevington, Case Western Reserve University. 320 pages, $7.50 (tentative for clothbound), $4.95 (tentative for soft cover). Available April | This introductory text covers the entire scope of data reduction and error analysis methods from the simplest to the most sophisticated. Methods commonly employed by physicists in research are presented in detail and breadth to make them useful to both the undergraduate and graduate student. Thirty computer routines, written in FORTRAN IV, are included to illustrate the use of techniques discussed.

ATOMIC THEORY: AN INTRODUCTION TO WAVE MECHANICS
Nunzio Tralli, Long Island University, and **Frank R. Pomilla,** York College of the City University of New York. *McGraw-Hill Series in Fundamentals of Physics.* 352 pages, $12.50 (tentative). Available May | Presents a clear and logical development of the theory of the atom. The book begins with the birth of atomic theory in the semi-classical formulation of Bohr and Sommerfeld and develops in sequence the formulations of Schroedinger, Pauli, and Dirac. Each formulation is evaluated in terms of its successes and failures in explaining the experimental evidence. This approach results in the sequential development of the theory.

INTRODUCTION TO MODERN PHYSICS, Sixth Edition
F. K. Richtmyer (deceased), **E. H. Kennard** (deceased); and **John N. Cooper,** U. S. Naval Postgraduate School. *International Series in Pure and Applied Physics.* 752 pages, $13.00 (tentative). Available May | This text maintains the classic, historical features of the earlier editions while updating the material on solid state physics and nuclear physics. New features include: shorter and more teachable chapters, more problem sets, new material on quantum statistics, four-vectors in relativity, and elementary wave mechanics.

THE PHYSICS OF WAVES
William C. Elmore and **Mark A. Heald,** both of Swarthmore College. *McGraw-Hill Series in Fundamentals of Physics.* 464 pages. Available May | An intermediate undergraduate text which presents an integrated treatment of classical wave theory — fundamental waves, Bessel functions, elementary elasticity, diffraction theory are among the topics discussed. The text carefully introduces each of the important areas of applied mathematics, and many problems extend discussion.

WAVE INTERACTIONS IN SOLID STATE PLASMAS
M. C. Steele, RCA Laboratories, Princeton, New Jersey; and **B. Vural,** City College of the City University of New York. *Advanced Physics Monograph Series.* 288 pages, $13.00 (tentative). Available May | This important book treats the properties of solid state plasmas and their wave interactions in a unifying approach. The first portion discusses wave interactions in terms of quasiparticles and the development of a macroscopic hydrodynamic model from the more fundamental microscopic models. In the second part, the macroscopic model is used to analyze the interaction of electrokinetic waves with each other and with other collective excitations of the solid. The comprehensive bibliography is oriented toward both theory and experiment.

QUANTUM PHYSICS, VOLUME IV
Eyvind H. Wichmann, University of California at Berkeley. 576 pages, $5.50 (tentative). Available May | Introduces the student to quantum mechanical thinking, acquaints him with some characteristic phenomena in microphysics, and familiarizes him with the orders of magnitude of physical quantities in this particular domain of physics. The emphasis is on simple intuitive physical reasoning, and mathematical complexities are avoided.

PRACTICAL PHYSICS
G. L. Squires, University of Cambridge. 224 pages, $6.50 Demonstrates the purposive approach that should be applied in all experimental work in physics and thus makes the student more critical of what he does and more aware of what he can do.

EQUILIBRIUM THERMODYNAMICS
C. J. Adkins, University of Cambridge. 288 pages, $8.95 | In this comprehensive yet concise book for undergraduate courses in classical thermodynamics, the author presents a clear, stimulating exposition of the subject in the context of modern physics.

INTRODUCTION TO QUANTUM MECHANICS, Second Edition
P. T. Matthews, Imperial College, University of London. 212 pages, $6.95 | Designed for the standard undergraduate course offered by many departments of physics in the junior or senior year, this book is extremely well written and broad in scope. It emphasizes physical principles and keeps mathematical formalism to a minimum.

McGRAW-HILL BOOK COMPANY
330 West 42nd Street,
New York, New York 10036

Physics Course, a suitable tome on elementary thermodynamics would be needed as a supplement.

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Nuclear structure

LANDOLT-BORNSTEIN, NUMERICAL DATA AND FUNCTIONAL RELATIONSHIPS IN SCIENCE AND TECHNOLOGY. NEW SERIES, GROUP 1, VOL. 2: NUCLEAR RADII. BY H. R. Collard, L. R. B. Elton, R. Hofstadter. 54 pp. Springer-Verlag, Berlin, 1967. $9.50

by JAMES O'CONNELL

Robert Hofstadter, the 1961 Nobel Laureate in physics, H. R. Collard, known for the experimental determination of the form factors of tritium and helium-3, and L. R. B. Elton, author of the book *Nuclear Sizes*, have put together a critical compilation of nuclear radii and associated material. An introductory text, in English and German in parallel columns, precedes a group of tables and graphs and references to the literature.

Hofstadter and Collard review charge radii and form factors and magnetic radii as determined by elastic-electron scattering. For each element several parameters are listed, such as root-mean-square radii, type of distribution, half-density radii and skin thickness. Following the tables an element-by-element discussion gives a short summary of the present status of interpretation. A table of commonly used charge-density functions together with their form factors is reproduced from the Hofstadter and Herman book *High-Energy Electron Scattering Tables*.

Elton's compilation is of data on charge distributions derived from sources other than electron scattering, mainly on the measurement of x rays from mu-mesic atoms. The tabular data are energies of the 2p to 1s and higher transitions, equivalent uniform radii, optical, mu-mesic and x-ray isotope shifts and quadrupole interactions.

H. Schopper, editor of the Landolt-Börnstein series in nuclear physics and technology, is to be congratulated on this timely addition to the series. Everyone interested in nuclear structure will want access to the basic facts contained in this book.

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James O'Connell works on the study of nuclear structure and reactions with photons and electrons at the Center for Radiation Research at the National Bureau of Standards, Washington, D. C.

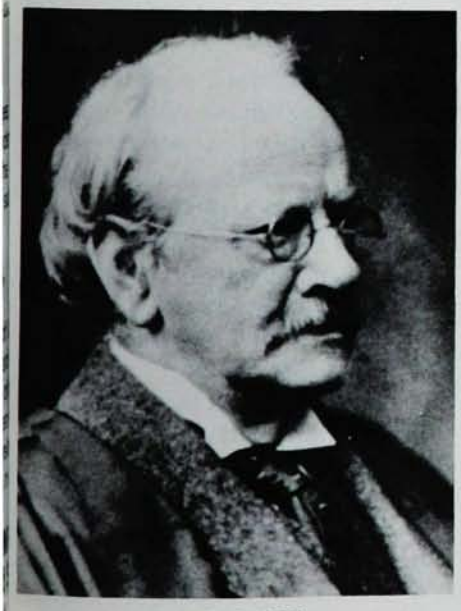
Evolution of the atomic concept

THE ATOMISTS (1805–1933). By Sir Basil Schonland. 198 pp. Oxford Univ. Press, London, 1968. $5.60

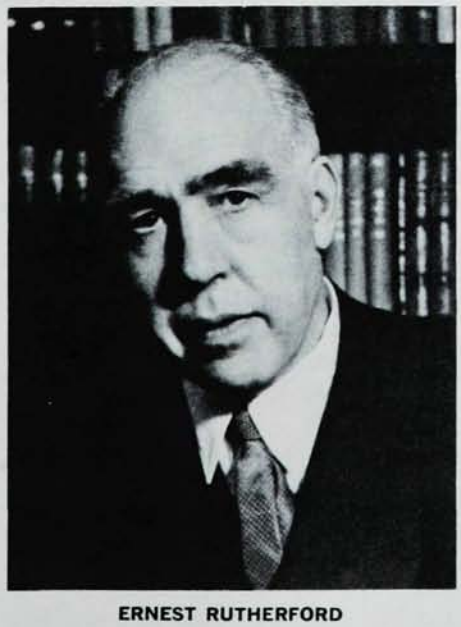
by BRUCE LINDSAY

The success of physics has depended in large measure on the appropriateness and all-embracing character of its concepts. One of the most successful of all physical ideas has been that of the atom. Arising in the mists of antiquity and suffering many vicissitudes through the ages, with many prominent scientists as late as the end of the 19th century denying its necessity, the concept has in our time achieved such a preëminence that the "reality" of atoms is now taken for granted by all.

The story of the evolution of the atomic concept is one of the most fascinating ones in the history of physics. Sir Basil Schonland is a well known geophysicist, authority on atmospheric electricity and former professor at universities in South Africa, as well as former director of the United Kingdom Atomic Energy Research Establishment at Harwell. He has restricted his brief and popular account to the period extending from the inauguration of the atomic idea in chemistry by John Dalton and his contemporaries in the early years of the 19th century to the end of the first third of the twentieth century after quantum mechanics was well established and contemporary nuclear physics had started on its spectacular career. Schonland has packed the story of four generations of atomists into the short space of about 200 pages. This feat has demanded considerable selectivity that will inevitably please some and displease others. Thus the rise of the chemical atom and the various phenomena of electrolysis receive rather full coverage, though the very important and influential 19th-century development of the molecular theory of gases rates much



J. J. THOMSON



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