consideration of collective rotational and vibrational modes of motion to arrive at the unified model, in which single-particle shell aspects are combined with multiparticle cooperative aspects of aggregate nucleon behavior.

The link between descriptions of shell-model and collective motion with the underlying nuclear forces furnishes the substance of the next presentation, in which the authors undertake an exhaustive survey of the recent advances in the handling of multinucleon systems. From second quantization, through the time-dependent Hartree–Fock method, the Tamm–Dancoff and random-phase approximations and the Bogoliubov–Valatin transformation, the superfluid model and Bardeen–Cooper–Schrieffer superconductivity theory, the linked-cluster expansion, Bethe–Goldstone equation, the self-consistent Hartree–Fock approach and Brueckner theory, the presentation leads to a microscopic examination of effective interactions. How nuclear structure relates to nuclear transitions is explored in the two final chapters of this volume, which respectively deal with electromagnetic (radiative) transitions and weak-interaction (beta-decay transition) processes. The study of weak interactions is carried through to include not only beta-decay and electron capture, together with the attendant considerations of interaction modes and parity non-conservation, but also to embrace muon decay and other elementary-particle transition processes. In a commendably up-to-date exposition, the treatment includes considerations of the conserved-vector-current theory and the partially-conserved-axial-vector-current theory, second-class currents, PC-violation and time-reversal invariance. An appendix presents the mathematical and formal adjuncts to some of the material utilized throughout the book. There is also an extensive bibliography, listing general and specific references ranging up through 1973.

The second volume will aim to elucidate the nature of nuclear dynamics as revealed by nuclear binding and reaction characteristics. It will in the first place deal with nuclear forces, their origins, effects, manifestations and attributes in three-body and four-body bound systems; in the second place, it will examine the entire gamut of nuclear reactions, from weak interactions to heavy-ion processes. If the treatment is as detailed and comprehensive as in this substantial first volume, a very complete account of the present status of theoretical nuclear physics and its trends will have been rendered.

The coverage in this first volume is intermediate between that of other recent major texts, such as *Nuclear Structure, Vol. 1: Single-Particle Motion* by Aage Bohr and Ben R. Mottelson (1969), and the very thorough three-volume *Nuclear Theory* by Judah M. Eisenberg and Walter Greiner (1970–72). It is doubtful whether, despite the publisher's claim, it will ever altogether replace the elegant, time-honored (if dated) work, *Theoretical Nuclear Physics* by John M. Blatt and Victor F. Weisskopf (1953), but it will certainly supplement it admirably, and worthily take up an adjoining space on the bookshelves of practically very active or aspiring nuclear theoretician. It should lend itself rather well to discerning use as an authoritative reference text and a stimulating, instructive, if perhaps somewhat massive, teaching text in advanced graduate courses for theoretical nuclear physics and nuclear-engineering students.

My highly favorable impression of this scholarly work was dimmed slightly by the occurrence of many minor printing blemishes, which have persisted despite the evident care lavished by the authors and publisher on the production of this book. It is to be hoped that they will be rectified in subsequent printings and that some un-English mannerisms in deShalit's style in certain passages will be revised (to say nothing of Feshbach's recurrent use of the term "nonparity conservation," which might perhaps be dismissed as "nonarrant sense"). A few important topics have been omitted, among them a discussion of level densities in the statistical model, and the seniority scheme and SU(3) group-theoretical classification system in the shell model. Greater emphasis in the collective-model development might have been placed on the variable moment-of-inertia (VMI) approach, and perhaps on the precursors to the 1953 formulation by Bohr and Mottleson of nuclear rotational/vibrational theory (such as the 1938 Teller–Wheeler discussion of nuclear rotation, the 1941 consideration of surface vibrations and rotations in nuclei by Flüge, the 1943 Guggenheimer investigation of rotational levels and the 1949 survey by Preiswerk of nuclear levels that lent themselves to interpretation in terms of a rotational nuclear model). For pedagogic use, it is regrettable that there are no numerical problems at the ends of chapters.

On the other hand, the well-chosen selection of illustrative examples and challenging problems interspersed within the text is illuminating in the extreme. The authors place their insight at the service of the reader and succeed not only in clarifying the obscure, justifying the assumed, and interrelating the fragmented, but in conveying their contagious enthusiasm for the subject to the responsive student. There is an enchantment to theoretical nuclear physics that transcends the anguish of trying to master its complexities, and this book most ably underlines this affirmation.

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Thermoelectricity in Metals and Alloys

R. D. Barnard
259 pp. Halsted, New York, 1973.
$21.00

Of all the electronic and thermal transport properties in metals and alloys, the thermoelectric power is perhaps the most difficult to understand and interpret because it is so sensitive to such a broad range of perturbing phenomena. Even very slight changes in the Fermi surface or the character of the electron-scattering processes can drastically alter the sign, magnitude and temperature dependence of the experimentally measured thermopower. It is not surprising, therefore, that, to date, only two authors have attempted to treat this problem in a general systematic way that is accessible to graduate students and others who are learning the field. *Thermoelectricity in Metals and Alloys* by R. D. Barnard is the recent contribution to the field; the first was *Thermoelectricity, An Introduction to the Principles* by D. K. C. MacDonald (Wiley, 1962).

The structure of Barnard's book is quite similar to the earlier work and includes brief introductory chapters on the phenomenology and some experimental techniques of thermopower measurement. In the chapters on theory, however, Barnard has far surpassed the MacDonald work by fleshing out the basic electron transport, electron scattering and phonon-scattering theory with a delightfully consistent approach to the mathematics, roughly on the level of John Ziman's *Theory of Metals*. His treatment of theory stresses physical insight rather than formalism and very seldom sends the reader to advanced texts on solid-state theory. These central chapters treat the basic theory of the processes involved in the thermoelectric power of solid and liquid metals and alloys. Barnard's chapter on diffusion thermoelectricity is a sort of interfacing transition that eases the reader into the intricate maze of experimentally observed thermopower phenomena by introducing multiple bands and multiple scattering processes, and finally an excellent treatment of the "giant thermopowers" related to the Kondo effect. This is particularly welcome since he has kept this treatment consistent with his earlier mathematics.

The last chapter of Barnard's book is a significant contribution to the field because it provides the most up-to-date review of recent experimental and theoretical work done in thermoelectricity in metals. It is essentially a review article covering work on the whole range of metals and alloys from alkali and noble metals to transition metals and rare earths. The references are fairly complete up to the time of publication. He treats the alkali metals and alloys in some detail where theory and experiment seem more compatible, and then threads his way carefully through the forest of the more complex metals, transition metals, and so forth, commenting briefly where there are some glimmers of correlation between theory and experiment. Particularly helpful are the abundant reproductions of experimental data plots—the complexity of thermopower behavior cannot be adequately communicated in any other way.

The book is, then, an excellent introduction to the theory and experiment of thermoelectric power in metals and alloys, adequate to bring a person with a basic understanding of solid-state physics to the point of reading current literature in the field. It provides, moreover, an excellent review of the experimental work done up to the time of publication.

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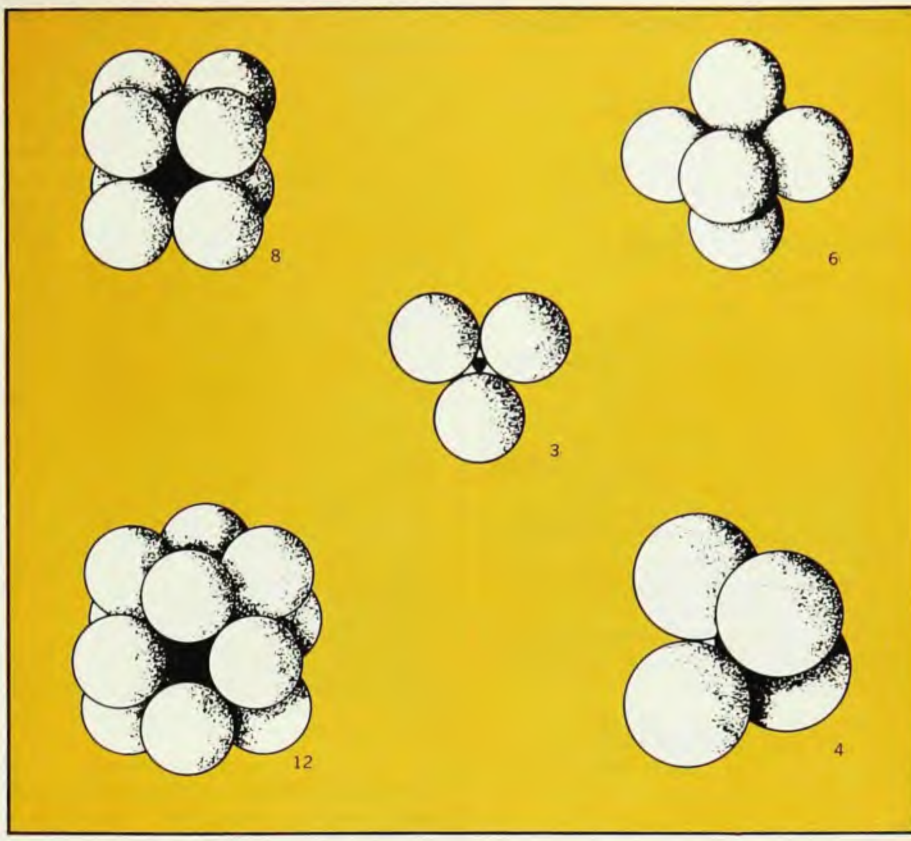

Geometries of 3, 4, 6, 8 and 12 anions surrounding a central cation are illustrated with packing diagrams. From *Crystal Structures, A Working Approach*, by H. D. Megaw, reviewed here.

Crystal Structures: A Working Approach

H. D. Megaw
563 pp. W. B. Saunders, Philadelphia 1973. $19.50

The structures of crystals—the repetitive arrangements of atoms in three-dimensional space—are fundamental to solid-state science. There exists a rich literature of crystal structure information, mostly derived from diffraction experiments with x rays or neutrons, and various compilations and indexes make these data very accessible to the *cognoscenti*. Unfortunately, the specialized notation and jargon serve as barriers for many. Too often the crystal structure is misunderstood or ignored in a study of a physical property.

Helen D. Megaw, lecturer in physics at Cambridge University, is well known for her studies of oxide and silicate structures, phase transitions and ferroelectric crystals, and as author of *Ferroelectricity in Crystals*. She is also interested in better crystallographic education. This book, *Crystal Structures: A Working Approach*, "is written for readers with no previous knowledge of crystallography but with a reasonable general background in the other physical sciences." It is a textbook for self-teaching, complete with numerous exercises. References to the original literature take the place of formal answers. By excluding almost everything about how structures are determined, Megaw is able to set forth a remarkable amount of material on the results for actual structures and on how to use symmetry to describe them.

There is a very clear exposition of the properties of space groups and crystallographic symmetries, of crystal coordinate systems and of geometrical transformations. Megaw discusses the structures of perhaps 300 substances with several dozen of them set down in precise detail. These include the most important simple structures, and this part of the book will be a convenient handbook for many workers. There is a rather broad discussion of chemical bonding and crystal-structure theory, but brevity sometimes leads to oversimplification.

In the discussion of the NaCl- and CsCl-type structures and the radius-ratio criterion for coordination number, Megaw follows many others in regarding as anomalous a NaCl-type salt with anion and cation of nearly equal size; she suggests that covalent bonding may give an explanation. In fact, the change of bond distance with coordination number is a bigger effect than the slight difference in Madelung sums for these two structures, and the CsCl-type structure must be regarded as the anomalous one for any radius ratio according to the simple ionic model.

The discussion of correction of bond lengths for thermal motion is marred by an incorrect definition of *riding*, and it fails to explain the role of phase correlation in this calculation. The reader might well skip this section.

These defects are more than compensated by the clear exposition of a great deal of information concerning structures and their relation to physical properties, phase transitions and chemical bonding. There is careful attention to nomenclature and to some of the difficulties concerning orientation. There is little chance that physicists will accept the crystallographers' definition of *lattice*, but perhaps they can be convinced that CsCl is not body centered. Anyone interested in the structure of a trigonal crystal should read of the incredible errors concerning choice of axes in quartz, and take heed. Other strong points are extensive indexes of authors, formulas and