have worked on the same problem, Rochester tabulates all sets of results; where differences exist—of fact or opinion—he tries to be fair to all sides. His coverage of the literature is remarkably complete, and I found no serious errors. The index is well done. Indeed, my only criticism is minor and subjective: Since the success of acidity functions depends on the existence of certain linear free energy relationships, I was disappointed that almost nothing is said about linear free energy correlations in general.

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Organic Compounds

Nonbenzenoid Aromatics. Vol. 1. JAMES P. SNYDER, Ed. Academic Press, New York, 1969. xii, 372 pp., illus. $17.50.

A theoretical basis for investigating the structures of nonbenzenoid aromatic compounds was provided by E. Hückel in 1931 at the time of the formulation of the pi-electron theory of aromaticity, but in a real sense the subject developed after World War II and is thus relatively new. In the space of approximately 20 years a wide variety of molecular species containing from 2 to 30 pi electrons and existing as cyclic cations, anions, radicals, or zwitterions, in complexes, or as more ordinary neutral conjugate unsaturated systems, for the most part previously unknown, have been synthesized and studied. This work has evoked an impressive total of theoretical interpretation and prediction aimed at understanding the general structure-properties relationship for this class of compounds.

Although there have been a number of review articles, especially in the past ten years, the only previous major survey of the field is *Non-Benzenoid Aromatic Compounds,* edited by David Ginsburg, which appeared in 1959. Thus the present work, which (reflecting the large increase in the literature that has occurred) will consist of several volumes to be published over a period of several years, is timely and will provide when complete an authoritative picture of, one hopes, all the significant areas. The size and complexity of the task precluded the appearance of all the volumes in the same year and also made it impracticable to have the contents of the individual volumes organized so as to be homogeneous, or fairly so. This is quite apparent in this first volume, which contains chapters, following a historical introduction by the editor, treating biphenylenes, cyclodecapentaene, sydnones, azepines, oxapins, thiepins, and aromatic oxocarbons.

The authors of this volume have achieved a good balance between experimental results and theoretical interpretation. The scope and detail of the chapters are adequate, but do not give the impression of including a reference to every paper that has appeared. An author index makes the search for a topic by this route possible. The subject index would be more useful if it were more detailed. The format, type, drawings of chemical structures, paper, and binding are excellent.

It may be expected that this book and its companion volumes will become the principal general source in the field.

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Magnetic Properties

Magnetism and Metallurgy. AMI E. BERKOWITZ and ECKART KNELLER, Eds. Academic Press, New York, 1969. 2 vols. xxviii, 838 pp., illus., + indexes. Vol. 1 (pp. 1–512), $29.50; vol. 2 (pp. 513–838), $17.

Magnetism and Metallurgy is a two-volume treatise on how structural properties affect magnetic phenomena, and to a lesser extent it explores the use of magnetism in the science of metallurgy. It is not the intent of the work to be a comprehensive treatise on the physics of magnetism. Introductory sections dealing with the principles of magnetism and experimental techniques provide the desired degree of self-containment. These sections are generally well referenced so that the reader can readily pursue topics that are outside the scope of the work.

The main purpose is to examine the effects of composition and a wide range of defects on the magnetic properties of materials. In particular the effects on magnetization curve parameters are dealt with extensively. Although the introductory section refers to some aspects of magnetism as a phase transition and mentions that interesting thermodynamic and transport anomalies exist near the Curie or Néel temperature, treatment of the role of composition and defects is confined almost exclusively to saturation magnetization, coercive force, remanence, energy products, and the like. These structural effects are considered primarily for ferromagnetic systems and in particular for transition metals and alloys. Complicated spin structures such as the screw types found in the rare earths, their alloys, and intermetallics are mentioned only briefly. In any work of this nature there exists the danger of merely cataloging behavior observed in a wide range of elements, alloys, and intermetallics. Only four of the chapters are of this nature, however. The remaining 13 are quite descriptive and oriented toward the phenomena. Of course sometimes significant results are not well understood and one must catalog or omit.

Discussion of the role of composition in binary and ternary solid solutions and intermetallics is confined to susceptibility and magnetization curve parameters, primarily in noble-transition metal, simple-transition metal, transition-transition metal, and transition-metal-rare-earth systems. Discussion of the role of defects is also confined primarily to magnetization curve parameters. The types of defects considered include finite size, dilute concentrations of nonmagnetic impurities, dislocations, stacking faults, point defects, agglomerates of both magnetic and nonmagnetic species, and atomic disorder especially near an intermetallic stoichiometry. In addition, the production of defects by working and the introduction of directional order by heat treatments in fields are discussed, as is the kinetics of defect recovery and recrystallization.

Several chapters are excellent. S. H. Charap provides a compact introduction to the range of magnetic behavior that occurs throughout the periodic table, introducing molecular field and band approaches. The main aspect of each type of behavior is clearly described, and reference to more thorough works is made straightaway in each instance. The chapter by P. E. Seiden on magnetic resonance is a model of succinct presentation of an intrinsically complex subject. A chapter by T. R. McGuire and P. J. Flanders provides an extremely handy survey of how to measure susceptibility, magnetization, magneto-optical, and galvanomagnetic properties. Immediate reference to an appropriate review article is made for each topic. How to determine transition temperature, effective number of magnetons, and exchange integrals is clearly

delineated, and warnings as to the limitations of various techniques are also given in this chapter. A chapter by J. S. Kouvel deals with the effects of atomic disorder. In particular, it is concerned with the effect of order-disorder (for intermetallic systems on or near stoichiometry) on the Curie temperature, magnetostriction, and magnetization parameters. The phenomenological model used is presented clearly and its consequences are discussed systematically.

Although the treatise will be of greatest worth to persons concerned with the role of metallurgy in magnetization curves or the use of magnetic properties in metallurgical studies, it also contains much information relevant for investigators of critical phenomena if they substitute do's for don't's and vice versa. Although the exact role of defects in altering the nature of the phase transition is not yet known, their elimination and then controlled introduction are central to the study of critical phenomena in magnetic systems.

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Effects of Nuclear Motion

Impurity Spectra of Solids. Elementary Theory of Vibrational Structure. KARL K. REBANE. Translated from the Russian edition (Moscow, 1968) by John S. Shier. Plenum, New York, 1970. xvi, 254 pp., illus. $19.50.

Because of the vast difference between the mass of the electron and that of the nucleus, it makes some sense initially to discuss the electronic spectra of solids in terms of a rigid lattice. There are several excellent books on the spectra of impurities and localized defects in solids which are based on this approximation, treating nuclear motion as a side effect. However, in the last few years a substantial theoretical and experimental effort has been made to understand in detail the effects of nuclear motion; and this book, which is devoted to the general theory of these effects, is most welcome.

The author tacitly confines his attention to transitions between nondegenerate electronic states. Within this limitation his treatment is as general as current theory permits, without, however, demanding mathematical apparatus beyond standard quantum mechanics. He begins with a careful discussion of the adiabatic approximation (by which the electronic and nuclear motions are separated). The second chapter treats a simplified but general model of the electron-vibration interaction covering strong and weak coupling to phonons, local modes, and quasi-localized modes (which are a cross between the first two). The extraordinarily wide variety of spectra so obtained is compared with some beautiful spectra obtained by the author and his colleagues in Tartu. Most of this work appeared in obscure journals of the Estonian S.S.R., not readily available in the West. Further chapters discuss the analogy with the Mössbauer effect, extend the simple theory to take more recherché effects such as anharmonicity into account, and discuss the effect of a localized electronic state on infrared and Raman spectra.

By ignoring electronic degeneracy (and thereby dismissing a large body of experimental data from his attention) the author permits himself a rigorous quantum mechanical approach. He can afford to be slightly contemptuous of the "semiclassical" approximation (in which initial states are treated quantum-mechanically and final states classically), since in the nondegenerate case it is merely a heuristic device for visualizing results obtained from the exact theory. It is indeed a mongrel theory, but it remains the only way of dealing, even qualitatively, with transitions to a degenerate state strongly coupled to the lattice. Excellent results have been obtained with it which should make us forgive, though not forget, the illegitimacy of its origins. For the same reason the method of moments is treated as little more than a mathematical exercise. Only in the degenerate case does the method reveal its power, and it is not for nothing that C. H. Henry and C. P. Slichter entitle their fine chapter in *The Physics of Color Centers* (W. B. Fowler, Ed., Academic Press, 1968) "Moments and degeneracy in optical spectra." It is a pity that Rebane has limited his purview in this way, particularly as he nowhere says that he has done so.

The book is studded with "exercises for the reader"; these are well chosen, but since no answers are given and many of the questions are in the form "Explain . . ." they are likely to be a source of frustration to the solitary student. The translation is free of obvious errors and reasonably clear, though often making heavy reading. The proofreaders did a good job except that they failed to check the cross references to equations. The bibliography is large and up to date to 1968; it is likely to be most useful to a reader of Russian.

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Solid-State Technique

Field-Ion Microscopy. K. M. BOWKETT and D. A. SMITH. North-Holland, Amsterdam, and Elsevier, New York, 1970. x, 258 pp., illus. $17.25. Defects in Crystalline Solids, vol. 2.

As part of the series Defects in Crystalline Solids (edited by S. Amelinckx, R. Gevers, and J. Nihoul) this book must serve two purposes. It must describe the technique of field-ion microscopy and its capabilities, and it must discuss those types of solid-state defects that can be studied by this type of microscopy. The authors achieve both of these ends in their compact monograph.

The complex principles underlying field-ion microscopy are presented concisely and yet sufficiently that anyone now using field-ion microscopy or anyone wishing to do so could easily understand them. The presentation allows the reader to see how each principle stands in relation to the experimental images and also introduces him to the conventions used in the practice of this type of microscopy. It is this very close connection between theory, experiment, and current literature that makes this monograph very useful to those interested in either the method or the results. Throughout the text there are citations from the present and historic literature that are more than ample to provide background to any particular topic.

The authors provide an experimentalist view of the construction and operation of field-ion microscopes as well as the names and addresses of suppliers of unusual but necessary components. They discuss methods of specimen preparation and provide detailed lists of procedures for each material that has been imaged.

Many schematics are coupled with experimental micrographs and text to explain the various types of defects