

maining chapters. J. C. Phillips and R. Sandrock point out with some force that with reasonable accuracy many of the first-principle calculations can be reproduced by quite small secular determinants that in turn can be derived from a "model Hamiltonian" approximation to the electron-band problem. This idea is vigorously pursued in David Brust's exposition of the pseudopotential method and its application to silicon and germanium. Extension to systems exhibiting hybrid mixtures of free-electron-like states and tighter bound states are provided in the article by Henry Ehrenreich and Laurent Hodges. This method has been contrived to handle metals in the transition groups, and its ability to incorporate relativistic (principally spin-orbit) and ferromagnetic effects augurs well for a useful empirical approach to these physical problems.

With only one omission the book gives, in a series of well-written articles, an excellent summary of the tried and true band-structure techniques. The omission is, of course, the cellular method (also attributed to Slater in its present form). It receives attention although it is not as popular as the others. Graduate students and researchers in solid-state physics will find the text both a useful compendium, and, particularly in Slater's opening account, an interesting verbal map of the route taken by the band wagon over the past few decades.

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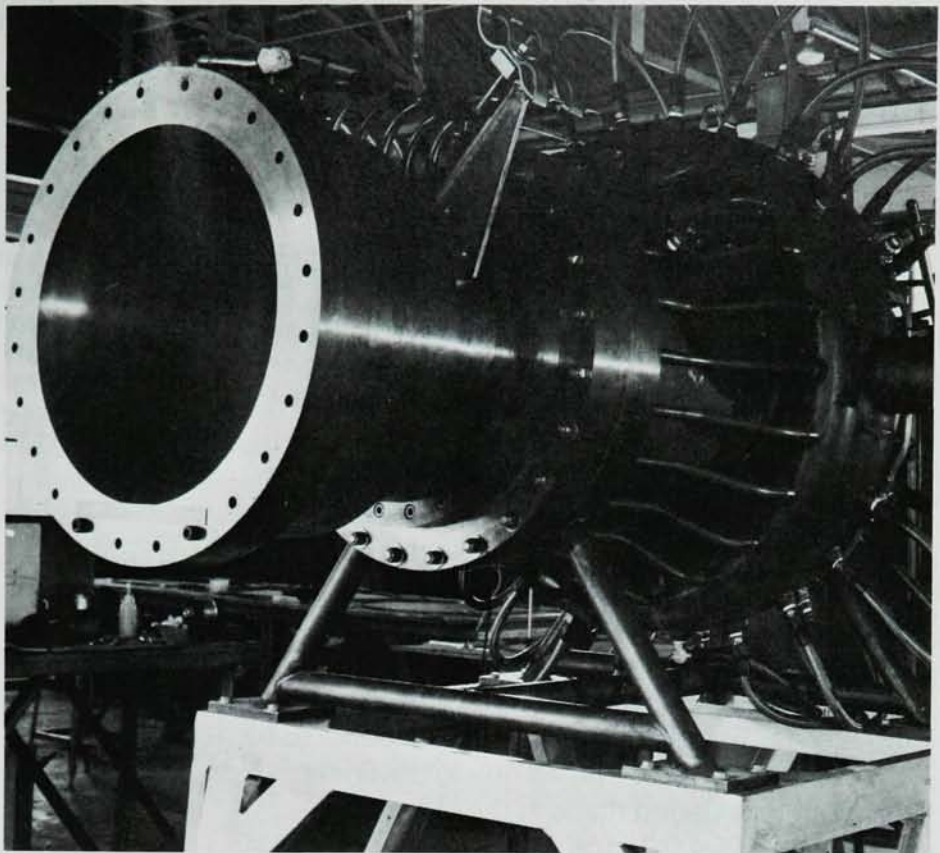
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Introducing MHD

MAGNETOHYDRODYNAMIC ENERGY CONVERSION. By Richard J. Rosa. 234 pp. McGraw-Hill, New York, 1968. \$17.50

by JAMES KELLEY

Despite its being at the very frontier of modern methods of energy production, magnetohydrodynamics goes back to Michael Faraday, at least in principle. As Richard J. Rosa (chairman of the MHD Generator Project Board, Avco-Everett Research Laboratory) points out in the introduction to his book, patents for MHD energy conversion had been applied for in the first decade of this century. But real-



COMBUSTION CHAMBER of the 20-MW MHD generator built by Avco Everett Research Laboratory to power a low-density wind tunnel at the Air Force Arnold Engineering Development Center, Tullahoma, Tennessee.

ly only after World War II could MHD be seriously applied to the energy-conversion process because of the postwar studies in plasma physics, the knowledge gained of the fusion process in nuclear physics and the deeper insights into gas dynamics. Now major producers of electrical power-plant equipment, both fossil and nuclear fueled, are seriously in the MHD energy-conversion business. A number of major electrical utility companies are also involved. So it is safe to say this method is here to stay.

Rosa's book is well designed for an introduction to MHD. A senior student in electrical engineering or a beginning graduate student would find it suitable. From a teaching viewpoint it has some deficiencies; there are no problems of any kind, as illustrations or at the end of chapters. The first three chapters are given over to review. They start with an introduction and general description and go on to ionization and conductivity and then fluid mechanics. These are well done but do presuppose some knowledge of these subjects. Of course ionization is not left there; it is treated

throughout and in some detail in the fifth chapter. There is a good discussion (chapter 4) of both the Hall effect and ion slip. Chapters 6 and 7 deal, respectively, with magnet design and a wide variety of essential design parameters.

In some respects the last chapter is the most interesting because the author deals with what will happen to research and development. He deals with the applications. There are, of course, practical engineering problems such as high temperatures (2000-3000K) in a daily operating situation or alternatively high-fired superconductors. In either case the practical engineering problems may be much simpler to discuss than to solve.

There is little doubt, however, that these and other problems will be solved by one means or another.

Rosa discusses costs, which I at least would not care to try to debate. I have gone through that experience comparing fossil-fired and nuclear-fired generating plants and have seen all the calculations end up meaningless and virtually all time schedules turn out wrong. After all that, I am one person who would say, let's try

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1966; xxiv + 1114 pp (two volumes); illustrated; A4 **\$25.92**

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MHD when it looks technologically possible for a public utility, and after several are built and operating, we will start worrying about comparative costs.

There appear to be many applications in the whole rocket-aerospace technology, and MHD may prove to be especially useful here. That MHD will become a practical method of generating electric power seems to be certain. When this can be done on a wide scale and in an economic manner may be another, but not unrelated, question.

All together Rosa has assembled a fine book, and certainly it is a valuable addition to the literature if only for the large number of references at the end of each chapter.

* * *

The reviewer is a professor at Marquette University.

Localized-spin magnets

SPIN WAVES. By A. I. Akhiezer, V. G. Bar'yakhtar, S. V. Peletninskii. Trans. from Russian by S. Chomet. 369 pp. Wiley (Interscience), New York, 1968. \$21.50

by MICHAEL WORTIS

"The Theory of Magnetic Insulators at Low Temperatures" might have been a descriptive subtitle for this somewhat disappointing translation from the Russian. The authors confine themselves almost exclusively to localized-spin magnets. There is only a cursory introduction to the physical origin of exchange (based on the Heitler-London hydrogen molecule) and no attempt is made to relate the sign and magnitude of exchange integrals to underlying atomic and solid-state properties.

Within these chosen limitations, the material divides broadly into two sections. The first discusses long wavelength, semiphenomenological and macroscopic magnetism (including macroscopic spin-wave theory, magnetic resonance and magnetoelastic effects). The second deals with the microscopic treatment of the Heisenberg Hamiltonian (including the Holstein-Primakoff transformation, spin-wave dynamics and kinetics and thermodynamics). The discussion covers ferro-, ferri- and antiferromagnetism and includes dipolar effects and anisotropy. Perhaps

the major omission is any mention of the more complicated types of magnetic ordering, for example, spiral structures.

The authors, from the Physico-Technical Institute of the Ukrainian Academy of Sciences in Kharkov, have extremely broad interests (Akhiezer's book with V. B. Berestetsky, *Quantum Electrodynamics*, is well known) and have made important contributions to the theory of magnetism. These contributions are primarily in the area of macroscopic magnetism; so it is not surprising to find that the first section has a coherence and elegance of exposition that the microscopic-development section lacks. The treatment is detailed and readable throughout, if somewhat uneven. At best it is quite lucid; at worst (especially in the microscopics), a mechanical reworking of inadequately acknowledged journal material.

The major defect of the work, however, is its total failure to make contact with experiment. How can a book entitled *Spin Waves*—indeed, a book that discusses the *formalism* of neutron-magnon scattering—fail even to make reference to the direct observation of spin waves by Brockhouse and others? Although a few (very few) experimental references are included, there is no discussion of experiments in the book and no attempt to compare theoretical predictions with experimental observation. This omission will often make it difficult for the uninitiated reader to assess the motivation for and relevance of the theory presented.

It is worth noting the authors' reluctance to use visual aids. There is a total of only 12 figures in the text, of which seven are lifted, without acknowledgment, from a single article and occur on five successive pages. The referencing, particularly in the second section, is inadequate by Western standards (for example, Freeman Dyson's famous T^4 term in the Heisenberg free energy appears for the first time on page 342 without reference).

The level of presentation is appropriate to the first- or second-year graduate student, although a previous exposure to many-particle theory will be helpful in later chapters. Because of its narrow scope, the book would not make a good text for a course on magnetism. For the experts, its sparse referencing will be a drawback.

One might have hoped that this book would be a fitting companion

volume to Conyers Herring's careful and provocative *Exchange Interactions Among Itinerant Electrons* (G. T. Rado and H. Suhl, eds., *Magnetism*, volume 4). Unfortunately, it is not.

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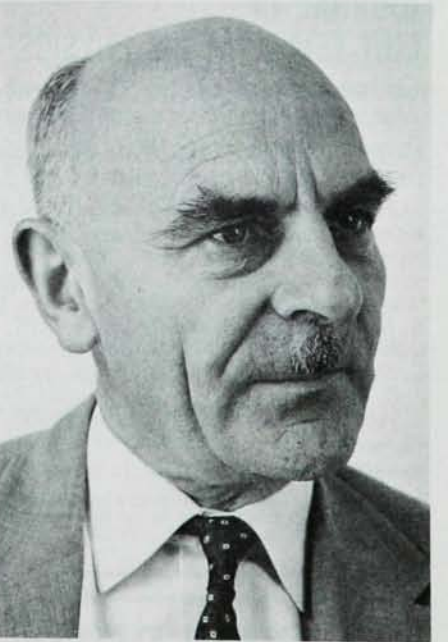
A festschrift to Massey

ADVANCES IN ATOMIC AND MOLECULAR PHYSICS, VOL. 4. D. R. Bates, Immanuel Estermann, eds. 465 pp. Academic, New York, 1968. \$20.00

by SIDNEY BOROWITZ

This volume is the fourth in a series, whose principal function is to provide a topical review of some aspects of atomic and molecular physics. Past volumes in this series have devoted themselves to a broad range of subjects in this general field, the choice of the subjects dictated by some special results and special activity in the area shortly before the volume was published.

This volume maintains the tradition by devoting itself to a large number of topics of current interest. That it can do so is all the more remarkable because the contributors to volume 4 are all former students or colleagues of Sir Harrie Massey, for whom this volume is a festschrift. The list of contributors and the wide range of topics covered are an accurate indica-



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