ing diffraction by gratings, the author uses the concept of scattering without explaining its origin. There is no explanation of why the de Broglie wavelength depends inversely upon the velocity. Errors have been noted in the treatment of the unit cell, low-temperature specific heat, dipole-dipole attraction, and the discharge of a mica condenser. In discussing structures the impression is given that bond directions and ion size ratios are the only determinative factors. However, these defects are minor and do not appreciably affect the overall worth of the book for the intended audience.

The introductory chapter is concerned with theories: macroscopic and microscopic. After this setting of the stage, the topics covered are heat, heat capacity, order, symmetry, atoms and ions, molecules and metals, structures, atomic motions, particles and waves, electrons in atoms, electrons in solids, electrical conduction, semiconductors, and magnets.

There is a good subject index. Numbering of the figures makes it difficult to find them when reference is made to figures in earlier chapters.

In general, this is a remarkably successful book.

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Leonard Muldawer, who is professor of physics at Temple University, has published extensively on solid-state physics.

Cooperative phenomena

EFFECTIVE FIELD THEORIES OF MAGNETISM. By J. Samuel Smart. 188 pp, W. B. Saunders, Philadelphia, 1966. $5.25.

by J. H. Van Vleck

Interest in the subject of magnetism has burgeoned enormously in the last few years, both because of its widened technological importance and the increased sophistication of its theory. A striking illustration of this statement is that within a year, two books, both dealing with essentially the same part of the theory of magnetism, have been written independently by two physicists at the same laboratory, that of International Business Machines at Yorktown Heights. The other volume besides the one now being reviewed is *The Theory of Magnetism* by D. C. Mattis (subsequently at Yeshiva University), which was reviewed in PHYSICS TODAY for November, 1965 by D. B. Butrymowicz. Both monographs are concerned primarily with the study of the cooperative phenomena resulting from the interaction between elementary magnets, which, without this coupling, would be simple entities. In other words, neither book makes any pretense of covering crystalline or ligand field theory, partial quenching of spin-orbit interaction, etc. Despite this common restriction, the overlap between the subject matter and style of presentation is so slight that anyone can own both volumes without fear of duplication in his library. For example, both books end with appendices tabulating special functions important for magnetism, as seems appropriate for volumes emanating from IBM. However, the functions tabulated are different. Mattis selects the characteristic function involved in the Ruderman-Kittel-Kasuya-Yosida type of indirect exchange, and Smart tabulates Brillouin and related functions, also pair functions involved in the coupling approximation. This distinction in the tables also, incidently, illustrates the different emphases of the two monographs.

As the title indicates, Smart's book is the more elementary and restricted in coverage of the two and so runs to less than half as many pages of text. It does not discuss spin waves or enter into the rather murky question of the convergence of series expansion of the moment in $1/T$ at higher temperatures. However, effective field theories have been so fruitful in the interpretation of a wide range of magnetic phemonena and at the same time have such a basic simplicity, that a monograph devoted exclusively to them is well warranted. Only the most rudimentary knowledge of algebra and calculus, or of quantum mechanics and solid state physics, is needed in order to follow the analysis in Smart's lucid presentation.

As already intimated, the scope of the volume is sharply defined. It consists of the application of the Weiss molecular field, Oguchi constant coupling, and Bethe-Peierls-Weiss methods to insulating ferromagnets, antiferromagnets, and ferrimagnets, mainly with the Heisenberg model. This is a subject in which Smart is experienced, as he has made notable original contributions in applying the B-P-W method to antiferromagnetic and ferrimagnetic materials. Two features of the presentation should be mentioned particularly. One is that the writer focuses attention on the physics of the situation—too often modern theoretical physicists are apt to be carried away by overdevotion to mathematical formulism. The other is that, despite the elementary level of the presentation, the writer conscientiously makes a critical comparison of the elements of strength and weakness of the various effective field theories, rather than giving an undigested compendium of information, as is so often the case. There is considerable comparison with experiment, though not as extensive as in the chapter on this subject which Smart himself has written in the Rado-Suhl series. The documentation of the literature impresses the reviewer as unbiased and authoritative. He has noticed only one error—this is the statement on page 129 that "the rare earth garnets all have a compensation point." Actually, for the lighter rare earth garnets, inclusive of samarium, the factor $g_J - 1$ entering the exchange field is negative rather than positive, and the rare earth magnetization reinforces rather than opposes that of the iron sublattice. This dependence on the sign of $g_J - 1$ is one of the nicest simple tests of the molecular field model of exchange coupling and could well have been cited.

Smart does not pretend to treat indirect exchange, anisotropy, or the ambulatory features of ferromagnetism in conductors. He does, however, devote a chapter to the helical and canted structures which are one of the spectacular recent developments in magnetism.

The author is overmodest when he says in the preface, "This book is primarily intended for the novice in magnetism, rather than the specialist." Few readers will be so sophisticated that they do not either learn something from the volume, or find it a convenient source of reference on subjects with which they already have some acquaintance. As Richard Stevenson says in the foreword, "Surprisingly enough there are only scattered accounts of these [effective field] theories. . . . This gap has been filled admirably by Dr. Smart. . . . His book, written in his usual felicitous style . . . in particular will be welcomed by experimenters who struggle Laocoön-like with the paper serpents being emitted by the journals."

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J. H. Van Vleck, who is Hollis Professor of Mathematics and Natural Philosophy at Harvard University, is well known for his work in the theory of magnetism.

International teaching survey

A SURVEY OF THE TEACHING OF PHYSICS AT UNIVERSITIES. 396 pp. Unesco, New York, 1966. Cloth $6.50, paper $4.50.

by Robert L. Weber

Surprisingly informative and lively, this international report surveys the teaching of physics in Czechoslovakia, the Federal Republic of Germany, France, the Union of Soviet Socialist Surprisingly informative and lively, the United States of America. The authors of the report express the hope that "it will serve as a chart for some adventurous exploration into better ways of teaching physics." Addressed especially toward informing and helping the developing universities, the report should interest any teacher of physics, enabling him to view his own efforts in a perspective which is international and which extends from elementary grades to the university, and beyond.

Each chapter begins with an introduction to define the problems to be discussed. The main portion of the chapter displays the current procedures in the teaching of physics, and those parts of mathematics which are a part of the education of a physicist, in each of the countries participating in the survey. Each chapter concludes with a summary stating the extent to which there is agreement among the educational practices described.

The broad scope of this report is indicated by the titles of its chapters: 2, Preparation for the study of physics in universities and related admission requirements of universities; 3, The education of professional physicists in universities to the first degree; 4, The role of physics in the education of school teachers, engineers, and others; 5, Advanced study toward higher degrees; 6, Academic research in physics: continuing education, evening schools, extramural education; 8, Teachers of physics in universities; 9, Material; 10, The improvement of physics teaching.

Valuable detailed information appears in 195 pages of appendixes: syllabuses, lists of experiments and books, sample examinations, etc. In describing the diversity in physics programs in the United States, the authors supplement general information with details about physics programs in four high-ranking institutions: Berkeley, Columbia, MIT, and Swarthmore.

One encounters on an international scale in this report some of the dilemmas painfully familiar to every physics teacher. On page 79 there is recognized the need to reduce the number of topics in the course so we can "uncover physics, not cover it." The opinion of the 1957 Carleton Conference that a satisfactory introductory physics course can be constructed around seven basic principles is quoted. Yet the report also faithfully records the proliferation of topics and the trend toward two-year basic courses. Again, while the reasonableness of the "new math" is welcomed, in more than one national report fear is expressed that the teaching of mathematics to physicists is in danger of becoming excessively formal and unrelated to physics (page 92).

It is unfortunate that in this comprehensive and elegant report it was not found feasible to give some student evaluation of introductory physics courses at the college level. Had this been done, I suspect that at least one other teaching dilemma would have been exposed. The physicists' conviction (displayed especially in the German report) that physics must be introduced through laboratory observation and manipulation is opposed by the view held by most students I have encountered that the introductory laboratory makes low-yield use of their time.

Teachers of physics and administrators of academic programs are indebted to the contributors to this international report, to its coördinator William C. Kelly and to the American Institute of Physics for a remarkably well-organized book which can be very helpful to an institution starting a physics program or to a faculty replanning an existing program.

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Robert L. Weber, who is professor of physics at The Pennsylvania State University, is the author of a number of textbooks.

Mainly for graduate students

THE THEORY OF TRANSFORMATIONS IN METALS AND ALLOYS. An Advanced Textbook in Physical Metallurgy. By J. W. Christian. 975 pp. Pergamon, New York, 1965. $28.00.

by H. M. Otte

In spite of the specialized sounding title, the 23 chapters, consisting of nearly 100 sections, that go to make up the body of this work, cover a broad spectrum of solid-state physics and physical metallurgy. The underlying guiding theme throughout is the rearrangements of the atoms in metals and alloys as produced by suitable thermal and mechanical treatments. Atomic processes are discussed in terms of the associated kinetic and crystallographic features. "Transformations" is used in the broadest sense to include all those changes in the solid state that occur by the same atomic processes, irrespective of the nature of the driving forces. Thus the book is concerned mainly with the mechanisms of phase transformations and not the reasons for them. Plastic deformation by slip is virtually the only major subject excluded, but, by admission of the author, principally because of the vastness of the subject rather than lack of proper justification for inclusion! However, a whole chapter is devoted to dislocation theory.

The introductory chapters, which form an appreciable fraction of the whole book, contain discussions of