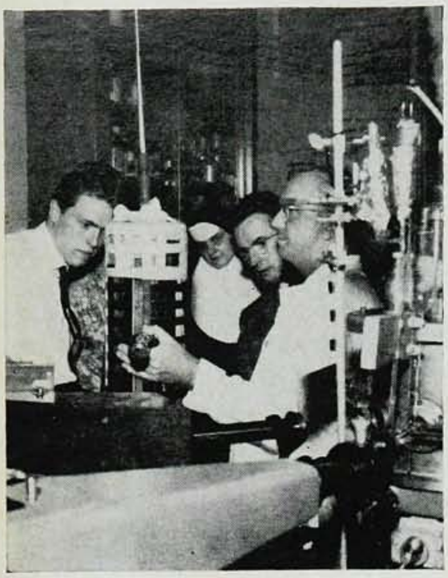

gory was considerably changed from that of the quality ratings; Columbia dropped into the second, attractive, category.

Physics was one of four fields chosen for special analysis of the replies and for a comparison rating by a special panel—in physics of 15 experts nominated by the American Institute of Physics. The select panel agreed with the other respondents on the top 10 departments as well as on the second ten, but with some difference in order in each group. The top ten departments in the rating by all respondents for quality were: California (Berkeley), Cal Tech, Harvard, Princeton, Stanford, MIT, Columbia, Illinois, Cornell and Chicago; the second ten were: Yale, Wisconsin, Michigan, Rochester, Pennsylvania, Maryland, Minnesota, Washington (Seattle), Johns Hopkins and UCLA.

The results for effectiveness of program of the comparison between the select panel and the other rating groups was similar to those for quality. Analysis of the results in physics for effect of rater's degree school, institutional affiliation, current region of location and position of current school affiliation in the rating scale showed suprisingly little variation except for the rating by respondents from schools in the bottom half of the scale.

Physicists will probably not be surprised to learn that there is general agreement on the quality and effectiveness of the programs offered by different institutions. The hierarchy, or pecking order, has long been clear from other evidence. The present study, however, will no doubt be used, and effectively, by schools below the top few to reinforce their appeals to administrations, legislatures and alumni for funds and help to improve their positions. Those whose position has declined markedly since the earlier surveys will be especially urgent while the schools which have demonstrated marked improvement will call for continued growth.

The American Council on Education has indicated its intention to repeat the survey within five years. At least two current federal policies may result in more changes in rank order of excellence than has occurred in recent years. In the past two years the National Science Foundation has made 13 grants totalling $47 million to institutions considered able to move up into positions of excellence in scientific fields. This program is continuing and seems certain to alter the ranking in some fields. The second policy change occurred when, on 13 Sept. 1965, President Johnson directed all federal agencies to spend more of their money earmarked for institutions on more schools in more places. This program has barely begun to be felt, but in the past the top 15 universities in the present ranking have been receiving at least 50% of the federal research and fellowship support. Any marked change in this distribution will have its effect on the quality of work done in universities of the second category at least.

An objective rating of the quality or attractiveness of graduate programs is impossible. Subjective ratings, like the present one, are open to complaints of halo effect, of persistence of outworn images, and of other sorts of regional or personal bias. In the case of Cartter's thorough and painstaking study these criticisms have been foreseen and guarded against. There are numerous cases where recent changes in departmental quality have been reflected accurately in the ratings. Physicists can take particular satisfaction in the consistency of rating by the four different groups of raters and in the virtual absence of parochialism. The report is excellent for careful design, clearness of presentation, and quality of typography. It will be indispensable to those with an interest in graduate education, both now and as a basis for future comparison.

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Ralph A. Sawyer, dean emeritus of the graduate school at the University of Michigan, is chairman of the governing board and acting director of the American Institute of Physics.

Behavior of solid matter

THE NATURE OF SOLIDS. by Alan Holden. 241 pp. Columbia University Press, New York, 1965. $6.95.

by L. Muldawer

This book is written for "anyone who has studied physics or chemistry in a secondary school" and aims to provide "a nonmathematical account of how some of the behavior of solid matter is understood at present." It is written by Alan Holden, a member of the research staff of the Bell Telephone Laboratories. He has been interested in high-school and college physics programs for a number of years.

The reviewer must evaluate the author's success or failure from two points of view: (1) How understandable is the result to the intended audience? (2) How faithful is it to the physicist's current picture of solids? On the whole, Holden has achieved his goal. His creation is quite readable and accurate; he gives some beautiful simple explanations of our theories of atoms and solids and the way they behave. While the subject matter sometimes becomes sophisticated, the treatment does not and the author does not hesitate to discuss subjects as elementary as powers of ten and the energy of springs. The reader should be able to obtain a good understanding of many of the concepts of modern physics starting from basic and simple ideas. In some areas (notably in magnetism) the author goes far back in history to introduce his subject in an intriguing way.

There are blemishes; many of these have arisen as a result of oversimplification or incompleteness. In discussing 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 sub-