

everyone when, in fact, they are somewhat obscure. The section entitled "Ligand-field Theory" includes an "out-of-the-blue" reference to Hund's rule that is in this category. At the very least a statement of Hund's rule should have been included. Second, the models given for some of the color centers in the alkali halides are several years out of date.

In summary, this book is an excellent introduction to those areas of solid-state physics that are becoming increasingly important for chemical applications.

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Math without meat

EQUATIONS OF MATHEMATICAL PHYSICS. By G. N. Polozhiy. Trans. from Russian. 543 pp. Hayden, New York, 1967. \$14.50

by George Weiss

One of the universal sins characteristic of publishers in both capitalistic and communistic societies is overkill. And one of the favorite targets is the subject of mathematical physics. Although there have been excellent treatments of the subject available for at least 40 years, books on the subject continue to appear at intervals that appear to be tending to zero. I do not want to imply that G. N. Polozhiy's book is not a good treatment of certain aspects of the subject, which indeed it is; rather there are other equally good treatments of the same subjects in many other textbooks.

If one were to characterize Polozhiy's book in a nutshell, it is a good, rigorous, 19th-century treatment of the subject. This treatment includes a rather complete catalog of techniques for solving all types of partial-differential equations in unbounded space and at least some of the methods for taking boundary conditions into account. It struck me as quite odd that the technique of separation of variables makes its appearance first on page 389. The coverage of variational techniques is quite skimpy; no account is given of numerical techniques, and there is in general little solace for the

reader who does not have a partial-differential equation amenable to exact solution. The Wiener-Hopf method and the class of problems to which it applies goes unmentioned although there is a chapter on integral transforms. Variational problems are given short shrift. On the other hand, there are some quite well handled topics, such as the idea of characteristics for hyperbolic equations and the asymptotic behavior of eigenvalues of Sturm-Liouville operators.

Although this is a good book for its treatment of some subjects, it would not be suitable as a text for a course in mathematical physics in an American department because of its important omissions of mathematical topics and because it lacks any real demonstration of how partial-differential equations are actually used in physics.

* * *

George Weiss is chief of the physical sciences laboratory at the National Institutes of Health and makes extensive use of partial differential equations in developing the theory and application of the ultracentrifuge.

Physics in one volume

HANDBOOK OF PHYSICS. (2nd edition) E. U. Condon, Hugh Odishaw, eds. 1626 pp. McGraw-Hill, New York, 1967. \$32.50

by Wolfgang Franzen

The second edition of E. U. Condon's and Hugh Odishaw's monumental one-volume compendium of physics follows the first edition by nine years. Extensive revisions and additions have been made in an attempt to keep the material up to date. This handbook is an heroic effort by one of the last "encyclopedic" physicists (Condon) to condense our increasingly specialized and fragmented science into a volume that one adult of reasonable muscular strength can lift with one hand out of a bookshelf.

Condon personally wrote 16 of the 92 chapters in the handbook. His contributions, on such diverse subjects as vector analysis, kinematics and dynamics of particles and rigid and deformable bodies, the theory of vibrations, electromagnetism, thermodynamics, molecular optics, quantum mechanics and atomic structure, and other subjects, are almost without exception models of clarity and of the

art of condensing much information into readable form. His example has been followed by many of the distinguished groups of contributors. To me, particularly well and conscientiously written appeared to be the chapters on "Wave Propagation in Fluids" by A. H. Taub, "Vibrations of Elastic Bodies" by Philip M. Morse, "Electric Circuits" by Louis Pipes, "Gaseous Conduction" by Sanborn C. Brown and J. Charles Ingraham, "Statistical Mechanics" by Elliott W. Montroll, "Infrared Spectra of Molecules" by H. H. Nielsen, and "General Principles of Nuclear Structure" by Leonard Eisenbud, G. T. Carvey and Eugene P. Wigner.

As one might expect in any compendium of this type, there is also a small number of weak chapters. In this connection, the chapter on "Electronic Circuits" appears inadequate, the ones on magnetic materials too qualitative, "Vacuum Technique" of doubtful value, "Fluorescence and Phosphorescence" outdated and overly empirical, "Atomic Spectra" not particularly enlightening, and the chapter on "Nuclear Reactions" almost completely lacking in references. These defects are more than balanced, however, by the generally high level of the remaining contributions, usually including large and relatively complete lists of references. The chapters by E. Richard Cohen and Jesse W. M. DuMond on "Fundamental Constants," "Nuclear Masses" by Alfred O. Nier, and "Nuclear Moment" by Norman F. Ramsey also contain very useful and extensive tables.

The opposing requirements of completeness and of being up to date cannot be successfully reconciled in any encyclopedia. For this reason, the chapters on the most rapidly changing subjects, such as the one on the "Physics of Strongly Interacting Particles," are not likely to satisfy any reader, through no fault of the author's. In fields that have attained a certain stability of subject matter and understanding, however, an encyclopedia should present as much concentrated information as possible, an aim that is largely though not completely achieved in this book, as indicated earlier.

In regard to the selection of topics, the weakest chapters are frequently the ones on technological subjects. Is it really necessary to include an elementary and old-fashioned chapter on

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"Electrical Measurements"? In the same class are the chapters on "Electronic Circuits" and on "Vacuum Techniques" mentioned earlier, as well as those on "Photometry and Illumination," and on "Accelerators." Such subjects might be reserved for a future handbook of applied physics, in which they could receive more complete attention.

The opposite conclusion might be drawn in regard to the chapters on branches of mathematics, where in a handbook of physics, a strong emphasis on applied mathematics (as this term is used by mathematicians), rather than on pure mathematics, would appear to be desirable. To be sure, there are very good chapters on "Analysis" and on "Numerical Analysis," by John Todd, on "Tensor Calculus" by Cornelius Lanczos, and on "Probability Theory" by C. E. Eisenhart and M. Zelen, but not all of the remaining chapters on branches of mathematics appear to be of comparable relevance to a handbook of physics.

This edition of the handbook contains a very extensive and carefully prepared index, with far more entries than the first edition. The typography and illustrations are excellent. On the whole, the publication of this revised edition of a highly regarded and useful book should be welcomed by the physics community, as well as by scientists generally.

* * *

Wolfgang Franzen is professor of physics at Boston University.

Phase shifts

VARIABLE PHASE APPROACH TO POTENTIAL SCATTERING. By F. Calogero. 244 pp. Academic Press, New York, 1967. \$11.50

by John L. Gammel

It is hardly necessary to review this delightful book in much detail. It can be read through very rapidly so that anyone interested in scattering theory will be able to judge its value to himself almost immediately.

The book starts with a derivation (from the Schrödinger equation) of a first-order differential equation for a quantity $\tan \delta(r)$ (the tangent of the phase shift resulting from a potential truncated at r , or, what is the same thing, the contribution to $\tan \delta$

resulting from that part of the potential lying between 0 and r), and similar equations for $\delta(r)$, or $S(r)$ [the S matrix $\exp(2i\delta)$], or the scattering amplitude $A(r)$. The advantage of the method is that it deals directly with a quantity of physical interest; namely, the phase shift, or at any rate a simple function of the phase shift. The method can be described as an imbedding method since the phase shift for many potentials (obtained by many different truncations of a single potential) are calculated simultaneously.

Then special subjects are treated: bounds on the phase shift and its variation with energy, Born approximation and a scheme for improving it, variational principles, simultaneous maximum and minimum principles, singular potentials, scattering by Dirac particles, scattering by nonlocal and complex potentials, multichannel scattering, poles of the S matrix and Levinson's theorem.

The author states in the preface that "... this method of discussing scattering phase shifts should be introduced in all elementary quantum mechanics courses that include a treatment of scattering theory." This statement may be true; I recommend that all teachers of such courses look at the material and form their own judgments.

It is more difficult to estimate the value of the method in advanced research. My guess would be that as a practical computing device, the method has no advantage over more usual techniques; in fact, $\tan \delta(r)$ is a spectacular function of r for some potentials and some energies as can be seen by inspecting the figures in the book. But this question is beside the point; the questions of principle that can be decided by the method are of more interest. Many interesting results on the poles of the S matrix and Levinson's theorem are obtained by elementary methods. I wondered if it might be possible to prove the convergence of the Padé approximants to the Born series for $\tan \delta$ by this method. This possibility presents itself because the first-order differential equation derived for $\tan \delta$ is a Riccati equation. No doubt other applications will present themselves to other researchers.

* * *

John L. Gammel is with Los Alamos Scientific Laboratory.

Toward a unified science of materials

STATISTICAL MECHANICS, THERMODYNAMICS AND KINETICS. By Oscar K. Rice. 586 pp. W. H. Freeman, San Francisco, 1967. \$12.50

by Herman A. Liebhafsky

In the preface to his *Statistical Mechanics*, J. Willard Gibbs wrote: "Moreover, we avoid great difficulties when, giving up the attempt to frame hypotheses concerning the constitution of material bodies, we pursue statistical inquiries as a branch of rational mechanics . . . Difficulties of this kind have deterred the author from attempting to explain the mysteries of nature." A successful fusion of statistical mechanics, thermodynamics, and kinetics—the consummation wished for above—would be a great step toward such an explanation, and it would be evidence that a single, unified materials science might someday exist. Fusion of the first two disciplines is well under way, but kinetics is certain to prove refractory because it deals with systems that usually change with time at rates that neither statistical mechanics nor thermodynamics can now reliably predict.

The author is Kenan Professor of Chemistry at the University of North Carolina. He has done distinguished work in each of the three disciplines in his book. Because of the difficulties associated with kinetics, it is fortunate that he has long been an authority in this field.

The book is intended primarily for chemists in their senior and graduate years. To an unusual and welcome degree, it bears the impress of its author. Again to an unusual and welcome degree, conclusions from statistical mechanics are compared with experimental results. Many searching questions and testing problems are included.

In most "statistical inquiries as a branch of rational mechanics," the approach to "rational thermodynamics"—another of Gibbs's phrases—is by way of Boltzmann's H theorem through the partition function and entropy to the Helmholtz free energy. The author, following the lead of W. F. GIAUQUE, in a sense reverses this approach in chapters 2 and 3. He begins with the Gibbs free energy, which is simply related to the