cialized, it has a great deal of appeal to physicists since it offers an insight into problems that go beyond celestial mechanics. A cosmic-ray physicist reading the discussion of Jacobi's integral and the zero-velocity surfaces will undoubtedly recognize the parallels formed by Störmer's theory of particle motion in a magnetic dipole field. Field theorists will see canonical transformations and regularization in a new and different aspect. Regularization is applied to collision orbits, which occur in spaceflight applications but hardly ever in the classical problems discussed in theoretical astronomy.

In addition to the more modern application of lunar and planetary trajectories, the volume discusses applications to the solar system, to cosmogony and to stellar dynamics. There are discussions of periodic orbits, stability libration-point problems, more theoretical topics such as Hamiltonian dynamics in the extended phase space and numerical explorations of the restricted problem. The volume is useful to physicists because it has a sufficient amount of mathematics but does not engage in mathematics for its own sake; the formalistic discussions are quite self-contained.

Each chapter has appended to it a set of carefully and interestingly written notes and references. There are more than 250 figures and many numerical examples. Some of the chapters have appendices with numerical results intended to aid in the solution of problems.

I find the last chapter, which discusses various modifications of the restricted problem, of special interest because areas for further research are introduced. Here one learns about such extensions as the three-dimensional restricted problem and the elliptic restricted problem, both of which have obvious application to the solar system. Although the three-dimensional restricted problem still possesses the Jacobi integral, the elliptic problem does not. But I would imagine that under many conditions of practical importance the Jacobi integral could be treated as an adiabatic invariant, with interesting consequences.

Finally, and with great pedagogic care, the author takes up Hill's problem, which is an important simplification of the restricted problem and of great usefulness in lunar theory.

This book is highly recommended to graduate students as well as to research workers in the field of theoretical astronomy. Physicists will find it useful also as a way of looking at a classical problem with many interesting similarities to modern problems.

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## Applying solid-state physics to chemistry

SOLID-STATE CHEMISTRY. By N. B. Hannay. 225 pp. Prentice-Hall, Englewood Cliffs, N. J., 1967. Cloth $6.95, paper $4.95

*by Paul W. Levy*

The phrase "solid-state physics" describes an area of current interest that could be well defined by almost any reader of PHYSICS TODAY. *Solid State Chemistry*, the title of the book being reviewed, is far less familiar even though the book's preface states that 5000 people work in this field. Any one- or two-sentence definition of solid-state chemistry must necessarily be imprecise. However, the following comment—it cannot be called a definition—may be useful in describing it: "Solid-state chemistry" refers to those aspects of solid-state physics that are applicable to what may be called "traditional chemistry," and those aspects of chemistry that provide some insight into traditional solid-state physics. Clearly one should not attempt to divide this overlapping area into physics and chemistry. Such divisions are made by man, not by nature.

Several applications of solid-state physics to chemistry could be cited. One of these that will be briefly described may become very important, both scientifically and technologically, in the near future. During the past two decades understanding of the electronic properties of solids has developed considerably. In particular, the bulk or interior electronic properties of semiconductors are now known to the extent that it is possible to "cook-book" transistors to specification. The electronic surface properties are reasonably well understood but to a lesser extent than the bulk interior properties. One can expect that the current work on surface properties of ultraclean crystals will eventually be extended to clean, pseudoclean, slightly contaminated, contaminated, somewhat dirty, dirty, and finally normal crystal surfaces. At each stage in this progression there should be a corresponding increase in the information on surface electronic properties. In particular the information on the interaction of absorbed, or chemisorbed, atoms with the various surfaces may develop to the point where one can "cook-book" specific catalysts. In a few cases it is possible to come close to this today. I doubt if anyone will dispute the usefulness of catalysts.

In addition to the content that is applicable to catalysts this book contains sections on almost all of the subjects needed for a cursory understanding of solid-state chemistry. This includes crystal structure, band theory, defects, imperfections, impurities and processes related to them. Also, there are sections on diffusion, phase changes, and an interesting recasting of the semiconductor-impurity–electron-hole interactions into terms that will be more familiar to chemists than physicists. After a discussion of applications to chemistry, the book concludes with a chapter on crystal growth and purification.

The author of *Solid State Chemistry*, N. B. Hannay, is well known in the semiconductor field, particularly as the editor of *Semiconductors* (Reinhold, New York, 1959). He has, according to the preface, adjusted the level of this new book to college seniors. However, anyone who has read, or taken a course, on the level of C. Kittel's *Introduction to Solid State Physics* (Wiley, New York, 1959) will be able to assimilate it readily. Even this degree of background may not be necessary since many concepts (for example, band theory, usually covered in beginning courses) are included in the introductory chapters. Thus this book is suitable for a wide variety of readers including those who may be relatively unfamiliar with solid state. It should be particularly useful for a chemical-applications part of a solid-state physics course, or perhaps a senior-level honors course in chemistry or physics.

Unfortunately there are minor faults that could have been eliminated by more careful prepublication review. Two examples will suffice: First, some concepts are introduced in a way that would make the student or nonspecialist reader think they are known by

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.

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## 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. Garvey 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