done) and electronics. Seven appendices present some mathematics, dimensional analysis, conversion factors, physical constants (in mksa units), the periodic table, and four-place log and trig tables. A 20-page index provides excellent access to almost every item in the book.

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Solid State Materials: Preparation and Properties, Vol. 1: Aspects of Crystal Growth

R. A. Lefever, Ed.

284 pp. Marcel Dekker, New York, 1971. $18.50

The usual review article is written by a specialist for other specialists, if not in his own field then at least in a closely allied one. There may thus be a brief introduction of fundamentals in a pedagogic fashion, followed by a detailed examination of the most recent boundaries of the field. Also often seen are reviews of a broad area of investigation intended for the nonspecialist, dealing with fundamentals as well as with the significance of recent results to other fields. Much rarer, however, are review articles that deal with the practical and theoretical details of a field for the semispecialist who might need a working acquaintance as distinct from an academic overview.

The solid-state materials area is a very broad one, and even a seasoned expert in some other corner of this area might always have wondered how, for example, one really would go about trying to explore the details of the flux growth of some specific compound. From his reading of the literature and from the brief description found in texts on crystal growth, he would, of course, already know the general principles and also how some specific crystals have been grown by this technique. But were he suddenly to come across some specific problem of crystal morphology or perfection he might find himself in some difficulty. It would appear that this is the type of reader for whom the three articles in Volume I of *Preparation and Properties of Solid State Materials*, subtitled "Aspects of Crystal Growth" have been written. The volume should also be useful to crystal users, who could gain insight into the tremendous variability of crystals—a concept rarely reflected in papers on crystal properties.

The approach taken is certainly a most desirable and needed one and it is refreshing to find realistic statements such as: ". . .approximately 50% of the experiments can be reproduced without change, another 20% can be reproduced when varying degrees of modification are introduced, while the remaining 30% are questionable at best" (W. Kunnmann, page 25); "The one striking thing about crystal growth experiments is the difficulties and hazards involved in making generalizations" (W. R. Wilcox, page 44)—itself a generalization, but one not at all difficult to accept, and "We have come a long way with a considerable speculation and little quantitative information" (A. B. Chase, page 262). The articles reflect the views of active workers writing in their areas of competence.

The brief 36-page article by Kunnmann (Brookhaven National Lab) on crystal growth by fused-melt electrolysis indicates the potentials of this technique and notes the lack of fundamental understanding of the high-temperature chemistry processes involved. The extensive review of the role of mass transfer in crystallization by Wilcox (University of Southern California) contains 116 equations used in this field. Most useful here is the compilation of some 516 references, including many recent ones through 1970. The article by Chase (Aerospace Corp.) "attempts . . .to characterize the crystal yield and quality obtained from simple flux growth experiments as related to growth mechanisms, defects, and impurities. . .". One might perhaps note redundancy in the 39 illustrations of this article.

It would be easy to point to occasional superficialities, specific omissions, differences of opinion as to significance, and so on, as indeed it almost always is. Yet this would be doing a disservice to a serious attempt to achieve a realistic approach to experiment and theory in a developing area. One can only hope that the editor, Robert A. Lefever (Supervisor of the Materials Division, Sandia) will continue this series with further useful volumes.

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A Quantum Approach to the Solid State

P. L. Taylor

322 pp. Prentice-Hall, Englewood Cliffs, N. J., 1970. $13.95.

The development and growth of modern theoretical solid-state physics has proceeded along two basic directions over the past two or three decades. One direction is the quantum field theory or many-body approach, which had its origins way back in the birth of quantum theory through the work of Albert Einstein and Peter Debye on the specific heats of crystals. Later

the work of Lev Davidovich Landau on elementary excitations and their interactions proved a milestone in the understanding of strongly interacting many-particle systems. The other direction of growth has been the increasing precision of characterisation of the simple excitations (phonons, magnons, electron states) for real crystals with the development, largely through the use of computing, of lattice dynamics and of electron band theory.

In his book, *A Quantum Approach to the Solid State*, Phillip Taylor follows the first direction in a text designed to give the beginning graduate student in experimental solid-state physics an acquaintance with the basic theory of the elementary excitations in solids and quantum fluids, and a chance to gain some idea about the effects of their interactions. A chapter on energy-band theory also provides a brief introduction to this branch of the subject.

A somewhat more recent and philosophically profound development of the many-body aspects of solid-state theory has been the formulation of the theory of measurements in condensed matter (thermal, magnetic and electrical measurements, neutron and light scattering, NMR, and so on) directly in terms of microscopic correlation functions, thus providing a fundamental link between the experiments and the elementary excitation concepts (and more recently to critical phenomena) analogous to the formulation of the S-matrix theory of elementary particle interactions by Werner Heisenberg in the 1940's.

My main criticism of the book is that it does not provide this systematic theoretical link between the techniques of measurement in solid-state phyyics and the concepts developed in the book. Thus the Kubo formula is mentioned but not derived, and the Van Hove–Plaezek formula expressing neutron-scattering cross sections in terms of a correlation function does not appear although this technique provides, in effect, the most direct way of observing elementary excitations (at least for phonons and magnons) and is an important conceptual link for the graduate student. With this reservation, Phil Taylor's book fulfills a need for a book written from an up-to-date point of view with a good deal of systematic and self-contained detail. Because the book is taken from a course designed to be taught concurrently with a graduate quantum-mechanics course, Taylor does not give a full-blown derivation of many-body perturbation theory, but restricts his use of the quantum-mechanical tools needed to low-order perturbation theory. The topics covered include the electron gas, liquid helium, superconductivity and the normal-state conductivity of metals. A final chap-

ter on perturbation theory to infinite order provides an introduction to many-body theory through a heuristic discussion of a number of specific examples.

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Dynamics of Nuclear Reactors

D. L. Hetrick

542 pp. Univ. of Chicago Press, Chicago, Ill., 1971. $18.50

Reactor physics is very much an applied subject, and it has grown over the last thirty years without much of a formal framework. It is not surprising then, that it is full of *ad hoc* solutions that are very confusing to beginners, and nowhere is this more evident than in the sub-field of reactor dynamics. David L. Hetrick has taken the more basic part of that subfield and has set out the underlying general principles and collected and discussed the mathematical techniques in a logical and comparative way.

He mainly restricts himself to the "point-source," reactor-as-a-whole, approach, and he deals with the effects of a wide variety of reactivity perturbations. The problems lie in the ground common to reactor physics and reactor control and the two chapters on linear and nonlinear stability are particularly good. The book is suitable for graduate students in nuclear engineering and just possibly at an earlier level for students who have decided on their specialization. It has the commendable habit of summarizing the methods before they are developed.

The solutions are essentially analytical and they are best suited to explain the behavior of small, rather simple, systems. The designer of power reactors has to find "approximate solutions to exact problems rather than exact solutions to approximate problems," and he is faced with the terrible spatial interactions of control rods, booster rods, temperature coefficients, void effects, xenon transients, and so on. In a balanced course for future designers the material in the book should be supplemented with the more numerical techniques that are needed for spatial details.

I have two minor criticisms. Firstly, in view of the precisely stated boundaries and comprehensive coverage, the words "point reactor" and "analytical methods" might well have been included in the title. Secondly, the last chapter contains a few pages on neutron pulses and waves and a very brief mention of the methods for space-dependent kinetics, and I think that it could have been omitted. However, I hope that someday soon the author will expand it into a review of the numerical, computer-oriented, techniques that are needed for the spatial problems with large numbers of variables.

I enjoyed reading the book and I recommend it strongly.

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Introduction to Quantum Chemistry

C. R. Gatz

550 pp. Charles E. Merrill, Columbus, Ohio, 1971. $15.95

Quantum chemistry can be loosely defined as the broad array of quantum-mechanical techniques—ranging from semi-empirical to *a priori*—employed by chemists in interpreting and predicting properties of molecules in their isolated, aggregate and reactive states. The methods of quantum chemistry are fast becoming indispensable for theoretical and experimental chemists alike. Thus it is vital that all chem-