

quality of the actual happenings and the deadly dullness of the writing.

If you want to join the game you have to begin with this book. Here are some basic rules of serious play that I have attempted to honor and would like to promulgate:

If we use circulating currents, we estimate the electrical conductivity of our model.

If we use exotic species, we compute their lifetime and production rate.

If we draw power out of the ball, we put the power in.

So onward all to the contest, and let the cry be heard, "Remember the Virial Theorem!"

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Physics for Biology and Pre-Medical Students

M. Burns, S. G. G. McDonald

614 pp. Addison-Wesley,
Reading, Mass., 1970. \$9.50

This is one of the few physics texts at present that is specifically addressed to the large and growing audience of pre-medical and biology students. It was three years in development at the University of Dundee by Senior Lecturers Desmond M. Burns and Simon G. G. MacDonald (the latter being Dean of the Faculty of Science and author of *Problems and Solutions in General Physics for Science and Engineering Students*, Addison-Wesley.) The result is a fairly coherent, well designed book with very broad coverage.

The authors have "attempted to give a basic understanding of the relevant principles of physics, illustrating these, where possible, with current examples of their use in biology and medicine." Understanding may not be as easy to give as illustrations, but the examples themselves are worth the price of the book. There are many examples of contributions by physics to advances in biological fields and medical technology, with which many physicists are not familiar. Physicists who have adopted another text in teaching life-scientists should use this book as a reference, both for themselves and their students. Unfortunately the book contains almost no references.

Formulas are of great importance in this book. There are about 400 numbered equations plus many unnumbered ones. Most of the problems test the use of formulas. Of the 500-plus problems, 90% have numerical answers (which are given at the back), 5% are proofs and only about 5% ask for explanations. There are numerous examples worked out.

It is obviously hoped that the student will gain a reading knowledge of mathematics and develop a facility with algebra, trigonometry and perhaps calculus. Simple calculus is developed with commendable brevity, lacking only the idea of the extremum. Oddly, the derivations of formulas for the energy stored in a capacitor or inductor say nothing of integrals. Vectors are discussed, but the dot and cross products are not. Good use is made of rotor diagrams. A good chapter on statistics, complete with clinical examples of various tests, seems out of place here except for use by graduate students. There is emphasis on dimensional analysis, mainly to justify the form of equations pertaining to viscosity that are used effectively in several different sections. All of this means that the mathematical level required of students is high.

The writing is good and impressively concise, but the coverage lacks depth. The broadside approach is excellent; students meet the motion of charged particles in electric and magnetic fields as examples of dynamics twenty chapters before those fields are studied. However, the molecular viewpoint, introduced early, is not used throughout to help interpret phenomena and to contribute to students' understanding. Too much is said to be a consequence of energy conservation (for example, even the minimization of the surface area of a liquid). At best, this adds little to one's comprehension although it does justify a formula efficiently. The style does not convey physical understanding or physical intuition, but it may appeal to students as being clear cut.

There is little humor or excitement in the book. Even when considering the possibility of wedding ultrasonics with optical holography to construct a three-dimensional image of the inside of the body, the tone is reserved. Seldom is there wonder. Experiment plays no role except as arbiter assuaging doubt.

There are 36 chapters. The first third of the book deals with mechanics and heat. Wave motion and optics constitute more than one quarter of the book. At the end of this the student is supposed to be equipped with the background necessary to understand and appreciate an electron density map as obtained by x-ray diffraction analysis. Chapters on the ear, the eye and on "specialist microscopy" make informative reading. A quarter of the book is on electricity and magnetism including conduction in solids and liquids, and ac circuits. There is much of interest on electrical effects in the body and on the use of magnetic fields in connection with blood flow. An attempt to illustrate impedance matching is a disaster, but the section ends on a sensible note of caution. The last sixth of the book treats atoms, tracers and x-rays (all well

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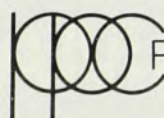
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done) and electronics. Seven appendices present some mathematics, dimensional analysis, conversion factors, physical constants (in mksa units), the periodic table, and four-place log and trig tables. A 20-page index provides excellent access to almost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

DAVID C. SUTTON
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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

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