

physics of internal reflection. There is a table of contents and a subject index that make the material readily accessible. The photographs and diagrams are superb.

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Joseph G. Hoffman is professor of physics specializing in biophysics at the State University of New York at Buffalo.

Electron technology

SPACE-CHARGE FLOW. By Peter T. Kirstein, Gordon S. Kino, William E. Waters. 509 pp. McGraw-Hill, New York, 1967. \$22.50

by J. Arol Simpson

Wandering through the scientific-technical community in obvious disarray is a small band. Members carry tattered banners identifying themselves variously as "electron opticians," "electron-gun designers," "accelerator engineers" and even "electron physicists." Since they have created useful artifacts such as the electron microscope, the family of microwave beam tubes, and that heart of the television industry, the cathode-ray tube and its derivatives, the band is tolerated by both the electrical-engineering and the physics community. The engineers find writings by this small group rather arcane, and the physicists find the writings rather "infra dig" and lacking in elegance and generality, and worst of all, solidly wedded to classical physics. *Space-Charge Flow* will stand for a long while as an honored totem for this nameless band and as a new landmark telling others of the progress the band has made. The book consists of a unified treatment of the mathematical methods that have proved useful for the design of dense electron beams and the guns to produce them. The book is in a sense a greatly expanded and updated version of J. R. Pierce's classic *Theory and Design of Electron Beams* (D. Van Nostrand, New York, Second Edition, 1954). The mathematical sophistication of the new work reflects the progress made in almost 20 years since the first edition of Pierce's text. Much of this progress is the result of the authors' own efforts although no parochialism is evident. Some of the methods presented have relevance for the design of electron spectrometers and microscopes even though the emphasis is on cases where space-charge forces are strong. Treatment

of the methods applicable to use on large-scale digital computers also fills a very definite need.

The book is admirably organized with excellent chapter introductions and summaries that separate for the reader the "trees from the forest." It is a book that is essential for anyone who, for whatever reason, finds it necessary to join the wandering band, even for a short time. The book also will be of interest to applied mathematicians who are interested in the progress being made in the solution of the barely tractable problems that arise in today's technology.

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J. Arol Simpson, Chief, Electron Physics Section, National Bureau of Standards, has been working with electron beams for 20 years and says that he is "still hoping some day to understand them."

Life insurance for the nuclear age

PRINCIPLES OF RADIATION PROTECTION: A TEXTBOOK OF HEALTH PHYSICS. Karl Z. Morgan, James E. Turner, eds. 622 pp. Wiley, New York, 1967. \$13.95

by John W. Baum

This book is addressed to the students and professional workers who concern themselves with the multiple facets of radiation protection or health physics in the nuclear age. The book has been in preparation for roughly 20 years, has 19 authors, and covers a profession that attracts persons with such diverse backgrounds as physics, biology, chemistry, mathematics and engineering. The subject matter included in a text that prepares such people for their careers must be equally diverse and must present a principal challenge to authors in this field; no doubt this difficulty is part of the explanation for the length of time and number of authors required.

Karl Z. Morgan has been one of the principal leaders in the field since its beginning. His contributions are well illustrated by the chapters he wrote himself. The other authors are all recognized authorities in one or more aspects of the profession of health physics.

Morgan's first chapter on the "History of Damage and Protection from Ionizing Radiation" is very thorough and provides an excellent introduction for newcomers, as well as a detailed

survey and summary useful for those familiar with the field. Both natural and man-made sources of exposure are tabulated and discussed in relation to early recommendations for radiation protection. This chapter is followed by 15 others on interaction of radiation with matter; principles of radiation dosimetry, detection and measurement; methods of calculation of dose from both external and internal sources; radiation biophysics and radiation biology; maximal permissible exposure levels; and prevention of criticality accidents.

R. H. Ritchie and G. S. Hurst describe well the physical basis and ionization methods of radiation dosimetry, including their important development of "a general principle of radiation dosimetry." W. S. Snyder's chapter on internal exposure outlines methods of dose calculation for various organs as well as the relation of these doses to the setting of maximal permissible concentration values for air and water. The chapters on radiation biophysics and radiation biology provide excellent up-to-date summaries of developments and thinking in these areas. An additional chapter on evaluation of human-exposure data includes an important section on medical management of radiation overexposure.

Other subjects covered are, in general, treated thoroughly and in a manner that should serve well the needs of the intended audience. The approximately 1000 references to the technical literature add considerably to the value of the book for those wishing greater depth or additional information on specific subjects. Similarly, about 300 questions and problems following the chapters serve a very important function in the academic use of the book.

The book emphasizes principles of physics and radiation biology and tends to avoid many of the practical problems of an engineering and managerial nature. For example: x-ray safety, neutron shielding, respiratory protection, laboratory design, bio-assay and whole-body monitoring techniques, atmospheric dispersion, waste disposal and related environmental problems and surveys, and problems peculiar to accelerators, reactors, and chemical-processing plants all receive little attention. Also, the important regulatory roles of the US Atomic Energy Commission (AEC), the Department of Transportation, and state agencies are not discussed and related

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to recommendations of the national and international groups establishing standards in radiation protection.

Technically the book is excellent. Only a few errors were noted during a first reading. The book is intended primarily as a textbook of health physics at the graduate level but will certainly be used widely by practicing health physicists as well.

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John W. Baum is Research and Development Group Leader in the Health Physics Division at Brookhaven National Laboratory. His 14 years of experience in health physics include several years of applied work in industry and four years of teaching health-physics courses at the University of Michigan.

Mathematically bound

INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS. By Rene Denneweyer. 376 pp. McGraw-Hill, New York, 1968. \$13.75

by Peter L. Balise

In spite of their great importance partial-differential equations are one of the mathematics subjects that often cannot be squeezed into the science or engineering curriculum. However, the author teaches a senior course for mathematics and nonmathematics majors and his book has evolved from this course. Compared with several other treatments of similar purpose, the work is little oriented towards physical situations, apparently reflecting the author's primary interest in mathematics more than his considerable industrial experience.

Instead of starting with the classic vibrating-string introduction, the book commences with classification, definitions and a treatment of first-order equations, including an existence and uniqueness proof for the Cauchy problem. In this and the following analysis of linear second-order equations, Denneweyer discusses characteristic curves and surface with notable clarity. Elliptic equations are considered next, especially Laplace's and Poisson's equations, but with negligible attention to the major role of these equations in physical situations. Not until the middle of the book is the wave equation treated, including three-dimensional, cylindrical and spherical waves. The last chapter deals with the heat equation, but no

mention is made here of mass diffusion.

Other omitted topics of importance in applications are conformal mapping, wave propagation in terms of complex exponential parameters, and numerical methods. Thus the book appears an unlikely choice for a course strongly directed towards physical problems,

Lab manuals: telling it like it is

DISCOVERY IN PHYSICS. By Leonard H. Greenberg. 239 pp. W. B. Saunders, Philadelphia, 1968. Paper \$4.75

by James B. Kelley

This is indeed a new type of "laboratory manual" because it is actually much more. Probably no part of a laboratory science can be more boring or seem more useless to a student than the laboratory part. The "cook-book" experiments (an old-fashioned cook book, at that!) usually prove little even to the interested science student, let alone the poor student who is taking the course to fulfill a graduation requirement.

What Leonard Greenberg of Saskatchewan University has attempted here is interesting, and in the hands of the right instructors could do a great deal to make laboratory work more challenging. Instead of following the usual procedure of going along the mechanics-heat-sound-electricity-optics-modern-physics path in what is always a hopeless attempt to keep laboratory and lecture together, he has set up his laboratory as though it deserved to stand on its own feet. And this is as it should be. The introduction he has written and the table of contents give the tip-off of what is to follow.

Actually what most laboratory courses in physics fail to realize completely is that such courses were not designed to measure once more the value of g or some other such thing, but that the laboratory experiments were (at some distant time, we hope) designed to show what experimental physics is all about. As the modern idiom would have it: "The laboratory should show it (experimental physics) like it is." Instead of studying errors, one does an experiment and then sees what happens; one learns, at least a little bit, of why we have experimental

but its soundly presented mathematics and ample exercises suggest it as a good text for mathematics courses.

* * *

The reviewer, professor of mechanical engineering at the University of Washington, teaches courses emphasizing the commonality of mathematics in different physical situations.

science and what it can and cannot do. We find, for example, Ohm's Law combined with apparent depth in related experiments. Resistors, rolling objects and chance are all combined in one section. And that's the way physics is; it is not a neatly compartmentalized subject that can conveniently be broken down into discrete (and unrelated?) parts.

Presentation of data, laboratory-record bookkeeping, graphical analysis of experimental data and so on are all here. And the important fact is that these sections are presented in relation to experiments the student is doing and are thus made a real part of the course.

The title of the book is itself the best indication of Greenberg's approach, "Discovery in Physics." This is what a laboratory should be, a discovery of the fun and adventure involved in the experimental process.

* * *

James B. Kelley, professor of physics at Marquette University, specializes in electromagnetism and electrodynamics.

On peace and people

PUGWASH—THE FIRST TEN YEARS: HISTORY OF THE CONFERENCES OF SCIENCE AND WORLD AFFAIRS. By J. Rotblat. 244 pp. Heinemann, London, 1967. 36s.

by Peter G. Bergmann

The Secretary General of the Pugwash Continuing Committee has prepared a well-documented historical record of the Pugwash movement and of the Pugwash Conferences that extends through the first months of 1967. The narration is contained in the first 74 pages; the appendices consist of the so-called "Russell-Einstein Manifesto," the formal statements issued after each