BOOK REVIEWS

Field Theory of Guided Waves. By Robert E. Collin. 606 pp. McGraw-Hill Book Co., Inc., New York, 1960. $16.50. *Reviewed by Howard Chang, Hughes Research Laboratories.*

GRADUATE students of science and engineering today must master an impressive number of novel and difficult subjects compared with the intellectual fare in which their teachers had to demonstrate competence before they were allowed to repair to the sheltered ranks of university life. This great disparity between the contemporary graduate curriculum and that of a generation ago is essentially a result of what deans of graduate schools proudly refer to as "the revolution in science and engineering that has occurred since the end of World War II". If this were the entire story, the current crop of graduate students would be trapped in the academic treadmill until their energies and funds were exhausted and they would never get their coveted degrees. Luckily, there is a very important new boundary condition working in their favor: the large number of excellent textbooks that have appeared since the war's end. In 1945, there were practically no good textbooks in atomic physics, nuclear physics, quantum mechanics, solid-state physics, aerodynamics, fluid mechanics, communication theory, guidance and control, network analysis and synthesis, statistics, numerical analysis, integral equations, and game theory. Today, there is a plethora of textbooks on these subjects, and one is faced instead with the problem of having to discriminate between the outstanding, the mediocre, and the poor textbook.

An excellent case-in-point is Professor Robert Collin's lucid and useful textbook, *Field Theory of Guided Waves*. From the late thirties through the years immediately following World War II, the propagation of electromagnetic waves in hollow waveguides, inhomogeneously filled waveguides, surface waveguides, and periodic waveguides, the use of variational methods to study discontinuities in waveguides, and the use of integral transform and function-theoretic techniques to solve boundary-value problems received the attention of some of the best applied mathematicians and physicists and were rightfully considered the subject matter of research papers. Today, such topics and techniques are regarded as old hat and are taught to graduate students in an almost blasé tone. Senior or first-year graduate textbooks in electromagnetic theory are legion. A very serious lack has been a comprehensive and readable account of guided-wave theory which might be suitable for use as a graduate textbook. Until now, the mathematical techniques and the detailed (approximate) solutions of complicated problems in this field were to be found only by laboriously searching the literature. With the appearance of Professor Collin's textbook, those interested in guided electromagnetic waves have a very reliable and valuable reference to help them acquire, in a minimum time, a very clear and up-to-date understanding of the basic theory and mathematical techniques necessary to work actively in this field.

The background and maturity assumed of the reader are minimal: a good course in applied mathematics, such as Pipes' *Applied Mathematics for Engineers and Physicists*, and a familiarity with Maxwell's equations of the level of *Fields and Waves in Modern Radio*, by Ramo and Whinnery. With this background, no student should experience any difficulty in following the presentation. A good test which will help a student decide whether he is ready for this book is to look over the skillfully compiled 28-page mathematical appendix. Only if the material looks familiar and the student understands most of it is he ready to embark on an exciting tour of the field theory of guided waves.

A review of the basic elements of electromagnetic theory necessary for the subsequent development of propagation in various types of waveguides and artificial dielectrics is given in Chapter 1. Then, taking a cue from Newton, who said, "In instruction, example is much better than precept," the author works out many interesting problems in considerable detail. Some of them are the transmission of waves through dielectric sheets and anisotropic dielectric media, strip-line characteristic impedance by the Schwarz-Christoffel and variational methods, dielectric-slab loading by the Rayleigh-Ritz method, the excitation of waveguides by probes, loops and apertures, inductive and capacitive diaphragms in waveguides, periodic structures with periodically varying electrical properties and with periodic boundary conditions, surface waveguides, and artificial dielectrics.

This reviewer is partial to books on electromagnetic theory which stress the electromagnetic field. Hence, he likes the author's emphasis on field solutions in contrast to a description of microwave structures in terms of equivalent-circuit parameters. Because electrical engineers like to think in terms of equivalent-circuit elements and because the final results are often better interpreted in such terms, a sufficient amount of microwave circuit theory has been included in order to make possible a clear and logical interpretation of field solutions in terms of equivalent circuits.

The outstanding feature of this book is the frequent and ingenious use of the Green's function technique in the solutions of problems. Both the theory and applica-

tion of Green's function are developed very carefully and clearly. The well-conceived problems at the end of each chapter help to supplement the theory of that chapter. The value of the book is also considerably enhanced by the numerous references at the end of each chapter.

It is safe to say that this book will enjoy a very wide sale and use and that it will shortly become a classic along with Stratton's *Electromagnetic Theory*. Professor Collin is to be congratulated for such a definitive job of presenting the field theory of guided waves to the harassed graduate student.

The Fundamental Atomic Constants. By J. H. Sanders. 88 pp. Oxford University Press, New York, 1961. Paperbound $1.60. *Reviewed by William F. Meggers, National Bureau of Standards.*

BECAUSE physical measurements are constantly improving and atomic information is rapidly increasing, we must expect new books on atomic constants, atoms, and particles. Unfortunately, most of them are out of date before they are printed.

The Fundamental Atomic Constants is an erudite but brief description of direct and indirect experiments and calculations leading to the presently accepted values (1955) of the electronic charge e, Avogadro's number N, the Faraday F, Planck's constant h, the specific charge of the electron e/m, the ratio h/e, the Rydberg constant R, the masses and magnetic moments of the electron and proton, and the ground states of hydrogen and deuterium. The velocity of light is discussed in greater detail because it is the constant directly measured with the highest precision (1 ppm). References are given to 193 pertinent papers, but an important verification of the accepted value of the Rydberg constant [William C. Martin, Phys. Rev. **116**, 654 (1959)] is omitted. This booklet was written too soon to report that the meter has been defined in terms of Kr^{86} wavelengths and that all atomic weights are now based on $C^{12} = 12.0000$ instead of $O^{16} = 16.0000$, improvements that will require further revision of some of the so-called "constants" of physics. In any case, this booklet will be a good guide for graduate physics students or anyone interested in constants.

Theoretical Physics in the Twentieth Century. A Memorial Volume to Wolfgang Pauli. M. Fierz and V. F. Weisskopf, eds. 328 pages. Interscience Publishers Inc., New York, 1960. $10.00. *Reviewed by Nandor L. Balazs, Princeton University.*

THIS volume is a beautiful memorial to Wolfgang Pauli and a reminder of the fragility of human fate. As the editors relate, several years ago a volume was planned to celebrate the sixtieth birthday of Pauli; the aim was to summarize the progress in those topics of physics which were near to Pauli's heart, and to discuss Pauli's influence on the development of physics during the 1930's. However, what started as a celebration turned into a memorial with Pauli's untimely death. This change in the course of events makes it understandable that the only contributions which deal with Pauli himself are a brief preface by Niels Bohr and a bibliography of Pauli's papers by C. P. Ens, since no epitaph can be written for a living person.

"Man soll keine Irrlehren verbreiten" was one of Pauli's favorite remarks and most contributions were written in this spirit. R. Kronig, W. Heisenberg, and B. L. van der Waerden deal with the early history of quantum mechanics and the exclusion principle. The articles which deal with physics itself fall in several classes. G. Wentzel gives an account of quantum field theories until 1947; the elimination of divergences from quantum field theory is discussed by F. Villars; R. Jost's article is a magnificent exposition of the relation between the exclusion principle and the Lorentz group; the theoretical and experimental developments concerning the neutrino and the nonconservation of parity is the object of C. S. Wu's note; L. Landau contributes a terse discussion on the fundamental problems one encounters in field theories with strong interactions. (There is a remark by Landau on page 246 which could reflect not only his but Pauli's attitude as well: "The brevity of life does not allow us the luxury of spending time on problems which lead to no new results.") H. B. G. Casimir and R. E. Peierls each contribute on solid-state physics. V. Bargmann describes Pauli's work in relativity, omitting, however, one of Pauli's basic contributions to unified field theories, to wit, his brief remark: "What God hath put asunder no man shall join."

Advances in X-Ray Analysis, Volumes 1, 2, 3. Conf. Proc. (Denver, Colo., Aug. 1957, 1958, 1959, respectively). William M. Mueller, ed. Vol. 1, 494 pp. Vol. 2, 359 pp. Vol. 3, 376 pp. Plenum Press, Inc., New York, 1960. Vols. 1 & 2, $8.50 each; Vol. 3, $12.00. *Reviewed by H. A. Liebhafsky, General Electric Research Laboratory.*

IN 1951, Professor Fankuchen was on the summer faculty at the University of Denver, and his presence led to the one-day symposium on x rays out of which has grown the Annual Conference on Applications of X-Ray Analysis, the eighth conference having been held in 1959. The volumes under review are a partial record of the conference proceedings, one for each year as indicated above. None of the volumes contains all of the papers presented at a conference, but so great is the variety of applications in each case that the omissions do not seem serious.

The scope of the conferences is widening, and it should soon include all ways of applying x rays to yield information and all the equipment this requires. Volume 3 not only contains papers dealing with the determination of elements by methods based on x-ray absorption and emission, but it also includes a paper on microscopy by total reflection of x rays, several on diffractometry