

The text would be suitable for a course for advanced undergraduates if the chapters on the electromagnetic field and on quantum mechanics are not used, and the book also would be suitable for a graduate course if it is used in its entirety and is supplemented by the instructor. It can be well recommended as a textbook and would certainly be useful reading for graduate students and working physicists as a self-study introduction to special relativity.

* * *

The reviewer is responsible for the application of optics to advanced-dimensional measurement systems at the Automation and Measurement Division of The Bendix Corporation, Dayton, Ohio.

Handbook of radio-wave propagation

ENCYCLOPEDIA OF PHYSICS, Vol. 49/2, Geophysics III, Part II. S. Flügge, ed. 596 pp. Springer-Verlag, New York, 1967, \$42.00

by Jules Aarons

Predominately a monograph on radio observations of the ionosphere, this volume of the *Handbook of Physics* fulfills its title in part; it delves with great detail into the physics, the experimental equipment and the data of its subject matter. The 546 page section on "Radio Observations of the Ionosphere" is jointly written by K. Rawer of the Ionospheric Institute of Breisach, Germany and by K. Suchy, who wrote his section when he was at the University of Maryland. The second article in the volume (approximately 50 pages) by S. Matsushita of the National Center for Atmospheric Research and the University of Colorado is on "Lunar Tides in the Ionosphere."

To graduate students and beginning research workers in the field, "Radio Observations of the Ionosphere" is a second book; it must come after mastery of such volumes as Ratcliffe's *Physics of the Upper Atmosphere* or at a more elementary level, Davies's *Ionospheric Radio Propagation*. Suchy, who is listed as the principal author of the introductory theoretical section, has developed his subject matter very completely. The advanced student can utilize the text in theoretical studies. Rawer, who has ranged in his research from experi-

mental observations and instrumentation of rockets to synoptic studies of ionosoundings, describes in great detail both the theory of individual distinct experiments, the equipment used and the resulting data. At times the details wander into such items as the schematics of pulse-power generators and resulting wave forms at specified power lugs (with photos); at this stage the handbook nomenclature is carried too far. At other times, however, the detailing is important; rather than presenting an idealized freehand drawing, for example, the authors have shown particle precipitation as a function of latitude and particle energy.

From the viewpoint of those who use a handbook for often needed graphs, diagrams and tables, this volume does not satisfy. The material is not oriented for the nonspecialist.

For advanced students or those seeking details on a facet of radio-wave propagation, the volume is excellent. A listing of symbols, general references and an excellent index make up a well-edited volume. However, the English is faulty; it appears as if there were no editor to "monitor" the grammar. Many sentences are awkwardly formed ("A complete theory is not yet existing"), but this fault detracts only slightly from the erudition of the text.

The review by Matsushita is careful and succinct. The author, a leading expert in ionospheric current systems, has written an excellent review paper on lunar tides in the ionosphere.

* * *

The reviewer is a senior scientist in the Ionospheric Physics Laboratory of Air Force Cambridge Research Laboratories.

For relativists and cosmologists

RELATIVITY THEORY AND ASTROPHYSICS, PART 1: RELATIVITY AND COSMOLOGY. Conf. Proc. (Cornell, July-Aug. 1965) Jürgen Ehlers, ed. 289 pp. American Mathematical Society, Providence, R. I., 1967. \$9.40

by Wolfgang Rindler

In the summer of 1965 some 30 fortunate graduate students and recent PhD's met at Cornell for the Fourth Summer Seminar on Applied Mathematics, organized by the American Mathematical Society. Students and graduates were joined by a distin-

guished group of lecturers. The backgrounds of the participants were divided between relativity and astrophysics, and the intention was to exhibit and further stimulate the already considerable interaction between these two fields of research. The three-volume record of the formal lectures, actively and ably edited by Jürgen Ehlers (his excellent introduction makes it hard for a reviewer to be original), attests to the beautiful job that was done. We are concerned here with the first volume on relativity and cosmology; the other two deal with galactic and stellar structure respectively. These lectures will hardly serve as a substitute for a textbook, although Alfred Schild's ten-lecture introduction to modern general relativity (occupying over a third of the book) comes closest to doing so. On the whole, this volume could be regarded as a "sampler" of modern activity in relativity and cosmology, slanted toward astrophysics. It should be of great benefit to students who wish to pick up basic ideas quickly and authoritatively, often brilliantly presented and always well-referenced. Teachers, too, should be interested in these methods of presentation.

Schild discusses very clearly and with the aid of over 30 diagrams such important topics as Lie derivatives, Killing vectors, Fermi coordinates, Kruskal's extension of Schwarzschild space, the contributions of the various terms in the metric to the "crucial effects," the deduction of the field equations from a variational principle and the deduction of the law of motion from the field equations (with a particularly elegant application to spinning test particles—soon, perhaps, another "crucial" effect). Also covered are such prerequisites to the study of gravitational radiation as jump conditions and the Cauchy problem, the weak-field approximation, spinors and Petrov classification. I was baffled by only one minor item, namely the unusually strong formulation of the equivalence principle as relating whole world *tubes* (rather than just *cubes*) with similar objects in Minkowski space.

The book continues with two short lectures on new observational tests of general relativity. In the first lecture, Leonard Schiff discusses orbital gyroscopic precession (a test originally proposed by him in 1960), the second-order stellar red shift (concluding that this is not only unfeasible but uninter-

QUANTUM PHYSICS SERIES

Education Development Center. A set of six film loops, \$110.00; individual film, \$20.00. Available February, 1969.

This important series represents a link between theory courses and laboratory work and will enable the student to gain a more intuitive feeling for quantum phenomena. The films visualize the time-development of wave packets in various one-dimensional environments. In the scattering sequences, the student can easily picture the continuity of the probability density and its slope at the boundaries of potential wells or barriers, as well as constructive and destructive interference of the reflected and transmitted packets.

CONCEPTS OF THE UNIVERSE

Paul W. Hodge, Associate Professor of Astronomy, University of Washington. Approx. 150 pages. Cloth cover, \$4.95; soft cover, \$2.95. Available April, 1969.

Brief, informal, and stimulating, the book is designed to provide the reader with a simple and graphic guide to the universe as a whole and to describe some of the concepts which astronomers use to understand it. The book concentrates on the universe as a whole—the universe itself, superclusters and clusters of galaxies, and the galaxies of stars. It is completely up-to-date and amply illustrated.

FUNDAMENTALS OF ELECTRICITY AND MAGNETISM, Second Edition

Arthur F. Kip, Professor of Physics, University of California, Berkeley. 512 pages. Off Press.

A major revision of the second volume in the *McGraw-Hill Series of Fundamentals of Physics*, this new edition presents an introductory course in classical electric and magnetic theory and provides new material on development of divergence and curl, including a display of the use of vector operators. Among the other special features: a more thorough development of the use of complex numbers; a new chapter on special relativity and its connection with electromagnetism; new material on semiconductor devices.

INTRODUCTION TO MODERN PHYSICS, Sixth Edition

F. K. Richtmyer; E. H. Kennard; and John N. Cooper, U.S. Naval Postgraduate School. *International Series in Pure and Applied Physics*. 752 pages. Available April, 1969.

Maintains the classic, historical features of the earlier editions while up-dating the material on solid state physics and nuclear physics. New features include new material on quantum statistics, four-vectors in relativity, and elementary wave mechanics, plus shorter and more teachable chapters.

INTRODUCTION TO PHYSICS FOR SCIENTISTS AND ENGINEERS

Frederick Bueche, University of Dayton, 768 pages. Available April, 1969.

For the calculus-level university physics course, this new text contains a realistic selection of topics whose treatment insures that both modern and classical physics can be covered in a three- or four-semester course. Although the text is moderately rigorous and sophisticated, care is taken at every step to make the results physically reasonable.

INTRODUCTION TO PHYSICS AND CHEMISTRY, Second Edition

Arthur Beiser, formerly with New York University; and **Konrad Krauskopf**, Stanford University. 720 pages. Available April, 1969.

Presents a major reorganization of topics and the addition of interest-stimulating essays on various subjects. New pedagogical aids include chapter-end glossaries, multiple-choice exercises, questions, and problems. Marginal notes appear throughout, and a mathematics refresher is included as an appendix. Two- and four-color artwork is also featured throughout.

ELEMENTARY PHYSICS: Atoms, Waves, Particles

G. A. Williams, University of Utah. 350 pages. Available April, 1969.

Designed for a brief course in physics for non-majors, this new text covers the essentials of classical physics and twentieth-century atomic and nuclear physics in an approach that is both historical and experimental. The book includes problems, questions, and bibliographies for each chapter as well as marginal notes concerning important new definitions, laws, and equations. The only prerequisite is high school algebra.

TWO COMPANION TEXTS FROM THE SAME AUTHOR**ESSENTIAL MATH FOR THE SCIENCES,****Volume I: Algebra, Trigonometry, and Vectors**

Arthur Beiser, formerly with New York University. 224 pages. Published January, 1969.

This book, explicitly aimed at providing, not merely reviewing, the mathematics background needed in non-calculus introductory science courses, particularly physics and chemistry, covers only those topics which will actually be of use to the student in these courses. Meant for self-study, completely self-contained, the book discusses each topic in a logical progression. It contains 500 exercises to which all answers are given and gives careful treatment to topics usually found difficult by most students, i.e., logarithms.

Volume II: Analytic Geometry and Calculus

250 pages. Available April, 1969.

The author's intent is the same in this text: to provide the background needed in introductory science courses, and to teach these topics not from the mathematician's point of view but from that of the working scientist. The text begins with the elements of analytic geometry, and proceeds step-by-step to differential and integral calculus. Like Volume I, Volume II is meant for self-study and is completely self-contained. Its explanations are straightforward with no sacrifice of understandability to formal rigor. This text may be used *independently* or *following* Volume I.

McGRAW-HILL BOOK COMPANY, 330 West 42nd Street, New York, N.Y. 10036

esting) and planetary radar reflection. In the second lecture, Freeman Dyson deals in a most refreshing way with radar observations of the planets in general, and he suggests a comprehensive program of observations from which the relativistic effects are finally to be extracted with the help of a computer.

In spite of the editor's valiant effort to weave a connection between these lectures, they are, to a large extent, independent units. But this is no disadvantage: One can begin reading this book almost anywhere. Some contributions are tantalizingly brief, and one begins to wish for much more of the same. I felt this particularly in such short treatments of long subjects as Rainer Sachs's lecture on gravitational radiation theory, Charles Misner's whimsically titled lecture on "Taub-NUT Space as a Counterexample to Almost Anything," Roger Penrose's beautifully illustrated essay on conformal methods, and Engelbert Schücking's sparkling but strangely offhand survey of cosmology. Sachs gets right down to several detailed examples of exact wave metrics and also discusses approximation methods. Misner lists the pathological features of his subject but concentrates on only one, which was then new: the non-unique analytical continuation of a subregion. A welcome didactic feature of his contribution is the use of differential forms. Penrose, in a *tour de force* with very little mathematics, paints an intuitive picture not only of the "ten conserved quantities" he discovered jointly with Theodore Newman, but also of that highly successful general method developed chiefly by himself—the conformal treatment of space-time infinity. To Schücking we are mainly grateful for some fresh ideas to shake us out of the usual rut. His subject is further treated by David Layzer in a contribution titled "A Unified Approach to Cosmology." Here a statistically homogeneous and isotropic relativistic substratum is embellished with Newtonian perturbations using methods of statistical mechanics. Interesting applications are made to cosmogony and to the arrow of time. One suspects, however, that some of the conclusions are a little more tentative than the author seems to imply.

A rather isolated paper by Jeffrey Cohen reports work done jointly with Dieter Brill on a strong-field solution of the famous Mach-Thirring effect—the dragging of the inertial compass by

a rotating mass. A reference to Mach's principle and *why* this problem is of interest would have been helpful.

Joseph Weber extends some of Sachs's theoretical remarks and then reports on experimental progress in the search for gravitational waves with his extraordinary and ever improving detector at the University of Maryland. Prospects for success, however, still appear remote. A. H. Taub contributes a concise and careful exposition of relativistic hydrodynamics, devoting a section to elastic shock waves and ending with problems in general relativity. As a natural application of some of these ideas, G. C. McVittie describes models of rather idealized gravitational collapse—which have in the meantime been further developed by himself, Whitrow, Bondi and other collaborators. Gravitational collapse, of course, was particularly pertinent at that gathering because it is one possible source of energy for the vast radiative emission of quasars, and quasars—then as now—formed a common focus of interest for relativists, cosmologists and astrophysicists. (More recently, pulsars have come close to usurping this role.) Quasars, then, not surprisingly, have a chapter to themselves in this book. In his usual masterly way, Maarten Schmidt presents the then current state of knowledge and conjecture, which, strangely enough, is still quite topical, though many more quasars are known today. The largest observed redshifts are still about the same, and the controversy over whether they are of cosmological origin is still unresolved.

The book ends with two lectures relevant to cosmogony. William Bonnor gives a very elegant and novel derivation of Jean's formula for gravitational instability, by submitting finite, spherically symmetric, Newtonian mass distributions to small perturbations. His motive is to put the formula on a more secure basis and also to study the formation of galaxies. P. J. E. Peebles discusses that other than highly topical subject of "Microwave Radiation from the Big Bang"—predicted *and* observed. Here, too, we have more data today, but the basic ideas have not changed. Unless some convincing alternative origin for this radiation can be dreamed up, it will be hard to deny the violent beginning of our universe. By an oversight, incidentally, no credit was given to the original and independent proposer of this effect, George Gamow; but this omission, I am given

☐ **Progress in Nuclear Physics, Vol. 10**
 Edited by D. M. Brink and J. H. Mulvey, Oxford
 Follows the precedence of earlier volumes in this widely acclaimed series—The authoritative papers, prepared by utmost experts in their fields, review the latest developments on low energy nuclear physics, with excellent articles on theoretical and experimental subjects in nuclear structure, nuclear reactions and the problem of nuclear forces—skillfully edited for the greatest accuracy, fluency and readability.
 Title No. 3559 1968 392 pages \$19.00

☐ **Coefficients for the Analysis of Triple Angular Correlations from Aligned Nuclei**
 By G. Kaye, I. J. C. Read, Univ. of Liverpool and J. C. Willmott, Univ. of Manchester
 These immensely valuable tables contain information relating to the angular correlations between the y-rays emitted from an excited state of a nucleus—one of the most powerful methods for determining the spins—and provide essential information about the initial nuclear state.
 Title No. 3167 1968 224 Pages \$12.00

Other Titles of Interest . . .
☐ **Optical Properties and Band Structure of Semiconductors**
 Title No. 3513 1968 170 Pages \$9.00
☐ **Progress in Nuclear Magnetic Resonance Spectroscopy**
 Title No. 3693 1968 485 Pages \$18.00
☐ **Handbook of Vacuum Physics, Vol. 2, Part 2: Thermionic Emission; Part 3: Secondary Electron Emission**
 Title No. 2469 1968 256 Pages \$7.50

To order these outstanding titles, please check the appropriate boxes, complete the form below and return this ad to PERGAMON PRESS.

NAME		AFFILIATION	
TITLE/POSITION		ADDRESS	
CITY	STATE	ZIP	
☐ Payment Enclosed		☐ Please Bill	

PERGAMON PRESS, INC.
 Maxwell House, Fairview Park
 Elmsford, New York 10523

For your texts, look to Allyn and Bacon, Inc.

New—the Second Edition of

Introduction to UNIVERSITY PHYSICS, Volumes I & II.

- By Joseph Morgan, Chairman of the Department of Physics at Texas Christian University.
- This textbook is intended for an introductory course in college or university level physics for students of science or engineering.
- The unique presentation makes the book suitable for use by students who have a knowledge of algebra and the elements of trigonometry and by students who are concurrently taking or have had an introductory course in calculus. Examples are given in both treatments throughout.
- In this Second Edition some chapters have been revised in the light of a more physical presentation, recent significant research, and curriculum evolution. Among the new topics are the laser and the production of X-ray spectra.

For further information, write:

Allyn and Bacon, Inc., 470 Atlantic Avenue, Boston, Mass. 02210

scientist

solid-state

image storage devices

Will be supervising a physics group in a program that is part of a long-range, company-sponsored research effort. Individual should have general background in the analysis, fabrication, and experimental evaluation of multi-layered photoconductor devices. Materials under consideration for such devices are II-VI compounds, ferro-electrics and organic semiconductors

Send resume in strictest confidence to Mr. C. D. Canfield, Professional Staffing.

Itek Corporation

10 Maguire Road
Lexington, Mass. 02173

An Equal Opportunity Employer

Itek

PHYSICISTS-SCIENTISTS

KEY PERSONNEL is a National organization devoted exclusively to the selective search for competent careerists among the technical disciplines.

Working closely with clients Coast to Coast, it is our policy to provide a professional service to scientists and engineers, that is ethical, knowledgeable and confidential. Our service is designed to provide YOU with a convenient focal point from which to explore, easily and efficiently, the numerous career opportunities existing anywhere in the U. S.

Our service to you—the individual scientist or engineer—is WITHOUT COST since our search fees are assumed by our organizational clients, who are Industrial, Defense and nonprofit organizations engaged in the advancement of the state-of-the-art.

We are currently searching to fill a broad spectrum of positions from semi-junior to General Manager across the entire continent.

If you would like to explore for yourself, our unique approach, write for our confidential summary form or forward a copy of your current résumé as soon as possible:

John F. Wallace
Executive Vice President



KEY PERSONNEL CORP.

218 Tower Bldg.

Baltimore, Md. 21202

to understand, has by now been rectified.

So much for the major benefits of this book. There may also be a minor one: Does it not reinforce the slowly growing and rather welcome view that relativists and cosmologists are a little useful after all?

* * *

The reviewer is a professor at the Southwest Center for Advanced Studies in Dallas, which has cosponsored the series of international Texas Symposia on Relativity and Astrophysics in recent years.

Two textbooks without teachers

PROGRAMMED PHYSICS, PART 4: KINETIC THEORY AND THERMODYNAMICS. By Alexander Joseph, Daniel J. Leahy. 208 pp. Wiley, New York, 1967. Paper \$4.95

PROGRAMMED PHYSICS, PART 5: TOPICS IN MODERN PHYSICS. By Alexander Joseph, Daniel J. Leahy. 269 pp. Wiley, New York, 1967. Paper \$4.95

by Gerald L. Pollack

These two books are the concluding texts for a one-year programmed course in physics. They are intended for senior high-school students and for liberal-arts majors in the first year of college. The mathematics does not go beyond intermediate algebra.

Part IV of this series is an elementary introduction in two chapters to the kinetic theory of gases and to heat and thermodynamics. The first chapter starts with definitions of density, pressure and temperature, and, with these as a base, it works up to problems in Boyle's law and Charles's law. The postulates of kinetic theory are then put forth, and the development goes through discussions of Boltzmann's constant, the van der Waals equation and the Joule-Thomson effect. The second chapter is an elegant, simple introduction to thermodynamics. It contains a careful discussion of the first law in the form $\Delta U = Q - W$, and includes numerical examples and treatment of adiabatic and isothermal processes. The second and third laws are also stated and discussed, but not as thoroughly.

The authors have an ingenious talent for teaching the student to solve rather complicated problems by leading him through a series of easier problems. In this way one is taught to find the equilibrium for problems in which two bodies with different specific

heats, masses, temperatures and phases are mixed. In the same manner the student learns how to solve several problems in thermal conduction and radiation. The problems are good ones, and well constructed tables give the student a good idea of what the appropriate magnitudes are for different materials. There are also good discussions of thermodynamic processes in the p-V plane, including isobaric and isochoric paths, cyclic processes, and finally a thorough treatment of the Carnot cycle and efficiencies of heat engines. There is an interesting section on entropy in terms of order and probability, and there is also practice in the use of the expression $\Delta S = Q/T$. This book is highly recommended to its intended audience, but it is only an introductory account. Some of the subjects that must be omitted at this level are free energies and other thermodynamic functions, chemical potential, temperature dependence of most thermodynamic quantities, and the Maxwell relations.

Part V is an introduction to modern physics in three chapters: wave-particle duality (blackbody radiation, photons, quantized energy), atomic physics (Rutherford atom, hydrogen energy levels, spectroscopy) and nuclear physics (radioactivity, nuclear reactions, binding energy, K capture). This is a book with a lucid presentation, a reasonable balance of emphasis and, like its predecessor, many other strong points. The presentations of the Compton effect, the detailed development of spectroscopy, and of nuclear reactions are all excellent. The treatment is somewhat old fashioned; for example, there is little mention of modern developments of solid-state or particle physics.

Both of these are books from which an interested student could really learn a good bit of physics without a teacher. At the beginning of each chapter the authors outline the objectives precisely, and at the end of each chapter there are good reviews and problems to test further mastery of the material. The bulk of the books is a well ordered presentation of the material in the form of narrative-question-answer. The questions are well chosen, precise and form a continuous story; the narratives are lucid and to the point. Difficult ideas are repeated, but the repetition is unfortunately not sufficiently spread out over the book. Many ideas are made clearer by fre-

Oxford



A German Source Book in Physics

By K. B. BEATON, *University of Sydney*; and H. C. BOLTON, *University of Monash*. Designed as an aid for undergraduate or postgraduate students learning to read scientific literature in German, the selections in this volume are from original papers and important books published during this century that are significant in the development of physical ideas. The text has been annotated so that the linguistic complexities should not prove a hindrance to the understanding of the scientific content. Cloth, \$11.20; paper, \$5.60

Measurement and Interpretation of Neutron Structure Factors

Edited by B. T. M. WILLIS, *University College, Cardiff*. Recent research on the magnetic and nuclear elastic scattering of thermal neutrons is reviewed by leading workers in the field based on papers presented at an international summer school held at Harwell in July 1968 on Accuracy in Neutron Diffraction. This work has led to new information on the electronic and nuclear charge distributions in solids, and the book should be of interest to crystallographers, solid-state physicists, and chemists. 130 text figures. \$9.60

Physics

AN INTRODUCTION

By ERNEST C. POLLARD, *Pennsylvania State University*; and DOUGLAS C. HUSTON, *Skidmore College*. An original and stimulating introduction to physics, this text is directed to the non-science student. Its central theme is the concept that the unseen world, revealed by science, is beautiful. To help the reader gain an appreciation of this point, the authors present physics as a logical development of science and emphasize the relationship of science to the individual and to society. The introduction to calculus is clear and sympathetic, and assumes no prior knowledge of the subject. Informative figures and diagrams, problems with solutions, bibliographies, and an index complement the study.

OXFORD
UNIVERSITY
PRESS
200 Madison Avenue,
New York, N.Y. 10016