Optics Baedeker

APPLIED OPTICS: A GUIDE TO OPTICAL SYSTEM DESIGN, VOL. 1. By Leo Levi. 620 pp. Wiley, New York, 1968. $18.95

by J. A. GIORDMAINE

Everyone undertaking the design of optical experiments or the engineering of an optical system finds himself consulting a wide variety of references for results of diffraction and communication theory, for lens designs, the spectra of flash lamps and a multitude of other matters. This unusual and very useful book, which succeeds in being both an introductory text and a valuable reference book, simplifies the job of information retrieval by collecting in one source many of the basic theoretical tools of optics, together with a systematic collection of information and data on lenses, prisms, mirrors and light sources.

Leo Levi, a member of the physics department of the City College of New York, has done an excellent and painstaking job of integrating basic theory with carefully selected data and technical information. The result is a reference work of lasting value, but also, "mirabile dictu," a well written and readable book in which opticists and experimental physicists will enjoy browsing for introductions to other areas of an interdisciplinary field.

The first third of the book is a self-contained survey of the fundamentals of physical optics, communication-theory aspects of optical imaging, the quantum nature of light, radiometry, photometry and colorimetry. The technical level is that of seniors or beginning graduate students; the physical content of equations and theory is emphasized throughout.

In the second third is a summary of the characteristics of light sources—the sun, incandescent and discharge lamps, luminescence and phosphors, and lasers, with many convenient tables and diagrams of spectra, output power, efficiencies, pulse durations, frequency response and other properties.

The final third of the book is devoted to the theory and practice of lenses, prisms and mirrors. Included in addition to the standard physical and geometrical optics is useful material on thin films, reflecting coatings, tolerances on surface quality, optical transfer functions, wave optical analysis of lens systems and numerous examples of important lens designs. The reader will also find here answers to such questions as: what performance to expect from standard inexpensive optical components, how to clean aluminum mirrors, and how to synthesize systems of multiple mirrors and prisms.

Levi does not discuss the detection of light, a subject to be covered in a projected second volume. The electrooptic effect, modulation, holography and nonlinear optics are treated only sketchily. A surprising omission is the theory of propagation of gaussian beams. The author does, however, include carefully selected references to review articles and books covering these fields. The book is well designed, and it has an excellent index.

This book is a needed and valuable contribution to the optics literature and should have a long and useful life. We can look forward to the second volume.

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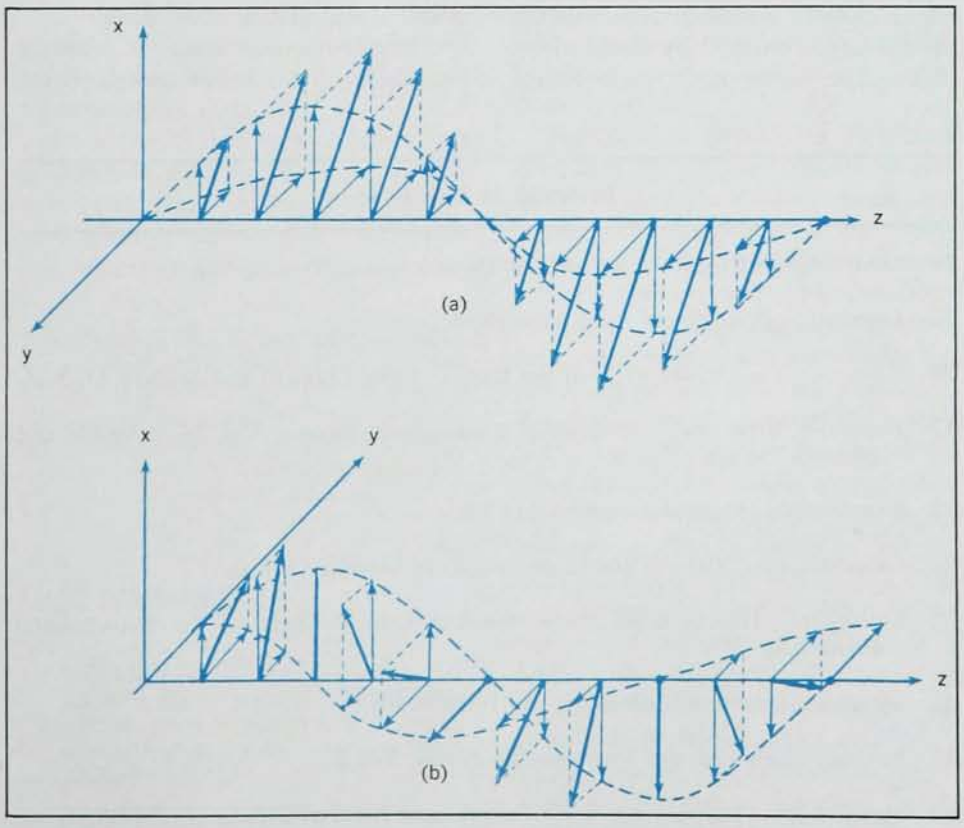
Compared to Kittel

PRINCIPLES OF SOLID STATE PHYSICS. Robert A. Levy, ed. 464 pp. Academic Press, New York, 1968. $11.50

by ROBERT J. COLLIER

"Reject nothing but reorder all" (Theodore Reuthke) is pretty good advice.



LINEARLY POLARIZED LIGHT (a) and circularly polarized light (b) for a simple monochromatic plane wave. (From *Applied Optics: A Guide to Optical System Design, Vol. 1*, by Leo Levi. Reviewed on this page.)

Far from rejecting the work of previous authors of books on the solid state, Robert A. Levy candidly admits to having "cheerfully and eagerly looted the publications of everybody in the field . . ." His intention has been to emphasize physical principles, anticipate questions and remain mindful of the "needs of the less than brilliant student." Levy has succeeded in keeping the principles visible at all times. He seems to understand that learning first flowers best in the absence of weed-like details. The book, as intended, will be a good text for the undergraduate student in physics.

Levy, who is in the physics department of the University of Cincinnati, has borrowed heavily from John Ziman, Frederick Seitz, John Slater, Adrianus J. Dekker and others, but no author has been embraced more warmly than Charles Kittel and his book, *Introduction to Solid State Physics* (Wiley 1956). Every substantive chapter is laden with references to Kittel. Thus it is appropriate to compare the book under review with Kittel's *Elementary Solid State Physics* (Wiley 1962), a similar text for the undergraduate. The two books derive many of their physical explanations from Kittel's *Introduction to Solid State Physics*, but Levy is a bit kinder to the student in providing more words of explanation. Levy has included a useful chapter on the dynamics of the crystal lattice omitted by Kittel in his elementary text. Each book covers lattice diffraction, thermal, electrical and magnetic properties of solids and band theory of solids and semiconductors. Notably in the discussion of semiconductors, Levy tends to stay with the basic principles and shy away from discussion of devices. He has also added a little spice in the form of a short section on superconductivity.

As a consequence Levy's book compares favorably with Kittel's *Elementary Solid State Physics*, maintains the primacy of basic principles and appears in a pleasant format.

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Terrestrial gravity

THE GRAVITY FIELD OF THE EARTH: FROM CLASSICAL AND MODERN METHODS. By Michele Caputo. 202 pp. Academic, New York, 1967. $9.75

by JOSEPH GILLIS

If any single development can be said to have ushered in the age of science, it is surely that of Newtonian gravitation. It set a standard of universality to which laws of physics would henceforth have to match up. Little ad hoc formulae and explanations were from that moment condemned to a minor place in our scheme of thinking.

These reflections come to mind as one picks up Michele Caputo's monograph on a particular aspect of the subject, that of terrestrial gravity. The fields due to spherical and ellipsoidal distributions of matter were favorite subjects for clever problems in the 19th century, and indeed some of this has survived to the present. In its time, this approach contributed much to the development of science and gave the impetus to the study of ellipsoidal coördinate systems and other devices—all useful in many other areas of theoretical physics. But if we have now passed the stage of weaving mathematical problems on the subject, we have come instead to very serious practical questions. The manifold problems attached to satellites and spaceships and to the inertial guidance of various "objects" make the detailed understanding of the earth's field a matter of prime importance.

The book under review expounds the theory necessary for tackling problems of this sort and also works out in detail a number of interesting applications. The basic tools used are fairly simple: ellipsoidal coördinates, Morera functions, and, for some special purposes, spherical harmonics and some very elementary integral equations. However, these suffice for the systematic study of a corpus of interesting problems. A large part of the book is devoted to the shape of the geoid, terrestrial density distribution, determination of the actual shape and dimension of the real earth from gravity measurements, ellipticity of the equator and, finally, some recently developed methods for the application to these purposes of unreduced terrestrial data. Moreover, before leaving the earth, the author finds time to examine the application of gravimetry to geophysics, including hydrostatic equilibrium of the earth and some problems related to stress distribution and to terrestrial heat flow.

Beyond the earth there is a study of what we can deduce about the moon from gravimetric considerations. The last part of the book is devoted to the computation of satellite orbits, including corrections up to the fourth order for noncentrality of the field, and to the gravimetric information that can be obtained from the motions of satellites.

Although the basic problems and methods dealt with in this monograph are essentially simple, the technical mathematics can become really complicated. However, it is all presented lucidly and well. To the best of my

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