Modern Approach to Optics

Introduction to Fourier Optics. JOSEPH W. GOODMAN. McGraw-Hill, New York, 1968. xiv + 287 pp., illus. $13.50. McGraw-Hill Physical and Quantum Electronics Series.

Optics has undergone a number of dramatic changes during the last 15 years. A number of factors caused the rebirth of this important branch of physics; some of these factors were the new theoretical ideas of the statistical properties of light, the influence of communication theory, and, finally, the invention of the laser. A significant portion of this revitalization came from electrical engineers discussing and participating in (and often rediscovering) optical physics. The concepts of Fourier analysis so familiar in a one-dimensional form to electrical engineers have in the two-dimensional form become a necessary part of teaching and research in optics. It is not surprising, then, to find an introduction to Fourier optics written for graduate electrical engineering students by an applied physicist turned electrical engineer. As Goodman says in his preface, "Fourier analysis and linear systems theory provide the foundation on which the theory of image formation, optical data processing, and holography are constructed." I think I would prefer to say that Fourier analysis and linear systems theory provide the mathematical tools for the understanding of the propagation of light which is basic to an appreciation of a majority of optical phenomena. Goodman clearly recognizes this order of importance, for after a brief introduction he discusses the analysis of two-dimensional linear systems and the foundation of scalar diffraction theory. This background is then used to develop a variety of topics, including Fresnel and Fraunhofer diffraction, image formation, frequency analysis of optical systems, spatial filtering, and information processing and holography.

This sounds exciting and interesting, and it is. Goodman does an excellent job of conveying the interest and fascination of this modern approach to optics. For example, I have always found students responsive to a derivation of the usual lens laws from a discussion of propagation of spherical waves through a lens.

It is pleasure to see the foundations of diffraction theory discussed in a straightforward manner: the Kirchhoff and Rayleigh-Sommerfeld formulations of diffraction and that using the angular spectrum of plane waves are all included.

The book as a text is well written, with very few errors. References are given with each chapter to some of the original papers; these are not really a satisfactory cross section, but they are nevertheless useful. Problems are well selected. It is a shame that the few photographs illustrating optical phenomena are so poor and infrequent—optics is a visual subject, and every opportunity should be taken to exploit that fact. The text has the brashness but also the refreshing excitement that a relative newcomer brings to a subject, and will undoubtedly find a deserved place among the best optical books.

BRIAN J. THOMPSON
Institute of Optics, University of Rochester, Rochester, New York

Bioclimatology

The Measurement of Environmental Factors in Terrestrial Ecology. A symposium, Reading, England, 1967. R. M. WADSWORTH, L. C. CHAPAS, A. J. RUTTER, M. E. SOLOMON, and J. WARREN WILSON, Eds. Blackwell Scientific Publications, Oxford, 1968. x + 314 pp., illus. $9.50. British Ecological Society Symposium No. 8.

It is stated that the purpose of this volume is to bring together details of methods which the ecologist can use in the field and to discuss recording and handling of the records obtained. In the reviewer's opinion the book falls considerably short of this objective. Twenty-one subjects are covered in a little over 250 pages. The brief amount of space allotted to each subject allows for little more than a superficial description of methods. The wide range of subjects covered limits the amount of material applicable to any one reader. The nearly 50 pages devoted to brief descriptions of demonstrations and an attendance list would have been better utilized in expanding the individual papers.

Subjects covered include the measurement of environmental conditions in stored food products, the measurement of climate of soil and litter animals, interception of rainfall, light and temperature in relation to the slug, soil aeration, data processing and acquisition, and radiotelemetric techniques. This wide range of topics results in there being little relation between consecutive chapters.

Certain chapters are of special interest to environmental biologists. Long gives a general discussion of the measurement of the microclimate and presents a large amount of information on instruments and techniques. Idle's paper "The measurement of apparent surface temperature" presents a good brief discussion of this rather complex problem. Caborn's paper briefly surveys workable methods for the measurement of wind speed and direction from the point of view of the ecologist. It is a good starting point for those interested in the problem. Szeicz's paper "Measurement of radiant energy" covers radiation components and possible instrumentation both above and below the canopy. The paper "Crop environment data-acquisition" by Blackwell and Blackburn presents in a few pages some very useful information for those in biology who are concerned with the acquisition of large quantities of data. It is interesting to note that the chapters that merit special mention are all among the longest in the volume.

Meteorologists and biologists already doing considerable specialization in measuring the environment will find the information too brief and elementary to be of much use. However, the book is not directed toward this group. Environmental biologists, in general, should find the five chapters mentioned specifically of interest to them. Most of the other 16 chapters will probably be of marginal use because of their specialized subject matter.

ROBERT H. SHAW
Climatology and Meteorology, Iowa State University, Ames

Statisticians' Meeting

The Future of Statistics. Proceedings of a conference, Madison, Wis., 1967. DONALD G. WATTS, Ed. Academic Press, New York, 1968. xviii + 318 pp., illus. $12.50.

This book comprises the proceedings of a conference held to celebrate the completion of the Computer Sciences–Statistics Center at the University of Wisconsin.

The first half of the book consists of six papers and two panel discussions on general topics relating to statistics. The participants in these sessions are G. A. Barnard, G. E. P. Box, W. J. Dixon, H. O. Hartley, J. S. Hunter, O. Kempthorne, J. C. Kiefer, L. M. LeCam, A. G. Oettinger, Guy H. Orcutt, L. J. Savage, and J. W. Tukey.

Several important themes appear and

reappear throughout these presentations. One is the importance of good descriptive methods. This was emphasized by L. J. Savage and W. J. Dixon, among others. A second is the importance of communication (including teaching) to the statistical profession. The preface is a good essay on the communications theme as it emerged at the symposium. One noteworthy remark on the subject (made by Tukey: "I think the term 'service course' is a term native to mathematicians, and I think in view of the earlier discussions at the session, maybe statisticians might stop using it, slowly. Are we interested in getting the world to think at least a little like a statistician some of the time? I think we are. And if so, then doing this ought to be one of our main businesses, not just a 'service course.'" A third theme was the relation between computing and statistics; included were questions of university organization, the impact of computing on the development of new theory—and on old theory (for example, some theory has become obsolete because there is no longer a need to design experiments amenable to simple computations)—and of course data analysis.

The latter half of the book contains seven technical papers. In the first five of these the authors appeal to theory (often developed largely by themselves) which appears in other publications, and the papers included in the volume are essentially expository accounts of the methods, showing data and their analysis. The papers are interesting, well presented, and accessible to the nonspecialist statistician. Discussants' contributions are varied and worthwhile, presenting both theoretical and practical points, as the composition of the conference justified. Often questions that have occurred to the reader are aired by them. Moreover, the discussion is lifelike; I could practically hear the tone of voice of some of the discussants personally known to me.

The sixth paper, "Measurement in the social sciences" by G. A. Barnard, is interesting indeed. Barnard proposes that where a social science problem can be represented by some complex mathematical entity such as a diagram or a matrix, the statistician should not rush to reduce it to one or a few numerical indices. The complex mathematical entity has an important descriptive, conceptual role of its own. He gives interpretations of likelihood functions, and shows how from a single graph of the scoring functions of two samples light can be thrown on what are conventionally regarded as problems of testing, estimation, and combining of samples. He argues persuasively that where there is no theoretical basis for preferring some one particular scale of measurement, that fact should not cause the statistician to turn immediately to nonparametric methods. Barnard proposes, rather, than transformations of the data and linear methods applied to them will frequently lead to deeper insights.

The conference brought together a varied and high-powered group of participants whose symposium has resulted in an interesting—and varied—book.

LINCOLN E. MOSES
L. L. Thurstone Psychometric Laboratory, University of North Carolina, Chapel Hill

Uses of Spectrometers

Mass Spectrometry in Science and Technology. F. A. WHITE. Wiley, New York, 1968. xvi + 352 pp., illus. $14.95.

The stated objective of this book, which is intended for nonspecialists and for students with interdisciplinary interests, is "to make a serious appraisal of the mass spectrometer's present and potential relevance to a large number of professional fields." The author succeeds well. Interesting applications of mass spectrometry to chemistry, physics, nuclear geology and cosmology, the space sciences, materials science, biology and medicine, and ecology and environmental science are described and possible extensions or new studies are suggested.

In the first third of the book, in which the principles and some of the instrumentation of mass spectrometry are briefly presented, the reader is introduced to the bases for the physical or analytical applications of the mass spectrometer that are detailed in the remainder. The exposition of the instruments is for the most part succinct. No mention is made of the monopole instrument, but the author's cascade analyzer and the ion-beam microprobe are included, as are most other important or commercially available instruments. The very beautiful applications of the Syrotron instrument to the study of ion-molecule reactions should have been given at least brief mention.

A few distracting errors are noted; these occur largely in the early chapters. For example, on page 7 $y/z^2 \propto m/e$ and not the inverse; and at least 11 instances of the incorrect use of "specie" in place of "species" were detected. Only a few typographic errors are to be found; the statement that U^{234} and $_6K^{39}$ have the same charge-to-mass ratios (p. 312) is probably the most serious.

The omission of reference to the important work of Biemann, McLafferty, and others in the determination of amino acid sequences of peptides (p. 329) is regrettable. This book is a source of much information, but the subject index is too brief.

Although some repetition of principles occurs as the various applications are presented, the most insistent is the advocacy of stable-isotope dilution. Eight substantial reasons for using stable isotopes rather than radioisotopes, particularly in the life sciences, are enumerated in chapter 14 (of course, limitations are imposed by the naturally monoisotopic elements Be, F, Na, Al, P, I, and so on), and a final invitation to consider the exploitation of stable-isotope labeling with associated mass spectrometric analysis is made in the closing paragraphs of the book.

The author draws heavily upon his own contributions to illustrate the wide variety of applications he discusses. Particularly timely and cogent is his appeal that mass spectrometrists give more consideration to ecological studies.

Strong and fascinating arguments for isotope coding of materials are presented. The approach is not unreasonable and may well be economically feasible now or very soon. It is suggested that industry may wish to lead the way and initiate promptly a careful examination of the implementation of this important suggestion.

ROBERT W. KISER
Department of Chemistry, University of Kentucky, Lexington

Sun, Planets, and Comets

Mysteries of the Solar System. R. A. LYTTLETON. Clarendon (Oxford University Press), New York, 1968. x + 261 pp., illus. $7.

Seven essays, expanded from a series of lectures given at Brandeis University in 1965, cover topics studied by the author during 30 years at Cambridge University and several astronomical centers in the United States, including the Jet Propulsion Laboratory. The informal style makes easy reading of Lyttleton's mathematical studies of the