ically on each other, a principle that has been used for microwave antennas.

Chapter 4 is concerned with first order optics, and chapter 5 with third order aberrations in systems of rotational symmetry. In chapter 6, we find a discussion of the diffraction theory of optical instruments. Two appendices deal with vector analysis and ray tracing; and four supplementary notes, the last three written by M. Herzberger, contain discussions on electron optics, optical qualities of glass, mathematics and geometrical optics, and the symmetry and asymmetry in optical images.

It is chapter 6 about which I have some more general reservations. In any highly analytical treatment of a topic in physics it is easy to elucidate mathematical complexities for their own sake rather than to consider them in their supporting role. Rayleigh's (not Raleigh's) criterion, for example, no longer occupies the central position that one is made to believe, especially not since the advent of transfer functions. Periodic structures, likewise, do not deserve such detailed treatment unless, of course, the treatment leads to a discussion of the intriguing possibilities of, under certain conditions, exceeding the classical "limits of resolution."

Still, I do not hesitate to call Luneburg's book, after perhaps the texts by Born and Wolf and by Sommerfeld, one of the outstanding advanced treatments of modern optics, at least of certain aspects of modern optics.

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Analytical Chemistry

Handbook of Industrial Infrared Analysis. Robert G. White. Plenum Press, New York, 1964. xiv + 440 pp. Illus. $19.50.

White's *Handbook of Industrial Infrared Analysis* consists of seven chapters: "History, theory, and terminology," "Instrumentation," "Techniques," "Qualitative analysis," "Quantitative analysis," "Applications," and "Literature."

In chapter 1, which is very brief, the author has deliberately minimized the theory of infrared spectroscopy for the benefit of the nonprofessional spectroscopist. Therefore, some of his theoretical explanation is unclear. For example, after briefly describing fundamental vibrations he states that "other internal motions in the molecule are combinations or overtones of such fundamentals." However, for those interested in this aspect of the subject, he has referred to some well-known texts on infrared (IR) theory. In my opinion, those seriously interested in using IR for anything other than the most routine investigations (for example, quality control and routine analytical analysis) will need a more detailed theoretical development.

Chapter 2 is useful, for in it the author has presented the salient features of commercially available infrared spectrometers; this information should help purchasers to select the instrument best suited for their particular requirements. Wavelength calibration and performance evaluation of spectrometers are included.

The high point of White's handbook is his thorough discussion of the many methods and techniques used to obtain infrared spectra of chemical compounds (chapter 3). White appears to have strong preferences for the use of the KBr technique. Also included, and by no means unimportant to the spectroscopist, are the physical hazards of the solvents commonly used in the IR laboratory. However, he fails to mention that many of the chemicals submitted for IR analysis can be as hazardous as or more hazardous than the solvents used to obtain their solution spectra.

Qualitative interpretation of IR spectra is dealt with in chapter 4. This chapter follows closely the spectra-structure correlations covered in Bellamy's book, which White cites frequently. White's treatment leaves me with the impression that most identifications of chemical compounds performed by the industrial IR spectroscopist are of compounds already characterized by other means; he seems to imply that all one has to do is obtain an IR spectrum of a particular substance, spot a few characteristic group frequencies, or the absence thereof, and, by the use of some sort of searching technique of standard spectra, all will be identified. But much of industrial IR spectroscopy is concerned with establishing or verifying structures of hopefully new and patentable organic compounds. The author mentions the competition of other physical methods with IR. The word "competition" should be replaced by "coordination" (preferably with the cooperation of those experts who use other physical methods of analysis—nuclear magnetic resonance, mass spectrometry, x-ray, Raman spectroscopy, and the like). Integration of these physical methods can only strengthen the final conclusion. Although White and I both believe that IR is the most versatile tool for structural analysis, one must realize that the method has some limitations.

Chapter 5, on quantitative analysis, is quite instructive for those who wish to learn to do this type of work properly. Chapter 6 covers much of the published work on the application of IR to the solution of chemical problems. The last chapter, although short, contains a wealth of information on the literature of the field.

White's handbook contains much information not readily available elsewhere, and most laboratories, including those in the universities, will find in it something of value. It is also recommended to those in the chemical profession who are not familiar with the ways in which the use of IR might be helpful to them.

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Introductory Volumes

Isotopes in Biology. George Wolf. Academic Press, New York, 1964. x + 173 pp. Illus. Paper, $2.45; cloth, $5.50.

A Tracer Experiment: Tracing Biochemical Reactions with Radioisotopes. Martin D. Kamen. Holt, Rinehart, and Winston, New York, 1964. 127 pp. Illus. Paper, $1.28; cloth, $2.50.

The first of these two short paperbacks, *Isotopes in Biology* by George Wolf, is an elementary and necessarily superficial introduction to the use of both stable and radioactive isotopes as tracers in biological systems. The presentation is designed for beginning and graduate students in biology as well as for scientists who wish to use the technique but have had no previous experience with it. The author begins with a brief discussion of the physics and chemistry of isotopes, units, and hazards. Some of the potential pitfalls in

tracer work, such as isotope effects and radiation damage, are mentioned, and there is a chapter dealing with the various modifications of the isotope dilution method. The last, and best, half of the book describes individual instances of the use of isotopes in the solution of important problems in numerous areas of biology. Famous experiments in such fields as metabolism, protein synthesis, chemical genetics, and the dynamic state of body constituents are discussed; however, the brevity often precludes an appreciation of the fine points of these experiments.

A Tracer Experiment by Martin D. Kamin, is written for the bright high school student or the adult with an interest in modern biology. The approach is very elementary, but the account moves quickly and requires considerable thought in places. Kamin begins with a brief statement of what a research question should be. Definitions of atoms and molecules are followed by a discussion of atomic structure and a short history of the discovery of radiation. The nature of electricity is illustrated with a detailed description of Millikan's "oil drop" experiment. The last part of the book deals with the tracer experiment of the title: The incorporation of labeled carbon dioxide into acetic acid by *Clostridium thermoaceticum*. Readers may feel letdown by the absence of a clear-cut conclusion, but the lack serves to accentuate the moral that "scientific knowledge is a thing of change." This book is well written and serves its purpose admirably.

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Desert Animals

The Lives of Desert Animals in Joshua Tree National Monument. Alden H. Miller and Robert C. Stebbins. University of California Press, Berkeley, 1964. vi + 452 pp. Illus. $10.

This is another of the famed faunal reports from the Museum of Vertebrate Zoology of the University of California where Alden Miller is director and Robert Stebbins is curator of herpetology. The authors were attracted to this desert region in southern California by their desire to study, as naturalists, the daily lives of vertebrate animals and to ascertain how they balance their activities with their physiologic requirements. Many laboratory studies, made on different desert species and entailing temperature, water, and metabolism, have served as a basis for interpretation of the field observations.

The initial sections of the book constitute an ecological discussion of the broad problems of desert existence to which the animals must adjust—for example, with respect to water, the shortage, vacillating supply, and thus the need for conservation; temperature extremes; limited concealment from predators; protection from the "elements" owing to the sparseness of vegetation; and respiratory problems caused by dust, sand, and loose substrate. Behavioral ways of solving the problems are discussed. The environment of the Joshua Tree Monument is then treated, largely in terms of plant belts and habitats. A fold-out map (Fig. 6) shows (by the use of different colors) the extent of the Piñon, Yucca, and Creosote bush belts. A faunal analysis shows, in tabular form, the occurrence of the species and races in the plant belts in the Monument and in the faunal areas within the Monument and in surrounding regions. The species composition, racial affinities, endemic races, intergradation, and relation of faunal elements to the vegetation belts receive attention.

The species accounts constitute the greater part of the book. For each kind there is a brief description and a statement of range and occurrence in the Monument, followed by general observations and a discussion of interrelationships, ecology, behavior, and adjustments. A tremendous amount of factual material is presented, but it is not just raw data; interpretations are made in terms of the objects of the study. Thus treated are 166 kinds of birds, 42 mammals, 36 reptiles, and 5 amphibians. Of these, 141 are residents. Literature citations cover six pages. There is a terminal index by subject and kind of animal.

The authors have not been unmindful of the growing popularity of desert regions for recreational uses. The book is superbly illustrated by Gene M. Christman. Of the 149 illustrations, 74 are photographs, 58 are black and white drawings, 9 are maps and diagrams, and 8 are colored plates. All but one of the last are of paintings.

Thus, this book has information for the specialist and for the layman. There are factual data for the zoogeographer, systematist, and ecologist. Of appeal to the general public is the list of animals that are found in the Monument, along with information on recognition and occurrence and on how the residents survive in the severe desert environment.

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New Books

General

The Ambidextrous Universe. Martin Gardner. Basic Books, New York, 1964. 304 pp. Illus. $5.95.

Animal Chemistry or Organic Chemistry in Its Application to Physiology and Pathology. Justus Liebig. William Gregory and John W. Webster, Eds. Johnson Reprint Corp., New York, 1964 (a facsimile reprint of the Cambridge edition, 1842). 407 pp. $14.50.

Archimedes in the Middle Ages. vol. 1, *The Arabo-Latin Tradition*. Marshall Clagett. Univ. of Wisconsin Press, Madison, 1964. 752 pp. Illus. $12.

Asimov's Biographical Encyclopedia of Science and Technology. The living stories of more than 1000 great scientists from the age of Greece to the space age, chronologically arranged. Isaac Asimov. Doubleday, Garden City, N.Y., 1964. 672 pp. Illus. $8.95.

John James Audubon. Alice Ford. Univ. of Oklahoma Press, Norman, 1964. 502 pp. Illus. $7.95.

Audubon's Wildlife. Edwin Way Teale. Viking Press, New York, 1964. 264 pp. Illus. $15.

The Beginnings of Modern Science. From 1450 to 1800. René Taton, Ed. Translated from the French edition (Paris, 1958) by A. J. Pomerans. Basic Books, New York, 1964. 687 pp. Illus. $17.50.

Beneficial Insects. Lester A. Swan. Harper and Row, New York, 1964. 447 pp. Illus. $7.95.

The Beyond Within: The LSD Story. Sidney Cohen. Atheneum, New York, 1964. 284 pp. Illus. $5.

The Biochemical Approach to Life. F. R. Jevons. Basic Books, New York, 1964. 184 pp. Illus. $4.50.

The Bountiful Sea. Seabrook Hull. Prentice-Hall, Englewood Cliffs, N.J., 1964. 352 pp. Illus. $6.95.

Broken Peace Pipes. A 400-year history of the American Indian. Irvin M.

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