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