of the enzymes and macromolecules above the molecular level into subcellular particles (chapters 3 and 4). In the next chapters attention is directed to the problems of finding out how molecular events underlie macroscopic phenomena, with special reference to the modes of action of vitamins, drugs, and genetic factors. The simple diagrams are accompanied by copious notes, in smaller print, which describe the transformations in more detail, but in the same clear and easy style. Chapters 5, 8, and 9 seem to be out of place in the text. If chapter 5, "Two approaches to biological explanation—analogy and analysis," followed chapter 1, "Biochemistry in relation to biology and chemistry," and chapters 8 and 9, "A common currency for energy transactions—ATP" and "Transmitting information—biochemical genetics," were placed immediately after chapter 4, "Organization and efficiency —subcellular particles and biological oxidations," the arrangement would be more coherent.

I can recommend this book very highly, not only to the uninitiated but also to more experienced biochemists. It should also be in the science libraries of high schools.

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Soil Properties

Soil Clay Mineralogy. A symposium held at Blacksburg, Virginia, in July 1962. C. I. Rich and G. W. Kunze, Eds. University of North Carolina Press, Chapel Hill, 1964. xvi + 330 pp. Illus. $8.

A seminar on soil clay mineralogy, sponsored by the Southern Regional Cooperative Research Project S-14 on Soil Properties, was held at the Virginia Polytechnic Institute in July 1962. Nine authorities on clay mineralogy were invited to give lectures in their specialties, and the stated object of this volume is to present condensed versions of these lectures "to the scientific community at large, particularly to all those working with clay mineralogy regardless of their ultimate interest in this subject."

Unlike papers in the series *Clays and Clay Minerals* (the proceedings of the National Clay Conferences, now the Clay Minerals Society), the chapters in this volume are not technical presentations of new data, nor do they form a textbook of elementary clay mineralogy. The contributions are aimed at an audience that is already familiar with the rudiments of clay mineral structure, chemistry, and nomenclature, and, with two principal exceptions, they are mainly reviews of the state of the art in each of several methods used to analyze clay minerals. The first exception is the first and longest chapter (73 pp.), a discussion by W. D. Keller (University of Missouri) of the physical-chemical factors involved in origin and alteration of clay minerals. The strong geologic orientation of this chapter emphasizes the fact that the material in this book is applicable to other disciplines as well as soil science.

The chapter "Structure and mineral analysis of soils," by Roy Brewer (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia), is in textbook form and treats the classification of soil structures, definitions of soil structure terms, and illustrations of soil structure features. In the section on mineral analysis, Brewer is concerned with the factors to be considered in analysis rather than with the description of analytical techniques.

The short (11 pp.) chapter on x-ray diffraction analysis, by W. F. Bradley (University of Texas), appears to be a considerably condensed version of his lecture; owing to its somewhat formidable, though accurate, language this chapter will probably be useful only to readers who are already familiar with the physics of x-ray diffraction. However, it is supplemented by a discussion of x-ray methods and interpretation in the chapter by M. L. Jackson (University of Wisconsin) on mineralogical analysis.

In the chapter on application of the electron microscope, Thomas F. Bates (Pennsylvania State University) presents illustrations of distinguishing features of clay minerals and discusses factors that affect their appearance in electron micrographs. Preparation techniques for electron microscopy are detailed in the chapter by John L. Brown (Georgia Institute of Technology).

Three chapters concern the history, theory of operation, and application to clay mineralogy of particular analytical tools—infrared analysis by R. J. P. Lyon (Stanford Research Institute); thermal analysis by R. C. Mackenzie (Macaulay Institute for Soil Research, Aberdeen, Scotland); and x-ray spectrographic analysis by A. H. Beavers and Robert L. Jones (University of Illinois).

In the final chapter, M. L. Jackson and R. C. Mackenzie discuss the principles of quantitative estimation of clay minerals from standard chemical analyses. This chapter, together with Jackson's chapter on mineralogical analysis, contains what appears to be as complete a catalog, in brief, of the many varied and often quoted analytical methods used by Jackson and his co-workers as any previous publication of which I am aware. Not every reader will wish to follow all the procedures in this book, but the procedures illustrate well what may be involved in a highly detailed analysis of a clay-bearing sample.

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Modern Geometric Optics

Mathematical Theory of Optics. R. K. Luneburg. With a foreword by Emile Wolf and supplementary notes by M. Herzberger. University of California Press, Berkeley, 1964. xxx + 448 pp. Illus. $12.50.

This book by the late R. K. Luneburg is based on the lecture notes that he used at Brown University during the summer of 1944. Those notes have long been regarded as an original and, in fact, classical treatment of modern geometric optics. We are fortunate to now have the same material made more readily available in the form of a book, for which Emile Wolf has written a foreword.

In chapter 1, it is shown how the two main avenues of optics, wave optics and geometric optics, can both be developed from Maxwell's equations. In chapter 2, Hamilton's theory of geometric optics is formulated, and, in chapter 3, some of its applications are outlined. These include complex lens systems, aspherical surfaces, media of radially symmetrical refractive index, spherical aberration and coma, and the "Luneburg lens." A lens of this type images two spherical surfaces stigmat-