lites (Newell), (4) The Sun's Ionizing Radiation (Friedman), (5) The Airglow, (6) General Character of Auroras, and (7) The Auroral Spectrum and Its Interpretation (Bates), (8) Radar Studies of the Aurora (Bosher), (9) The Ionosphere (Ratcliffe and Weekes), (10) The Upper Atmosphere and Geomagnetism (Vestine), and (11) The Upper Atmosphere and Meteors (Greenlow and Lovell). Each chapter represents an authoritative, detailed review with an adequate set of references to the important papers published. The advances made during the IGY have led to the addition of a separate chapter in which some of the more recent contributions are described. Consequently, this text is valuable not only to the specialist but also to the worker who wishes to get acquainted with the subject with the least expenditure of effort.

The contents of this book reflect our present state of knowledge or lack thereof. Also, the information presented points to some of the yet unresolved problems, as for example, the chemical kinetics of the species found in the upper atmosphere, which are responsible for such phenomena as the airglow. In this area rapid progress is to be expected during the next decade, stimulated in part by the authors of *Physics of the Upper Atmosphere*. It is hoped that by that time the scientific workers will have come to an agreement on atmospheric nomenclature.

Perhaps one would expect that the contribution of eleven authors to eleven chapters of this book would result in a series of independent, unrelated monographs. Yet due credit must be given to the editor (who is also the author of one chapter) for his skillful fitting together of the individual pieces, so that the book is more than an assemblage of unrelated sections.

Frozen Free Radicals. By G. J. Minkoff. 148 pp. Interscience Publishers, Inc., New York, 1960. $5.00. *Reviewed by Stuart A. Rice, Institute for the Study of Metals, The University of Chicago.*

IN the past few years remarkable progress has been made in the study of unstable atomic and molecular species. One of the most useful techniques has been the matrix isolation of free radicals, the subject to which the book under review is addressed. It has long been apparent that an authoritative treatment of this subject would be extremely valuable. Unfortunately, brief perusal of Minkoff's monograph clearly indicates that such a treatment is still needed.

In almost all respects I have found this book unsatisfactory. The section dealing with experimental methods is over-abbreviated and superficial. For example, the information given on low-temperature technology is insufficient to allow the novice either to build or find in the literature suitable apparatus of general character for work in this region, although the details of some very special apparatus are discussed. The treatment of radical detection would charm a layman, but does not give any real information to the student.

A major fraction of the book is given over to review-

ing (i.e., recording with scanty detail) the available information on a number of systems. Although there is a section dealing with ESR and triplet states, the very important work of Hutchison and Mangum is not even mentioned, and the work of Weissman and McConnell dealing with spin density in various radicals is also overlooked. In the section dealing with polymerization, the work of Morawetz on γ-induced solid-state polymerization is not mentioned.

In view of the probable widespread interest in the subject matter, it seems a pity that I cannot recommend this book on any grounds.

Finite-Difference Methods for Partial Differential Equations. By George E. Forsythe and Wolfgang R. Wasow. 444 pp. John Wiley & Sons, Inc., New York, 1960. $11.50. *Reviewed by William Nachbar, Lockheed Missiles & Space Division.*

TECHNIQUES for the numerical integration of partial differential equations by finite difference methods have been greatly advanced by research papers appearing in the mathematical and physical literature over the past ten years. This advance may be associated with the widespread availability, which came about during that same time period, of internally programmed, electronic digital computers with large, high-speed memories. These machines not only have stimulated theoretical mathematical research in numerical analysis but also have been the instruments for mathematical experimentation, whereby, for example, stability and error growth in numerical techniques at large scale are studied empirically. The computer programmer and the physicist, who are interested in becoming familiar with this very recent literature and in making use of its results, have available now in this book a comprehensive monograph which presents the new developments in a proper background of the more classical theory of partial differential equations.

The mathematical material covers 415 pages and is presented in four parts: Hyperbolic Equations in Two Independent Variables (69 pp.); Parabolic Equations (61 pp.); Elliptic Equations (230 pp.); Initial Value Problems in More than Two Independent Variables (55 pp.). In the third portion, detailed attention is paid to explicit and implicit overrelaxation methods, such as the Young-Frankel Theory (1950), and to their application to the computer.

Professors Forsythe and Wasow are well qualified to discuss new results, having made numerous contributions themselves to original research. The senior author is also especially well noted for his bibliographic work and his knowledge of Russian literature. The summaries of and references to papers written since 1950, many of which exist in foreign languages or as company reports, greatly enhance the value of this work.

Adequate reference is also made to other texts which treat more exhaustively special topics in mathematics and physics only briefly touched upon in the present