observed must be interpreted in terms of current concepts of biochemistry, and in such a rapidly developing field it is regrettable that a book published in 1964 is based on material gathered in 1961 or earlier.

A brief description of the physical characteristics of ionizing radiations and modes of energy transfer to absorbing matter precedes some 80 pages devoted to a review of radiation effects in biologically important systems. The radiolysis of water is discussed in detail, and a separate chapter is devoted to the formation of peroxides. Radiation effects in simple proteins, nucleic acids and nucleoproteins, carbohydrates, lipids, and enzymes and vitamins are considered in separate chapters. In part 2, 160 pages are devoted to the effects of radiation on the metabolism of living cells and tissues. A final chapter presents a biophysical and chemical interpretation of radiation injury in cells.

Although the present volume is more of a review, one cannot resist comparing it with Lea's classic *Actions of Radiation on Living Cells*. In Lea's treatise much emphasis was placed on the target theory. Kuzin, writing with a wealth of new concepts and experimental findings at his disposal, gives more attention to the fate and biological action of the primary products of radiation absorption.

This book will be valuable to workers in the field and to advanced students. The bibliography of 1000 items is separated into the Russian and non-Russian languages. For those with capabilities in the Russian language, references are given to the translation and the original text.

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Nematodes: A Review and Résumé

The Physiology of Nematodes. D. L. Lee. Freeman, San Francisco, Calif., 1965. 164 pp. Illus. Paper, $2.50.

During the 13 years since publication of Von Brand's *Chemical Physiology of Endoparasitic Animals*, the thin stream of work on nematode physiology has grown to a small rivulet. Lee has written an important and timely review of our knowledge of the physiology of this neglected group. The complexion of work in nematology has changed from the narrow emphasis which in the past was placed on nematode parasites of animals, and, in addition to the familiar *Ascaris* and *Trichinella*, we are now concerned with a growing group of such plant parasites as *Heterodera, Meloidogyne,* and *Ditylenchus*. Because these parasites inhabit soil during a part of their life cycle, and it is possible to control nematodes in soil, study of the physiological aspects of the ecology of nematodes in the soil has begun. New techniques of in vitro culture of animal parasites, free-living forms, and plant parasites have opened many possibilities for studies of nematode physiology.

Lee begins with a short discussion of nematode morphology, then proceeds to feeding and digestion, metabolism and oxygen transport, osmoregulation and excretion, hatching and moulting, the nervous system and sense organs, and locomotion and behavior. He provides 161 references that guide the reader toward the most important work in the field. Unaccountably, the author fails to discuss important recent advances in techniques of nematode culture.

It was refreshing to note the close attention paid to developments in phytonematology as well as to classical parasitology. The book emphasizes our vast ignorance of the physiology of the great majority of types found in soil and the total lack of work on marine nematodes. Nematodes have attracted attention as important agents of human and animal disease. The recent addition of phytoparasitic forms still leaves the bulk of the group unstudied.

Lee's monograph shows that nematodes utilize many of the usual biochemical and physiological processes, but that they are peculiar in some respects. At least one nematode synthesizes many of the so-called "essential" amino acids. Many forms are partially anaerobic; some marine nematodes inhabit mud that is completely lacking in oxygen. Lee's *The Physiology of Nematodes* should help to attract general physiologists to the study of nematodes.

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Reliability Analysis

Mathematical Theory of Reliability. Richard E. Barlow and Frank Proschan. With contributions by Larry C. Hunter. Wiley, New York, 1965. xiv + 256 pp. Illus. $11.

From sparse beginnings, reliability theory as an independent discipline has developed considerably during the last 20 years. This book attempts to provide mathematical justification for some of the practices now being used to solve reliability problems. It is my opinion that, mathematically at least, the authors have accomplished their objective. As they are careful to point out, however, statistical problems are in general not treated.

The format of the book is basically theoretical and requires a sound background in calculus and a knowledge of probability theory at the level of Feller (1957) for reading ease and appreciation. Even so, proofs of theorems are precise and not always easy to follow. Also, there is little or no discussion of the significance of the results obtained. Notation is consistent throughout and is basically identical with what has now become "standard" notation in reliability analysis. There appear to be no errors in the material presented other than an occasional misprint.

The authors derive some useful properties of probability distributions having monotone failure rates and use these in the solution of problems relating to estimation and prediction of the probability of survival for components or systems, maintenance policy, optimization procedures, and system availability. Generally speaking, system reliability is characterized either by a stochastic model (Markov Process) or by a "structure function" which attempts to describe the qualitative relationships that exist between a system and its components.

Specifically then, the book contains chapters on failure distributions, operating characteristics of maintenance policies, optimum maintenance policies, stochastic models for complex systems, redundancy optimization, qualitative relationships for multicomponent structure, and a brief discussion of pertinent reliability definitions. The useful bibliography cites most of the important contributions to reliability analysis.

Renewal theory is reviewed in the chapter on operating characteristics of maintenance policies. The renewal

equations are then used in a discussion of block replacement, replacement based on age, and random replacement. Next, optimum replacement policies subject to cost and availability constraints are analyzed, with special reference to dynamic programming procedures when these procedures are applicable. In the chapter concerned with stochastic models, the authors consider repair problems and optimal maintenance policies when the deterioration law of the system is assumed to be Markovian or semi-Markovian.

Chapter 6 is concerned with postulating models that give the amount of redundancy (both parallel and standby) necessary to maximize the probability of system survival subject to various constraints. Finally, monotonic (coherent) structures are discussed with special emphasis on k out of n structures. Bounds are given for structure reliability. Also, a generalized version of the Moore-Shannon inequality is employed to obtain the number of components needed to achieve a specified reliability.

In conclusion, it seems that this book will be a worthwhile addition to the libraries of probabilists and mathematicians working in the area of reliability analysis; however, owing to its theoretical nature and because adequate examples are not provided in some cases, it is doubtful whether the practicing reliability engineer will find it of much value.

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An Encyclopedic Survey

Structure of Matter. Wolfgang Finkelnburg. Translated from the 9th/10th German edition (1964) by the author and Ottilie Matossi-Riechemeier. Springer, Berlin; Academic Press, New York, 1964. xii + 511 pp. Illus. $14.50.

This book covers a huge range of material with a competence that is almost frightening. There are seven basic sections: Introduction; Atoms, Ions, Electrons, Atomic Nuclei, Photons; Atomic Spectra and Atomic Structure; Quantum Mechanics; Physics of Atomic Nuclei and Elementary Particles; Molecular Physics; and Solid-State Physics from the Atomistic Point of View. The last section, for example, is roughly equal in word count to some of the smaller books on the subject, such as Wannier's *Elements of Solid State Theory*.

Structure of Matter has the format of a textbook and it is, according to the preface, "written for students of physics, chemistry, biology, and engineering, in fact for all who wish to keep abreast with the rapid progress being made in this important field." The idea of a student of biology "keeping up" with the Gell-Mann theory of elementary particles, the developments in connection with controlled fusion, the shell model and collective model of the nucleus, the wave-mechanical theory of radiation, and a host of similar topics seems all too much like a dream (or a nightmare?). Accordingly, it appears to me that the major value of the book is not as a textbook, but rather as a kind of "low-brow reference book." To put it simply, there are very few (if any) subjects covered here which are not better covered somewhere else, so the value of the book is in the package deal that it offers.

The first edition of Finkelnburg's *Einführung in die Atomphysik* appeared in 1948, the present work being a translation from the 9th/10th German edition. It is amazingly up-to-date in its descriptive sections which are, by their nature, easy to update—for example, the table "Presently Known Elementary Particles" proudly lists the Ω^-. But the authoritarian spirit that allows the author, on page 335, to quote an equation without any explanation (much as $E = mc^2$ might appear in the New York *Times*) does not lend itself to exposition of matters where understanding is more important than facts. One may perhaps forgive the refusal to use the notation $\hbar$ instead of cluttering the equations with factors of 2π; that is symbolic more than symptomatic of the approach. What is less forgivable is the old-fashioned introduction of quantum mechanics as an improvement of the old Bohr-Sommerfeld theory, accompanied by fanfares about gamma-ray microscopes, thought experiments, and the uncertainty principle. The present generation of physicists knows that the essence of quantum mechanics, in the sense of superposition of probability amplitudes, is not complicated and, incidentally, has nothing to do with partial differential equations. What *is* complicated is the connection between quantum mechanics and classical mechanics. Because classical mechanics was known earlier, it is understandable that the historical development had to go through that very difficult path, but there is no reason for an introductory treatment to become deeply involved with it. Along similar lines, the section "Achievements, Limitations, and Philosophical Significance of Quantum Mechanics" is ponderous and not particularly useful. Quantum mechanics is something one does not so much *learn* as *get used to*—a fact which should not be hidden behind contrived attempts to make it look reasonable.

It remains true that some shortcomings of the sort encountered in this book are virtually inevitable when one considers the huge compass of material covered. Rather, it is impressive that such an encyclopedic work is, unlike most encyclopedias, apparently quite free of factual errors.

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Organic Analysis

Qualitative Organic Microanalysis: Cognition and Recognition of Carbon Compounds. Frank L. Schneider. Academic Press, New York; Springer, Vienna, 1964. xii + 535 pp. Illus. $22.50.

This book is a classical approach to qualitative organic analysis. Chapter 1 deals with fundamental apparatus and operations. The second chapter is devoted to preparation of the sample, including separation methods. This chapter gives an excellent description of apparatus and techniques for such microscale operations as distillation, recrystallization, and extraction. Techniques like liquid chromatography and ion exchange are included, but thin-layer chromatography and gas chromatography are not mentioned. The next three chapters are concerned with preliminary examination and include elementary analysis, determination of physical constants, and solubility.

The rest of the book is devoted to systematic analysis, much like that used by Shriner and Fuson and available in other texts. However, the inclusion of many quantitative methods for various functional groups is a distinct improvement over previous books on identification of organic compounds. Many quantitative, functional, group methods are simple to carry out, and they provide information that is