'Treating the whole subject.' Indeed, the topics are in large part derived from chapters in the life of Harold Clayton Urey . . ." (p. xvii). Even among the very great men in science, few can expect such a birthday present.

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Technology for the Layman

Masers and Lasers. How they work, what they do. M. Brotherton. McGraw-Hill, New York, 1964. xvi + 207 pp. Illus. $8.50.

The Story of the Laser. John M. Carroll. Dutton, New York, 1964. 181 pp. Illus. $3.95.

Masers and Lasers. H. Arthur Klein. Lippincott, Philadelphia, 1963. 184 pp. Illus. $3.95.

These three volumes were written to provide accounts that would give the layman some understanding of the new field of laser technology and of its great potential. The three books have much in common. Each consists of roughly 200 pages of lucid, nonmathematical discussion of lasers, stimulated emission, waves, electromagnetic theory, atoms, and certain aspects of solid-state physics.

Brotherton's book is distinguished by unusually careful and clear discussion of the physical principles and details of maser and laser operation. The great communications potential associated with the unusually large bandwidths available in the optical region and the problem of attenuation in long distance transmission are treated very nicely. It is evident that Brotherton writes about all these things with a deep understanding. Carroll's book is distinguished by the discussion of many possible applications and by his description of the construction of lasers. Klein places more emphasis on the basic physics, and his book appears to be intended for readers at the level of the high school.

There are inaccurate features. The speed of signaling by use of wires is determined by the group velocity of electromagnetic waves guided by the wires. Carroll suggests that the electron drift velocity determines the signaling speed. Also he appears to be unaware of the principle of complementarity.

The reader whose knowledge is limited to facts gleaned from Klein's book will be surprised to learn that the present time standard is a cesium beam clock and that there can be coherence in spontaneous emission processes of an assemblage.

Brotherton and Klein imply that all noise is due to heat motion. The spontaneous emission noise that really limits all voltage amplifiers is not discussed.

The free electron vacuum tube amplifier operates by stimulated emission of photons from the electrons in the interaction region. Masers and lasers differ only in the use of different kinds of quantum states. All three authors appear to be unaware of this as well as of other issues relating to the comparison of maser devices with free electron devices. Thus, the statements that masers provide a great improvement in noise performance over free electron devices are indeed true for microwave free electron devices, but at low frequencies, above the flicker noise range, free electron amplifiers can have noise performance comparable to, or better than, the performance of a microwave maser. Brotherton tells us that a black body must be at a temperature of 10^{15}K to match the laser brightness. However, a black body must be at 10^{27}K to match microwave klystron brightness.

The early history of masers and lasers is complex. Objective judgments with respect to the importance of principles, and of what constitutes reduction to practice, are somewhat difficult to make. None of these authors does a sufficiently careful job in this respect. The history presented is incomplete and inaccurate and appears to be based on newspaper accounts. There is a traditional respect for published work, arising from the fact that a scientist who publishes assumes responsibility, runs the risk of criticism, and makes his results available to large numbers of other workers. All three authors have only partially accepted this view. Among the important published work not discussed is a paper by R. H. Dicke and his 1958 patent proposing the Fabry Perot cavity.

To be consistent a historian who includes unpublished work should include all such work about which information can be obtained at the expense of reasonable effort. The well-documented unpublished work of G. Gould (1957 and early 1958) contained proposals for a Fabry Perot cavity, an optically pumped alkali vapor laser, the enhancement of inverted populations by collisions of the second kind, the achievement of laser action in electrical discharges, and the ruby as a possible working substance. But this aspect of the history is not considered in any of these volumes.

Each book is good for an evening of enjoyable reading. Brotherton's book will appeal especially to one whose interests are mainly in the physics of these devices, Carroll's book will appeal most to the engineer, and Klein's book will appeal most to the young reader.

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Protozoology

Progress in Protozoology. Proceedings of the First International Congress, Prague, 22–31 August 1961. J. Ludvík, J. Lom, and J. Vávra, Eds. Czechoslovak Academy of Sciences, Prague; Academic Press, New York, 1963. 730 pp. Illus. Plates. $24.

As the chronicle of an important international conference [see *Science* **135**, 110 (1962) for a meeting report], this volume presents a valuable cross-section of protozoological studies recently completed or now in progress. All major aspects of protozoology are represented—taxonomy, cytology, genetics, ecology, biochemistry, biophysics, and electron microscopy. There is also a section devoted to toxoplasmosis, and an assortment of papers dealing with a variety of parasitic protozoa.

Only a few of the contributions are extensive articles. The majority of the entries are less than five pages in length, and many are short abstracts. If we include the synopses of speeches offered at the opening and closing sessions of the congress, there are about 200 contributions. Recent studies by protozoologists in the United States, Czechoslovakia, Poland, the U.S.S.R., and England are particularly well represented.

Most of the papers and abstracts are in English, and the few that are in French or German have been given English titles in the table of contents. Line drawings are incorporated directly

into the papers that they illustrate, but the many photographs and some halftone drawings and color plates are collected at the end of the volume. Some of the photographs, especially the electron photomicrographs, are excellent. The editors are to be commended for seeing to it that the index is so remarkably complete. It lists almost all of the genera and species referred to in the text, as well as the principal topics. If we make allowances for the discontinuity that one must expect in a work of this type, the format of the book is pleasing, and the printing and binding are of high quality.

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Synthesis of Research

An Introduction to Radiation Chemistry. J. W. T. Spinks and R. J. Woods. Wiley, New York, 1964. xii + 477 pp. Illus. $12.75.

This book represents a valuable addition to the small but growing list of books in the field of radiation chemistry. In the past the rate at which research in this field has been published has far outstripped the efforts of those equipped to effect a synthesis, making it quite difficult for the nonspecialist to obtain a comprehensive picture of developments in the area of chemical effects of ionizing radiation. It has been equally difficult for the interested novice or the beginning graduate student to find a suitable introduction that would give him the background necessary to evaluate the status of the various problems to which the radiation chemist has addressed himself. *An Introduction to Radiation Chemistry* admirably fulfills these needs. It provides fairly complete coverage of the literature up to 1962 and in most cases provides an evaluation of this literature. In addition to a survey of aliphatic and aromatic compounds, which includes a discussion of the energy transfer problem, a rather extensive chapter is devoted to consideration of water and aqueous solutions. The mechanism of radiolysis of water is discussed mainly in terms of hydrogen atoms and hydroxyl radicals. However, the important developments of the past several years, which involve the solvated electron, are dealt with in a number of lengthy footnotes.

The general types of species implicated in most mechanisms—ions, excited molecules, and free radicals—are dealt with in two chapters, which also include elementary and necessarily brief discussions of the experimental techniques of electron spin resonance and mass spectrometry, especially as they are employed by the radiation chemist. Other experimental matter is dealt with in chapters on radiation sources and dosimetry. The treatment of dosimetry is sufficiently practical to permit the new experimenter in the field to proceed with some confidence.

Gases and solids are dealt with in two additional chapters, the chapter on solids being limited mainly to a discussion of inorganic materials The low molecular weight hydrocarbons are discussed in the chapter on gases where an effort is made to correlate radiolytic results with mass spectral data. The very nice agreement is, however, dismissed as "probably fortuitous."

A final chapter is devoted to industrial applications. A small number of numerical problems are also included.

This book will be of considerable value to those seeking an introduction to this rapidly expanding field, and it should serve as a useful textbook for beginning graduate courses in radiation chemistry.

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Biochemistry

The Biosynthesis of Vitamins and Related Compounds. T. W. Goodwin. Academic Press, New York, 1963. x + 366 pp. Illus. $11.

Although it is true, as the author states in the introduction to this book, that investigations in the field of vitamin biosynthesis are increasing both in number and sophistication, it is equally true that, with respect to the subject, much remains unknown; in fact, so much is still unknown that one wonders about the advisability of writing a book on the subject of vitamin biosynthesis at the present time. It is still not possible to give the complete biosynthetic pathway for a single vitamin. Because much of the significant information is just now being published, Goodwin is, of course, incomplete in his treatment of a number of the vitamins, such as folic acid, vitamin B_{12}, and riboflavin.

For each vitamin the author presents sections on history and occurrence; environmental effects on production of the vitamin by plants, bacteria, and animals (where applicable); an exhaustive review of what is known about the nature of the precursors of the vitamin; and a discussion of the enzymatic reactions leading to the synthesis of the vitamin and its coenzyme forms. Although this approach is certainly comprehensive, having to plow through so much relatively irrelevant information before the significant work is presented makes for rather dull reading. In some instances the reader himself has to select the significant information from a mass of observations that are presented in a noncritical manner. The author is especially guilty of the lack of critical treatment of his subject in the section on folic acid biosynthesis.

In a number of instances, facts are misrepresented—for example, I counted five such mistakes in the chapter on pantothenic acid and coenzyme A. These mistakes could and should have been avoided by paying more careful attention to the preparation of the manuscript.

The author's practice of presenting the biosynthetic pathways for precursors of precursors of vitamins is entirely unnecessary and out of place in this book. The most flagrant example of this practice is in the chapter on folic acid, where he uses the fact that glutamic acid is a component of folic acid as an excuse to present the biosynthetic pathways for the formation of histidine and for the conversion of histidine to glutamic acid. This information is completely irrelevant because the glutamic acid found in microorganisms is probably made entirely from α-ketoglutaric acid.

Although the book suffers from the several faults discussed above, it does provide a complete bibliography through 1962 for publications on each vitamin. The author is to be commended for what must have been a monumental task in reading and cataloging these references. The book certainly will be useful as a source of information about who has published what in the field of vitamin biosynthesis, although it falls considerably short of being an appropriate textbook for undergraduate biochemistry students, a goal that the author had set for himself according to the introduction.

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