

processes to an extent that they become useless and completely wrong. In a very concise manner, well-known procedures and not so famous methods, as well, are investigated, always with the thought in mind when and where errors are likely to occur. This excellent book should belong to every library, private or official, which is concerned with methods of numerical computation.

Optical Masers. By O. S. Heavens. 103 pp. Wiley, New York, 1964. \$3.25.
Reviewed by William S. Bickel, The Pennsylvania State University.

It has not been a very long time since the first optical maser was successful, but in that time there has been an almost fantastic amount of progress in maser technology and in the associated areas of physical optics and optical instrumentation. With the maser giving us physical quantities enhanced by many orders of magnitude over those which had previously been accessible to us, it is natural that this device, coupled with a variety of optical instruments, would create some surprises and even cause a reexamination of some well-understood concepts of optics. It is also understandable that even with a field so young and developing so fast, that an attempt be made to stop and summarize concisely some of the basic principles and important techniques of current maser research. This monograph does just this and in a way that should be interesting and enlightening to anyone associated with maser research or just generally interested in the maser field.

Dealing entirely with masers of the optical region, the book begins with a succinct and elucidative introduction to electromagnetic radiation and its interaction with matter with special emphasis on the concepts of time and space coherence that have been so remarkably demonstrated by masers. Boltzmann statistics and transition probabilities are discussed with specific reference to the population inversion necessary for maser activity. Subsequent chapters treat the maser in the optical region with a considerably detailed discussion of the excitation of the maser system and the operation and characteristics of vari-

ous solid-state and gaseous masers. The last chapter deals briefly with the applications of optical masers to such fields as communications, optical radar, Raman spectroscopy, photography, and plasma research.

An especially impressive and important feature of this little book is that it is not written in generalities. The author has taken unusual care in specifically quoting the various experimental values—temperatures, pressures, percentage compositions, power outputs, line widths, wavelengths, etc.—that characterize various maser systems. I think it will be a while before one will find a book that summarizes this fascinating field so comprehensively but at the same time so specifically.

Biographical Memoirs of Fellows of the Royal Society, Volume 9. 321 pp. The Royal Society, London, 1963. \$6.00.
Reviewed by R. B. Lindsay, Brown University.

These biographical memoirs continue to serve as very useful source material for the history of contemporary science. The present volume contains notices of seventeen fellows who died between 1961 and 1963. In their professional interests, nine were physical scientists or technologists, six were life scientists, one was a statistician whose chief concern was with the life sciences, and one was a historian. To those interested in the longevity of scientists, it may be pointed out that the oldest at death (a medical scientist) was 94 and the youngest (a molecular biologist) was 63. The average age at death was close to 77.

Of greatest interest to physicists are the biography of Niels Bohr by Sir John Cockcroft and that of Sir Charles Galton Darwin by Sir George Thomson. Bohr, who died on November 20, 1962, was elected a Foreign Member of the Royal Society in 1926. Cockcroft's eighteen-page memoir is a very readable survey of the principal events of Bohr's professional life and pays particular attention to his close relations with Rutherford and other prominent British atomic physicists. In addition to the emphasis on his outstanding contribution to physics as the founder of the quantum theory of atomic structure, there is a relatively

long account of his activities in connection with the atomic bomb and the peaceful uses of nuclear energy. There is less about Bohr's concern with the epistemological aspects of atomic physics to which he returned again and again throughout his life and which will continue to be a source of philosophical inquiry and discussion for years to come.

The memoir of Darwin will also be read with interest and satisfaction. Due justice is paid to the professional accomplishments of his very active life as a teacher, research investigator, and educational and scientific administrator. He was a man of great personal charm and a persuasive and effective lecturer, even on somewhat unpopular topics.

Other biographical sketches which will probably appeal to physicists are those of R. A. Fisher, the statistician, John Read, the chemist and historian of chemistry, and George Macaulay Trevelyan, the historian, who for eleven years was Master of Trinity College, Cambridge.

Each memoir is accompanied as usual with a complete bibliography and an autographed portrait. The quality of book production continues to maintain the high standard set by the previous volumes in the series.

Progress in Biophysics and Molecular Biology, Volume 13. J. A. V. Butler, H. E. Huxley, and R. E. Zirkle, eds. 328 pp. (Pergamon, Oxford) Macmillan, New York, 1963. \$12.75.
Reviewed by George H. Weiss, Rockefeller Institute.

The modern developments in biology with the best publicity are usually those related to "The Code". However, there is a new feeling which pervades many fields in biology that physics and chemistry are the keys to unlock all of the mysteries of life phenomena. This volume is a good introduction to several biological problems that can be stated in essentially physical terms.

One of the most important and oldest of these problems is the mechanism by which radiation affects biological structure. A long review of the work on radiobiological mechanisms is given by L. G. Augenstein. Not only are these problems intriguing from the

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biological point of view, but they are also challenging as purely physical problems in the mechanisms of energy transfer.

The field of botany provides another fascinating area of investigation in enumerating the mechanism for movement of liquids through the stems of plants. Although this problem might sound simple it gives rise to difficulties which require great ingenuity in the unravelling of the several possible transport mechanisms. A review of research on this topic by R. D. Preston makes for stimulating reading. Other articles in this fine collection include ones by G. Scholes on the radiation chemistry of aqueous solutions of nucleic acids and nucleoproteins, by O. Kratky on small-angle x-ray scattering applied to substances of biological interest, by M. Grunberg-Manago on enzymatic synthesis of nucleic acids, and by F. D. Carlson on the mechanochemistry of muscular contraction.

This volume is of interest not only to biophysicists but also to other physicists as an introduction to frontier problems in biology.

Principles of Magnetic Resonance. By Charles P. Slichter. 246 pp. Harper & Row, New York, 1963. \$8.25.

Reviewed by J. H. Van Vleck, Harvard University.

This book is based on the popular graduate course on "Magnetic Resonance in Solids" which the author gave as Loeb Visiting Lecturer at Harvard in 1961. This fact should be kept in mind in appraising the volume; it does not pretend to be a treatise covering in detail all aspects of the subject, but rather it aims to give graduate students a "feel" for the subject. This objective is well described by quoting some sentences from the author's preface: "The problem faced by a beginner today is enormous. If he attempts to read a current article, he often finds that the first paragraph refers to an earlier paper on which the whole article is based, and with which the author naturally assumes familiarity. That reference, in turn is based on another, so the hapless student finds himself in a seemingly endless retreat. I have felt that graduate students or others beginning research

in magnetic resonance needed a book which really went into the details of calculations, yet was aimed at the beginner rather than the expert."

The book opens with a brief introductory chapter on the "Elements of Resonance". The next chapter is called "Basic Theory" and presents with unusual clarity such subjects as rotating frames for alternating fields, the Bloch equations, 180° pulses, and the Kramers-Kronig relations. The text goes on to consider the method of moments, chemical shift, the Knight shift, indirect nuclear coupling, and the density-matrix and its use in the Bloch-Wangsness-Redfield theory of line structure. Professor Slichter cites Tolman's *Principles of Statistical Mechanics* as having an exceptionally good discussion of the density matrix, but this comment applies equally well to his own presentation. The chapter on electric quadrupole effects includes discussion of Clebsch-Gordan coefficients and the Wigner-Eckart theorem. After opening with a taste of ligand field theory, the final chapter, "Electron Spin Resonance", treats especially the V_k centers, which were first observed by Castner and Kanzig and which are diatomic complexes formed by the trapping of electrons in irradiated alkali halides. Possibly one may wonder why this subject is included, as it is a rather more specialized one than most of those treated in the book. The discussion of it can, however, be regarded as a sort of graduation exercise, since this single problem involves simultaneously so many of the interactions studied in earlier pages.

At the end, the book includes eight pages of problems, a selected bibliography, and five appendices dealing with mathematical details.

Since the volume is only about half as large as Abragam's massive *Principles of Nuclear Magnetism*, the coverage of subject matter obviously cannot be as extensive. The book does not include such subjects as negative temperatures, Landau-Lifshitz in distinction from Bloch damping, and the Overhauser effect, even though Professor Slichter pioneered in confirming this effect experimentally. However, a title "Selected Topics in Nuclear Resonance" would have been too restric-