Delhi, India, and apart from his publications in the scientific journals has also to his credit another book with T. Venkatarayuda, *Theory of Groups and Its Application to Physical Problems* (Andhra University, Waltair, 1962, 3rd ed.) with which this reviewer is not familiar. In summary, I would say that Bhagavantam's new book will be most useful, especially in conjunction with Nye's book; furthermore, it is very readable and well organized.

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Electron beams and electromagnetic waves

NON-LINEAR ELECTRON-WAVE INTERACTION PHENOMENA. By Joseph E. Rowe. 591 pp. Academic Press, New York 1965. $18.00

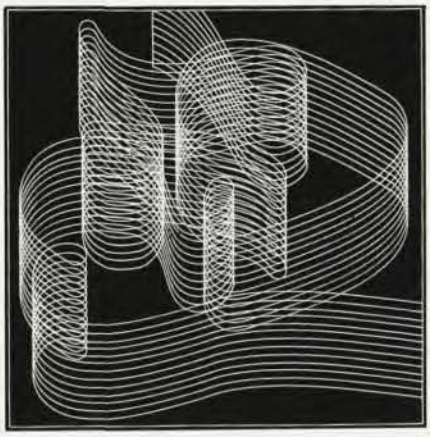
by H. J. Hagger

There are very few systematic treatments of electron-wave interactions; we find, however, discussions of this topic in books on specific types of microwave tubes. In almost all these cases a linear, small-signal theory is developed. Rowe based the book on his own research and the work done by his research students, and has succeeded in treating the large-signal and nonlinear behavior of all types of microwave tubes. The topics are developed essentially from one single base that makes the difficult subject quite easy to follow.

The first four chapters provide the general framework for more detailed applications to specific interaction configurations. After a general introduction two approaches to the problem are treated, the consideration of the electron beam as a whole and the particle-wise development of the theory. The latter may be applied both to normal and crossed-field devices. In chapter 3 there follows a quite general introduction into rf equivalent circuits, both for metallic transmission lines and for surface-wave propagation of a plasma beam. Multidimensional and backward-wave structures are considered. The next chapter is devoted to space-charge field configurations.

In chapter 5 we find a one- and two-dimensional klystron analysis together with radial and angular as well as relativistic effects. Chapter 6 is similar in its systematic construction for travelling-wave tubes without crossed fields. The next chapter deals with O-type backward-wave oscillators. In chapter 8 drift-space interaction phenomena in crossed fields are considered, serving as a basis for the next two chapters on forward-wave crossed-field amplifiers and M-type backward-wave oscillators. For tubes with an emitting sole, e.g. the travelling-magnetron oscillator and amplifier, we find just the remark that they can be treated in a similar way. The remainder of the book is then devoted to special problems in microwave electron-beam tubes.

In chapter 12 the author discusses multibeam and beam-plasma interactions. In general the crossed-field devices show higher efficiencies than linear beam tubes because with the potential energy conversion process in the former tubes the electron bunch stays in synchronism with the rf wave. In chapter 13 Rowe investigates some phase-focusing means, e.g. velocity tapering or a dc gradient in the beam flow, which improve the percentage of energy extracted from the beam. This investigation applies both to amplifiers and oscillators. In the next chapter the influence of pre-bunching the beam before it enters the interaction space is considered and the power required to bunch an electron beam is calculated. In order to increase the efficiency even further the collector-depression technique is investigated.



The last chapter is devoted to low- and high-frequency modulation processes. In three appendices rf structure impedance variations and Kompfner dip conditions for normal and crossed-field tubes are considered. We find a selected list of references to each chapter and—unfortunately—quite a small subject index. The reviewer might add that there are captions to the figures that often lack the information required to understand the figures and the conclusions to be drawn from them. This very minor criticism has been mentioned just to improve a next edition of the book.

As a whole we have here an excellent book on the large-signal behavior of electron-beam tubes, the theory of which is based on the same basic relations for all microwave electron-beam tubes. The approach derived by Rowe will certainly find other applications to field-plasma interactions. The book will serve as an outstanding book on nonlinear analysis of interactions. The research scientist interested in this field will be pleased to have this book.

The reviewer doubts, however, that it will find much use as a textbook for a graduate course. Parts of it will serve excellently as a source and root for an advanced course and it must be left to the lecturer to select the problems to be treated. The book requires that the reader be familiar with the basic theories of electron-beam tubes found in well known standard books and famous papers. In any case Rowe's book can be highly recommended for research studies in nonlinear interaction theory. The book will be an excellent guide through the field and it will occupy its well deserved place as a standard work on this special field for a very long time.

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Quanta and large things

WAVE MECHANICS AND MOLECULAR BIOLOGY. Louis de Broglie, ed. 186 pp. Addison-Wesley, Reading, Mass., 1966. $8.75

by R. Bruce Lindsay

In the past 20 years application of quantum chemistry to structure and behavior of large organic molecules has made great strides. This has par-

alleled the great experimental discoveries in what has come to be called "molecular biology." The phenomenal success of quantum mechanics in the description of the physical properties of solids, liquids and gases in terms of their atomic and molecular constitution, aided in recent years by fast computer calculations, strongly suggests that the same fundamental methods will ultimately be successful in unraveling the mysteries of the molecules at the basis of the behavior of living organisms.

The present volume surveys some developments in this general field. It is a translation of the French work "Mécanique Ondulatoire et Biologie Moleculaire," edited by Louis de Broglie. A volume in the Adiwes International Series in Biology, it consists of twelve separate essays by as many authors. There is nothing to indicate the origin of the essays, but their style suggests that they are based on a conference in France organized by de Broglie. The authors are for the most part French, though there is one British contribution as well as one from Sweden. The professional associations are not provided in every case, though most of the French authors would appear to be connected with such organizations as the Institut Henri Poincaré, the Institut de Biologie Physiochimique, the Radium Institute and the Faculty of Pharmacy of Paris. The only name well known to American physicists is Leon Brillouin.

The book exhibits both the merits and defects usually associated with a collection of this kind. For the expert it provides a good summary of rather recent results on some highly specialized but important problems in theoretical biological research, accompanied by useful bibliographical references. For the general reader, it unfortunately fails to contain any real thread of continuity of background material, such as for example one finds in the recent book *Bioenergetic* by A. L. Lehninger. Indeed a perusal of the latter work could make the reading of the book under review much more meaningful for the average physicist.

Perhaps one exception to this criticism is found in the general article by Didier Bertrand on "Chemical Constitution and Biological Activity." In this the author presents in persuasive fashion a review of the inadequacies of the conventional organic-chemistry terminology (structural formulas, etc.) in facing the problems of biological activity. He also indicates fairly clearly with a few well chosen examples how quantum mechanics, with its ability to calculate charge and field distributions by the method of molecular orbitals, may be able to shed light on the interactions of macromolecules. The reviewer found this the most readable article in the collection.

Only about half of the papers contain specific reference to quantum mechanical calculations. The others contain summaries of experimental results on enzyme action and biological catalysis in general, the study of carcinogenesis and methods of chemotherapy. Physicists will find special interest in Leon Brillouin's article on macromolecules and semiconductors.

Though the translation into English is in general adequate, there remain numerous careless errors of spelling and grammar that detract from the attractiveness of the volume.

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X rays, electrons, neutrons

DIFFRACTION METHODS IN MATERIALS SCIENCE. By J. B. Cohen. 357 pp. Macmillan, New York, 1966. Cloth $8.95, paper $4.95

by Martin E. Straumanis

The present book is the second of the "Macmillan Series in Materials Science." As can be easily understood. "Materials Science" is now a collective word for the chemical, physical, mechanical and crystallographic properties of various crystalline and amorphous substances, inorganic as well as organic. Diffraction methods can be applied for the investigation of all of these substances, including gases, and numerous books are written to cover the separate topics. Was it necessary to write one more? The answer will be given at the end of the review.

The title of the book is somewhat misleading as it does not cover the application of visible light: Only x-ray, electron and neutron diffraction methods are described. Hence, the book starts with the "Principles of Crystallography" (pp. 1–60). Then follow the chapters "The Nature of Diffraction" (61–120), "The Production of Radiation Useful for Studying the Structures of Materials" (121–147), "Recording the Diffraction Patterns" (148–226), "The Interaction of X-rays, Neutrons and Electrons with Atoms" (227–266), "The Integrated Intensity" (267–284), "Equipment for Measuring Intensities" (285–296), and "Imperfections" (297–338). There are three appendixes at the end of the book and an index. Each chapter concludes with problems (answers on some problems are given in appendix B) and with additional references for further reading.

As can be seen from these contents, the book covers a very wide range of diffraction phenomena, including their explanation and application. Therefore, a very concise treatment is expected and is found. Nevertheless, the book is easily readable, however, only to those who have some knowledge in the whole subject matter. I have worked in x-rays since 1934, and it is my opinion, based on experience, that with rare exceptions, a student can not use a book like the present one alone as a guide when applying, for example, x rays in his research, because it is simply too short. With the exception of a few chapters, for example that on the application of Laue patterns, there are not enough explanations for the experimental solution of problems. The book may be useful if a student has an experienced instructor who introduces him to all the details not mentioned in the book. Otherwise he has to consult many of the books frequently mentioned by the author (those of Azároff, Buerger, Cullity, Guinier, Feynman, Klug, and Alexander and of other authors) and the International Tables of Crystallography, for the use of which there are good comments in the text.

Thus, the book gives a good overlook over the large field of x-ray diffraction combining it with the respective phenomena observed with electrons and neutrons. For instance the chapter "X-ray Scattering Factor" is followed by "Electron Scattering Factor" and "Neutron Scattering Factor," which can be appreciated by