

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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Henry M. Otte is manager of the Martin Co. Materials Research Laboratory in Orlando, Fla.

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

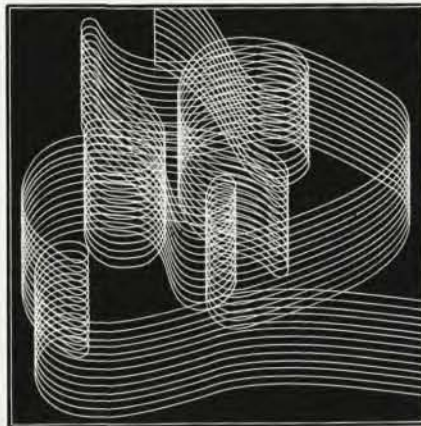
There are very few systematic treatments of electron-wave interactions; we find, however, discussions of this topic in books on specific types of microwave tubes. In almost all these cases a linear, small-signal theory is developed. Rowe based the book on his own research and the work done by his research 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 ta-



pering 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 struc-

ture 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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H. J. Hagger is an electronics engineer associated with Albiswerk Zurich, Switzerland.

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-