

properties, including the interesting possibility of charge reinforcement by the incorporation of combustible metal filaments.

A principal aim of all the authors, directly or indirectly, is to eliminate empiricism from the design and development procedures used in solid propellant technology. This is a formidable task, and the project engineer, working with real propellants and aware, therefore, of their often wide departure from either ideal or even reproducible mechanical behaviour, will perhaps derive little comfort from the analytical complications associated with the simplest of model materials. Nevertheless, enormous increases in the size of motors in the past decade have made empiricism intolerably expensive, and the next ten years will certainly see development engineers, chemists and theoreticians moving closer together. Furthermore, the researches which have been stimulated by the complex requirements of solid propellants will benefit other branches of engineering and technology. The sponsors, editors and authors of these papers are to be congratulated on providing a text which will do much to accelerate both of these processes. R. HERON

## UNDERGRADUATE ASTRODYNAMICS

### An Introduction to Astrodynamics

By Robert M. Baker, jun., and Maud W. Makemson. Second edition. Pp. xiii+439. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1967.) 94s.

THE second edition of *An Introduction to Astrodynamics* is much revised, and expanded to two volumes. So far only the first introductory volume has appeared; it is larger than the single volume of the first edition. The authors define astrodynamics as the engineering or practical application of celestial mechanics and allied fields, which include, for example, the study of atmospheres and observational techniques.

The book is based on undergraduate courses given by the authors during several years at the University of California; this is reflected in an improvement in presentation. Throughout this volume, especially in the introductory sections, there is a tendency to describe methods by which equations are derived, and to state them. The most important proofs, however, are given either in the text or in one of the appendixes, the scope of which includes interpolation formulae and vector analysis, as well as orbital relationships.

The early chapters cover in a convincing fashion a description of the classical calculations made for, and discoveries of, the minor planets, the Moon and comets; there is also a discussion of interplanetary matter. The undergraduate who is interested in the subject cannot fail to be intrigued by these analytical sagas.

The mathematical chapters serve chiefly as introductions for the advanced volume. A lot of work on co-ordinate systems is presented, leading up to some basic equations used in the calculation of orbits.

A fairly long chapter is devoted to constants and their determination, by both classical methods of celestial mechanics and modern methods involving the use of radar. The constants include masses and other gravitational constants of the planets and the Moon; also atmospheric constants, which are not, however, true constants, for they are subject to irregular fluctuations.

More than a hundred pages are devoted to a chapter on observational theory. This is almost entirely descriptive, and relates to the determination of time, systems for observing space vehicles, and brief details of observational instruments. It is typical of the comprehensiveness of the book that a section on anomalistic observational phenomena, that is, flying saucers and the like, is included.

Key equations are collected, and a set of exercises is given at the end of each chapter. Although, from a mathematical point of view, astrodynamics would still be considered to be part of celestial mechanics, this book clearly shows that a distinctive course on astrodynamics can be given at undergraduate level. The book, however, is priced well out of the undergraduate market.

R. GRAHAM

## FEATURING FERROELECTRICS

### Ferroelectricity

By Ennio Fatuzzo and Walter J. Merz. (Series of Monographs on Selected Topics in Solid State Physics, Vol. 7.) Pp. x+289. (Amsterdam: North-Holland Publishing Company, 1967.) 35 guilders; 70s.

FERROELECTRICITY is a rapidly advancing subject. Every year new ferroelectrics are discovered and new types of ferroelectric behaviour shown to exist, either in the newly discovered ferroelectrics or in the old and well-known ones. In these circumstances the publishing from time to time either of books or of review articles is valuable to both the student and the research worker. A number of useful books on ferroelectrics have been published, and this book is a valuable addition to them.

The subject of ferroelectricity can be treated in two main ways. Individual ferroelectrics or classes of ferroelectrics can be described in detail, or the various types of phenomena associated with ferroelectricity can be considered, referring to individual ferroelectrics only as examples. The first approach was used in an excellent book by Jona and Shirane, while Merz and Fatuzzo have used the second approach. They have discussed all the important ferroelectric phenomena, but have properly paid most attention to the recently discovered ones, particularly those that have not been previously described in a book or review article.

The book starts by discussing the "classical" equilibrium properties of ferroelectrics and the thermodynamic theory used to interpret them. There is then a chapter on the lattice dynamic theory first developed by Cochran, which has not been previously described in a book; its relation to the older local field theories is also considered. After a brief chapter on the static properties of domains there is a chapter on the switching and other dynamical properties of domains. This last is a subject on which the authors have done a great deal of work, and, as might be expected, it is treated at some length. There is then a short chapter on the theory of these dynamical properties, followed by three short chapters on radiation damage, some special effects (mostly recently discovered) and applications of ferroelectrics.

A. F. DEVONSHIRE

## DEALING WITH MACHINES

### Eddy Currents

By J. Lammerauer and M. Staff. English translation edited by G. A. Toombs. Pp. 233. (London: Iliffe Books, Ltd.; Prague: SNTL—Publishers of Technical Literature, 1966.) 37s. 6d. net.

ORIGINALLY a Czech publication, this book has been well translated and the style is easy to read. The material which it contains is largely a collection of particular cases of eddy current problems which arise frequently in electrical machine design, although the applications are certainly not restricted to this field alone. Each example is carefully treated and whenever possible rigorous mathematical arguments are developed leading to many well-known results and others which are less frequently encountered. The authors have not restricted themselves to the linear regime where iron is concerned