Nicolaides and M. M. Macomber, is satisfactory, though the examples quoted are not always the best. The contribution by W. M. Kaula, who discusses how satellites should be used to investigate the gravitational fields of the Moon and planets, is an excellent introduction to a difficult subject.

The final and longest chapter, of nearly 100 pages, is by K. A. Ehricke, on "Orbital Operations": this is not concerned with surgery under weightless conditions, but with the "controlled change of conditions of a technical system in space". Biological terms do appear, however, as is quite natural since space vehicles, like animals, can propel themselves and execute purposeful actions: thus we find discussion of "coupling, docking and mating". Dr. Ehricke's chapter is a masterly survey of what may well be going on in space in twenty years time when operations in cislunar and interplanetary space may be as routine as airline schedules are now. Occasionally Dr. Ehricke falters over points of detail, but this does very little to reduce the value of his survey.

The book is well printed and produced, with good indexes and only a sparse crop of misprints. The jacket strikes a slightly false note: a moonscape on the dust cover may be better than a dust cover on the Moon, but the lunar scene shown is too unrealistic for a soberly scientific book. This superficial blemish does not prevent the book being an admirable addition to the literature of lasting interest on space science and technology.

D. G. King-Hele

A SURVEY OF KRON'S THEORIES

Tensors in Electrical Engineering

By J. W. Lynn. Pp. x+216. (London : Edward Arnold (Publishers), Ltd., 1963.) 52*s.* 6*d.*

WITHIN the compass of about 200 pages, the author of *Tensors in Electrical Engineering* gives quite a detailed survey of Kron's application of tensors to electric networks and machines. He is firmly convinced that tensors are an essential feature of the unified theory of electric machines.

A brief first chapter summarizes the necessary groundwork of determinants and matrices, after which Dr. Lynn plunges at once into Kron's network analysis. Tensors are described and used early in the book without excessive use of geometry. From the development of a set of general equations describing the performance of a generalized machine, Lynn proceeds to the equations of actual types by derivation from the general equations.

A substantial proportion of the book is devoted to hunting, and the analysis of a two-machine system is given in full. It is pleasant to see that stability tests were carried out on a laboratory two-machine system, and the results compared with the theoretical calculations. Although the author's principal topic is electric machines, he includes in his final chapter a fairly comprehensive treatment of Kron's circuital models of the electromagnetic field equations.

This is by no means a book for beginners. It is aimed at postgraduate students of electric machines and research workers in this field. For such readers, it is probably not too difficult if they are already conversant with the subject. The book is obviously the culmination of many years of research and reflexion. The text is clear and concise. Lynn shares Kron's philosophy and follows his methods very closely with, however, less reference to geometry. He proceeds with ease and assurance through the more difficult parts of the mathematics.

It is necessary to pass now from praise to protest. The second chapter opens with a figure showing two simple static networks the power inputs of which are patently unequal. A transformation matrix which is singular (three rows and two columns) is also displayed. Yet the author opens his mathematical analysis of the two networks by equating the unequal power inputs. A few lines later, he uses the inverse of his transformation matrix which obviously has no inverse. There are other holes in the theory, but these two will suffice. The author is well aware of them and indeed discusses them: it is sobering to reflect that he can muster support for such avoidable subterfuges. The theory is bad and should be abandoned; Kron's technique is so impressive and so successful that it merits a rigorous theory.

W. J. Gibbs

ELIMINATION FROM THE BODY OF RADIOACTIVE ISOTOPES

Radioactive Metal Mobilization in Medicine

By Prof. Alexander Catsch, translated from German by Dr. Bergene Kawin. (Springfield, Illinois: Charles C. Thomas, 1964.) 7.50 dollars.

THE ever-increasing peace-time production and use of radioactive substances, including metals, together with the potential hazard of their extensive release in time of war, have brought a greater danger of accidental contamination to those handling these substances and otherwise exposed to them. The elimination of radioactive isotopes from the body, before they have had time to become irreversibly fixed to the tissues, calls for the use of every available means.

The author reviews, in *Radioactive Metal Mobilization in Medicine*, the present-day methods of removal of radioactive metallic isotopes, restricting his observations to a few of the metals likely to be encountered in the laboratory and to those which have so far been investigated. Attention is directed mainly to the use of chelating agents which the author regards as the most promising substances for this purpose. After a description of the chemical structure and probable mode of action of chelating agents, there follows a discussion of the results of their use under experimental conditions in animals. Although most of the present knowledge of this subject is based on animal experiment, it is probable that much of the information so gained is applicable to man, as the action of chelating agents depends very largely on physico-chemical forces. The author is, however, careful to point out that some of the experimental results may not apply to man.

The first attempts at heavy-metal elimination from the body date from the use in man, some 30 years ago, of calcium salts and parathormone in an attempt to remove lead incorporated in the skeleton. A similar competitive action using a stable isotope to dilute a radioactive isotope bound to body-tissues is still used, but has to a great extent been replaced by the use of complexing (chelating) agents. Of the chelating agents at present in use, the polyaminopolycarboxylic acid group offers the most promise. Much work still remains to be done to improve the complexing properties of chelating agents for individual isotopes, and the problem of toxicity of both chelator and its metal complex has prevented many active substances from becoming therapeutic realities.

The removal of radioactive isotopes from the body requires not only an understanding of the probable action and structure of complexing agents, but also a knowledge of how individual isotopes are stored in and eliminated from the tissues. The effectiveness of any chelating agent in binding a metal in any particular organ varies considerably and has to be established by experiment. Furthermore, a chelating agent used to complex with a given radioactive isotope may be found to complex with other metals, producing such serious effects as the removal of zinc from carbonic anhydrase and iron from succinic anhydrase.

Prof. Catsch also considers factors influencing the effectiveness of chelating agents, such as delay in their administration and the effects of competition with endo-