spectrum too briefly, instead of concentrating on matters wholly relevant to the rest of the book. The second chapter on introductory corrosion firmly delineates at the outset those aspects of a vast subject on which it is proposed to concentrate. The result is an excellent digest that is readily understandable to a newcomer to the subject and contains all that is required to pursue the remaining sections of the book.

The four chapters which follow deal in detail with various aspects of microbiological corrosion and comprise an informative and mostly highly readable account of a very wide variety of problems from both theoretical and practical considerations. A quiet word, however, should have prompted the author who coined the appalling term "desulfovibriologist" to think again!

The section entitled "Microbial Corrosion of Buried and Immersed Metal" concentrates rather excessively on the work of one particular school of investigators and might well have been placed after the succeeding chapter on corrosion in industrial situations of which it forms but one, even if probably the most important, example.

The chapter on microbial corrosion in aircraft fuel systems is particularly well ordered and concentrated and that on microbial infections in relation to corrosion ends with a practical appendix that should prove very useful to a novice wishing to embark on a little practical investigation into his own problems.

The book ends with two short chapters on the more constructive activities of microorganisms in aiding the extraction of metals from low-grade ores. The first of these, very short, is almost wholly redundant, there being little in it of relevance that is not repeated more clearly and concisely in the second.

G. H. BOOTH

Microscopes Confined

Some Biological Techniques in Electron Microscopy. Edited by D. F. Parsons. Pp. x+186. (Academic: New York and London, August 1970.) £4.65.

BIOLOGICAL electron microscopy has made great progress in the twenty years since the development of thin sectioning techniques. Histology and many aspects of physiology have had to be rewritten, yet there are still technical limitations that impede the realization of the full potentialities of electron microscopy. This book indicates some of the problems. In the longest chapter, Parsons discusses the physical factors that limit the resolution of biological materials. He deals with aberrations, specimen damage and specimen contrast. The biologist tends to ignore the effects of thermal and radiation damage but it is a depressing fact that electron diffraction patterns from most biological crystals disappear within a few seconds. Reduction of specimen damage may yet turn out to be the chief advantage of high voltage electron microscopy. The chapter ends with an interesting discussion of the possibilities of electron phase contrast and related methods.

The next two contributions, on chemical effects of fixation and on freezing techniques by Riemersma and Bullivant respectively, deal with topics of immediate practical importance. Unfortunately, the article on fixation is mainly restricted to osmium tetroxide and potassium permanganate; the aldehydes are mentioned almost as an afterthought. Freezing methods, apart from freeze-etching and freeze-fracturing, have been rather disappointing so far, but progress will have to be made if we are ever to use electron microscopy to locate diffusible ions and molecules.

The fourth main article is on substrate noise, by Harris. It deals with the effects of the supporting medium, beam potential, the ideal substrate and optical methods for improving the signal/noise ratio. Optical image processing is an expanding field and may have an important part to play in electron microscopy. Finally, there is a short account by Banfield of attempts to introduce automation into tissue processing for electron microscopy.

This book, like others of similar type, suffers from some lack of coherence and from variations in quality and approach. Nevertheless it contains much of interest and many useful references for those who want to keep in touch with current ideas and future possibilities.

R. BARER

Orbits Transformed

Linear and Regular Celestial Mechanics: Perturbed Two-body Motion, Numerical Methods, Canonical Theory. By E. L. Stiefel and G. Scheifele. Pp. ix+301. (Springer-Verlag: Berlin and New York, 1971.) 68 DM; $18.70.

THIS book is concerned with ways of formulating the differential equations that occur in celestial mechanics so that they become both linear and regular. The usual equations of motion for the two-body problem have a singularity corresponding to the collision of the two bodies. By a suitable transformation of variables, the equations can be regularized so that this singularity disappears. The resulting equations are also linear. These regularized equations have been used by many authors to study collision and near-collision orbits. The emphasis in this book is more on the advantages to be obtained from the linearity.

Before 1965, the only regularizing transformations known were for two-dimensional motion, which rather restricted the application of the technique to problems of a theoretical nature. The regularization of the differential equations of three-dimensional motion was achieved by Kustaanheimo and Stiefel in 1965, and the book is essentially a discussion of what is known as the KS-transformation.

The theory of the transformation is first described. The equations of motion are derived in terms of the transformed coordinates and also in terms of a set of elements analogous to the orbital elements of the classical theory. A useful feature of this part of the book which makes the mathematics easier to follow is the collection at the end of each chapter of the important equations derived therein.

The transformed equations are simpler than the classical, but the number of equations is increased. The authors show by numerical examples that, as a result, the two sets of equations can be integrated numerically on a computer in approximately equal times. They also show that the regularized equations are more stable than the classical equations so that the errors in the numerical integration build up more slowly.

The transformed equations of motion are derived for a body perturbed by a third body and by the oblateness of its primary, and examples of the numerical integration of these equations are given. This should make it possible for anyone faced with a practical problem of numerical integration in celestial mechanics to use these methods without spending too much time understanding the theory. The transformed equations for unperturbed two-body motion are the equations of a harmonic oscillator, and the authors develop several numerical methods to integrate these equations exactly. They show by numerical examples that these methods are more accurate for perturbed motion than ordinary methods.

The second part of the book is concerned with canonical theory. First, there is a derivation of the classical equations of motion in canonical form, and then various canonical forms of the transformed equations are derived, one of them having the eccentric anomaly as the independent variable. This is particularly advantageous as it is shown that Fourier expansions of the perturbation function in terms of the eccentric anomaly generally converge better than those in terms of the mean anomaly which are usually used in celestial mechanics.

In the third part of the book, various geometric and topological properties of the KS-transformation are discussed. The authors conclude that the search for other transformations to regularize the attraction of a single centre is not very promising. The KS-transformation promises to play an important part in future developments in celestial mechanics. This book is a clear exposition of it.

A. T. SINCLAIR