Celestial mechanics

Orbital Motion. By A. E. Roy. Pp.89. (Adam Hilger: London, 1978.) £12.50.

THE number of textbooks on celestial mechanics currently in print can be easily counted on the fingers of one hand. Professor Roy's excellent book is therefore very welcome. It provides a valuable bonus too, for, apart from the familiar topics which are to be found in other textbooks, *Orbital Motion* contains much other fascinating material. Though intended primarily for advanced undergraduate and postgraduate students, a good deal of the material could usefully be included in first and second-year undergraduate courses in applied mathematics and astronomy. Apart from a basic understanding of calculus and vector algebra, the reader requires little other mathematical knowledge.

There are fifteen chapters, each having a very good introduction to the subject matter and in most cases references to background and other pertinent material. The first chapter describes the various orbital phenomena which are observed in the Solar System and the more distant parts of the Universe. Coordinate and time-keeping systems and the reduction of observational data take up the next two chapters. There follow four chapters in which are developed the basic mathematical principles of celestial mechanics.

I like Professor Roy's treatments of the two and n-body problems, but I prefer some other derivations of Lagrange's solutions of the three-body problem. The restricted three-body problem is nicely handled, and an informative introduction to periodic orbits is provided. Lagrange's equations of planetary motion are derived in a standard way, but Gauss's form of the equations is stated without proof. This is a pity, for Gauss's equations are more general and their construction from first principles is instructive.

There is a very brief discussion of Hamiltonian systems, but the opportunity is missed to introduce the student to the widely used canonical variables of Delaunay. An ample and clear account is given of special perturbation techniques.

Chapter eight is devoted to a discussion of the evolution and stability of the solar system. The abundance of commensurabilities in mean motions is remarked on and possible reasons for their occurence put forward. Many useful references are given here, though others are conspicuous by their absence (for example, papers by

A. T. Sinclair and by S. F. Dermott).

Elementary lunar and artificial satellite theories are developed next and the principal features of the motions described. I believe it must be an oversight on the author's part that Vinti's pioneering work in artificial satellite theory is not even cited in the bibliography.

There follow three interesting chapters concerning rocket and space-probe dynamics, in which the theories of orbit transfer, orbit determination and space navigation are clearly presented. The motions of binary and many-body stellar systems are investigated in the concluding chapters.

The student reader should be warned that several errors occur in the text; fortunately most of these are very minor. An error of a more serious nature occurs on p.174 where the author suggests that Lagrange's planetary equations and an appropriate

disturbing function R can be used to investigate the problem of atmospheric drag in artificial satellite theory.

Although the diagrams and tables are clear and informative, I feel that their usefulness would be enhanced if captions were provided. Many problems are listed, ranging from trivial to difficult, and their solutions, with hints if appropriate, are given at the end of the book. The index is comprehensive, and much useful data are assembled in several appendices.

The criticisms I have made hardly detract from the great value of the book. Professor Roy's style is fresh and pleasing to read and the overall presentation is of a high standard. I shall certainly be recommending the book to my students.

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Limb development

Vertebrate Limb and Somite Morphogenesis. Edited by D. A. Ede, J. R. Hinchcliffe and M. Balls. Pp. 498. (Cambridge University Press: Cambridge, London and New York, 1978.) £20.

THIS book, which comprises papers given at the third symposium meeting of the British Society for Developmental Biology in 1976, should interest all who are concerned with pattern formation in development and the problems of polarity determination. The volume, which is attractively presented, contains 29 papers: 5 on somitogenesis and 24 on aspects of limb development and regeneration.

In a short review it is not possible to comment on all the papers in this volume. The book is well represented, however, by the first contribution, which is a review article by Saunders. This is admirably clear and introduces the reader to the zone of polarising activity (ZPA) and to the apical ectodermal ridge, about which there has been so much fuss recently. Indeed, one of the surprises of the meeting was the comment, by Saunders, that polarising activity can no longer be regarded as exclusive to the ZPA.

It is refreshing at a time when approaches to development are largely molecular and biochemical to come across work which utilises so extensively the classical methods of experimental embryology. Many of the series of experiments reported here involve transplantations, deletions, reconstitutions, and so on, requiring great skill and, more often than not,

using the chick limb bud as the object of investigation. The questions being studied are basic to an understanding of animal development, such as the nature of, and the mechanisms underlying, axial polarisation, handedness, symmetry, reduplication, and so on. These questions are older than the science of experimental embryology; and though we must admit that (almost) none of the answers are known, this book does a very good job of reviewing the field and bringing the reader up to date in these complex matters.

The study of limb development and regeneration seems to have reached a stage when serious hypotheses can be proposed. This is suggested by the profusion of model-making activity here demonstrated. Models of limb development (and regeneration) discussed in this book include those of Wolpert, Summerbell and Tickle, Wilby, and Bryant. The competition to produce the most helpful model seems to be fierce but interactions between the various protagonists are friendly and positive. Such diverse activity can only help towards the understanding of the systems.

The chapters are in general clearly written and comprehensible. The line drawings are excellent, and the halftones are acceptable (barely). The volume has a good subject index but unfortunately no general index of authors cited. Even so, the book can be strongly recommended to all interested in pattern formation and the determination of polarity.

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