five are of the crystal structure of polyethylene. It seems a pity, when plates are provided, not to include more than one example of the industrial equipment and processes which are so difficult to visualize from the conventional flow sheet diagrams.

It is on the whole, however, a good book and should certainly be of considerable use to honours students specializing in polymer science and technology.

The second book has an immense amount of information, and considerable credit is due to the editor and his colleagues in managing to keep the text both readable and interesting.

The first chapter provides a general introduction to the basic physics of semiconductors, and the treatment is extended in chapter two to cover such topics as the chemical structure and electronic behaviour of polymers and macromolecular solids. After this, the available data on the electronic behaviour of different classes of polymers are discussed. This chapter contains a well-documented section on charge transfer complexes. These low molecular weight donor acceptors, although not strictly speaking polymers, are interesting electronic materials in their own right and they often contribute to polymer-like structures.

The fourth chapter deals with semiconducting organic polymers containing metal groups. The book concludes with a chapter on an interesting class of materials—semiconducting biological polymers.

There are many indications that polymers are likely to make increasing contributions towards semiconductor applications and this book provides a very useful source of references for those interested in the field.

W. A. HOLMES-WALKER

THEORETICAL ASTRODYNAMICS

Methods of Astrodynamics
By P. R. Escobal. Pp. xiii + 342. (Wiley: London and New York, February 1969.) 140s.

THE trouble with this subject is that there are still no really satisfactory textbooks on it. This book does not solve the problem either; but it at least attempts to systematize a certain amount of knowledge in the field, and succeeds in a degree.

Chapter one deals with known theories of the physical environment of the primary planets of our solar system, Bode's law, mean planetary orbital elements, approximate theory of lunar motion and atmospheric models. In an attractive form, it offers working formulae for the determination of the ecliptic longitude of the ascending node, mean longitude, longitude of perihelion, orbital eccentricity, and orbital inclination of the ecliptic plane (all for given semi-major axes) as functions of the ecliptic argument of perihelion, mean anomaly, time of perifocal passage and mean sidereal motion.

The second chapter is called "Optimization Techniques", but it is weak and disappointing. Its first half or so offers only common mathematical knowledge in maxima and minima of ordinary functions; but the second half may be useful to beginners.

Hohman's transfer theory, circular velocity at a given point, transfer velocity required, velocity increments to escape to infinity and for the total manoeuvre, minimum cotangential velocity increment transfer, velocity requirements with plane change, velocity minimization methods and associated problems are neatly presented in chapter three, and the reader will find them pleasing.

The book (chapter four) then deals with minimum fuel, minimum time and minimum weight-in-orbit interplanetary trajectories whose rapidly growing importance has recently been underlined once again by the Soviet and American automatic stations aimed at Mars and Venus. The specific problems discussed are: the method of patched conics, transfer processes, position and velocity vectors and secondary impulses, total velocity increment

minimization, algorithms for various transfer modes, velocity expenditure for Earth to Mars flyby, Earth to Mars rendezvous in circular orbit, time minimization processes and techniques.

Chapter five concentrates on the well known and well developed three-body mathematical theory, but in a rather condensed and certainly simplified form. The analysis offered by the author is of undoubted interest, but the non-expert reader will find it difficult in places without first having read earlier publications on the subject (listed in the references).

Space exploration requires space flights which, in turn, require a very extensive, complex and costly network of ground tracking-control stations. The stations cannot, however, be used just at any time. Therefore one of the most important problems of applied astrodynamics is the determination of the earliest and latest times of transmission, of communication between the network and space vehicles. And this is the subject of chapter six, called "Geocentric, Lunar and Interplanetary Communications". I find the somewhat simplified but straightforward mathematical analysis and conclusions of the chapter interesting, instructive and useful.

Then, in chapter seven, the author develops "special perturbation" techniques of trajectory integration—a numerical procedure used in the determination of orbits—and he discusses the two most prominent methods currently used. The "perturbative function", Cowell's integral, effects caused by oblateness, the problem of small differences, algorithm for Encke's method with shifting reference orbit, the first- and second-order corrections, the basic equations of motion and evaluation of the fundamental constants, are questions dealt with in a condensed yet attractive manner.

Finally, chapter eight contains a detailed description of the complicated selenographic coordinate transformations required to locate spaceships relative to the lunar surface. The geometric schemes and mathematical relationship of this chapter are not only absorbingly interesting but also useful, and I would recommend them to anyone engaged in orbits and trajectories theory and optimization.

All in all, I consider this book to be a valuable contribution to the printed world of theoretical astrodynamics.

G. A. TOKATY

ATMOSPHERIC DATA

Daily Aerological Cross Section at Latitude 30° N during the International Geophysical Year Period, December, 1958
By UK Meteorological Office. (HMSO: London, 1968.) 55s.

THIS completes a set of four publications, and gives the daily vertical aerological cross-sections of the atmosphere around the Earth at latitude 30° N for March, June, September and December 1958. They are published with excellent detail on large charts (about 30 × 50 cm), each representing a vertical section along half the latitude circle, east and west of the Greenwich meridian. Isopleths show temperature, potential temperature, humidity mixing ratio, and north–south wind component. West-to-east components are also indicated by numerical values. A mean cross-section for the month is given at the end.

The set of four publications is a contribution made by the United Kingdom Meteorological Office to the tremendous task of processing, analysing and publishing in chart form the upper air data which were collected during the International Geophysical Year 1958. It is a weakness of major international observational programmes that the systematic reduction and publishing of the results are tasks which, taking much time and effort, are often neglected. These publications, although representing but a small fraction of the IGY aerological data, are the result of several years of continuous work by a small team of