## Materials in use

*Metals, Ceramics and Polymers: An Introduction to the Structure and Properties of Engineering Materials*. By Oliver H. Wyatt and David Dew-Hughes. Pp. xiv+640. (Cambridge University: London, May 1974) £12.00 boards; £4.95 paper.

OF books on Shakespeare's plays, the Malaise of Western Man, and materials science, there is no end. No blinding new insights are to be expected on any of these topics: selection, clarity and economy must be our touchstones. Anyone with a shelf-full of such books must be tempted to pluck out some of them and follow Prospero's heroic resolution: "And deeper than did ever plummet sound I'll drown my book".

The volume under review is not for drowning. It is one of the very best of the many English-language texts on materials that have appeared in recent years. Unlike some of these, the new book has a pronounced engineering bias: the fact that Dr Wyatt worked for years in an engineering school which prepares its students for what used to be called a Mechanical Sciences Tripos shows in the special emphasis on mechanical behaviour which is evident in many parts of the book. Thus, although there is a sound summary of the present understanding of dislocation behaviour, macroscopic plasticity theory gets exceptionally thorough treatment; the application of this theory to metal-working processes is unusual in a materials textbook. Ceramics and polymers each receive a good concise presentation, including for the former an informative account of the setting of concrete: glasses are rather too much compressed (a state possibly natural to the material). There is an excellent chapter on steels, particularly thorough on the problem of heat-treating objects of various sizes. The electrical and magnetic chapters are also well presented, with more emphasis than normal on superconductivity (one of Dr Dew-Hughes's special interests) and dielectric materials. Magnetic materials place much more emphasis on domain behaviour than intrinsic magnetism—a good test of fitness for engineering purposes.

The treatment of particular materials is underpinned by a fairly conventional introduction to topics such as crystallography, diffusion, phase diagrams (including a good treatment of ternaries) and band theory. As so often, the thermodynamic treatment is too concise for real clarity; in particular, the statistical basis for entropy has to be taken on trust, which must tinge the crucial concept of an equilibrium population of vacant lattice sites with a touch of black magic. But on the whole, the theoretical underpinning is very clear and sufficiently comprehensive.

It is easy enough to pick out individual small inadequacies and as always these largely reflect the reviewer's predilections: there is almost nothing on the important subject of recrystallisation; the intriguing explanation of how doping with an impurity permits the removal of pores in sintered alumina is muffed; the crucial importance of crystalline states in polymers receives only the most glancing recognition. But the list of these shortcomings (which another reviewer might deem of little consequence) is short and the positive achievement of balance and clarity is very considerable.

Each chapter has a collection of questions, partly numerical and partly purely verbal, designed to test conceptual understanding, and each has an excellent bibliography.

As a basis for a comprehensive course on materials for engineering students, or as a foundation for the much smaller tribe of material specialists, this book can be warmly recommended. The paperback version in particular is excellent value.

R. W. CAHN

## Valence calculations and molecular orbital theories

*Ab Initio Valence Calculations in Chemistry*. By D. B. Cook. Pp. ix+361. (Butterworth: London, March 1974.) £7.50.

THIS is a book which describes the technical aspects of computing wave functions and energies of electrons in molecules as approximate solutions of the Schrodinger equation. It is concerned only with the *ab-initio* method, that is, the approximations contained in such calculations arise from the termination of series expansions of the wave functions rather than the use of a model Hamiltonian. In addition to the technical aspects of the book the author gives a personal justification for the place of such calculations in chemistry which may be summarised as follows. Many of the important concepts of valence theory are not observables, but in order to maintain contact with and influence the main stream of chemical thinking, quantum chemistry must apply itself to the analysis, criticism and quantitative investigation of these concepts. In other words the book is not written just for chemists who want numbers, but also for those interested in ideas.

The book fills a gap in the current literature. It does not set out to present a broad view of quantum theory or valence theory and therefore assumes a fair amount of basic knowledge in these areas. It is elegantly written and printed and I believe it will be widely accepted as a very useful book.

*Molecular Orbital Methods in Organic Chemistry—HMO and PMO: An Introduction*. By William B. Smith. Pp. xi+161. (Studies in Organic Chemistry, vol. 2.) (Dekker: New York, April 1974.) $14.50. £6.00.

IT is thirteen years since the first books on molecular orbital theories in organic chemistry appeared and one must admire the courage of both author and publisher in adding another volume to this crowded market. About half the book is devoted to an elementary account of Huckel theory (HMO) and its perturbative approximations (PMO). The remainder gives a wide coverage of organic reactivity including the recently popularised symmetry rules. As an elementary account of the subject it is quite acceptable but it is hardly value for money when compared with other books that are available.

J. N. MURRELL