$CH_3{\cdot}C_2H_5$, goes back to Paneth in 1929, but it took another thirty years before their ultraviolet spectra could be unambiguously obtained. Yet the study of radicals such as OH, C_3 and SiC_2 is of first-rate importance for the understanding of stellar atmospheres, and the spectra of comets are almost wholly free-radical in character.

All this, and a good deal else, is set out in this little book. There are chapters on diatomic radicals, linear polyatomic ones, non-linear polyatomics and a discussion of dissociation and predissociation. Throughout, the argument is illustrated by a superb collection of experimental spectrograms. As one would expect from someone with the experience of the author, there is a complete control of the material; the account is crystal clear, and there is an admirable index.

It almost seems ungracious to cavil about any omission; but the complete neglect of any account of electron spin resonance does leave a gap in the story. For although electronic and rotation–vibration spectra can be made to give us information about the size and shape of a radical, ESR can tell us about the charge distribution. The two types of experiment supplement each other (though, where a full resolution is possible, Carrington has shown that almost all the information that we can want about a gaseous radical can in principle be obtained from its ESR spectrum).

The Fisher-Baker lecture series at Cornell has provided some very fine volumes. The present set is in good company, and it deserves its place.

C. A. COULSON

Chemical Plant

Chemical Plant Simulation: an Introduction to Computer-Aided Steady-state Process Analysis. By C. M. Crowe, A. E. Hamielec, T. W. Hoffman, A. I. Johnson, D. R. Woods and P. T. Shannon. Pp. xiv+368. (Prentice-Hall: Englewood Cliffs, New Jersey, July 1971.) $15.59.

THE evaluation of process plant usually involves complicated and extensive procedures containing lengthy, repetitive and tedious calculations. The advent of easily accessible digital computers was therefore a boon to chemical engineers who rapidly adopted them for process design, and later for simulation of the behaviour of plants in operation. Indeed effective simulation of plant is not feasible without the use of a digital computer. The useful result is that now a wide range of possible designs and operating modes can be investigated and searched for their optimum cases.

This book is concerned primarily with digital simulation of chemical plant for the purposes of steady state process analysis. It introduces and explains the techniques involved and points out the value of such an analysis through a real example, by developing in detail a complete digital simulation of an existing sulphuric acid plant, using a particular simulation language called PACER. Inevitably this requires the use of much conventional chemical engineering, especially where it is being shown, in the middle chapters of the book, how digital models of the individual units making up the plant are constructed. The core of the work lies, however, in the earlier chapters where the methods used to link individual models into a complete simulation are described. It is here that it is seen that the approach needed for the simulation of a complex of plant is necessarily more ordered and disciplined than is common in process design, and that this quantification of what is usually done intuitively should be used more often in design.

The book is well planned, well written, sensibly arranged and supplied with clear diagrams. Several of the authors are known for their work in other fields of chemical engineering and it is significant of the importance of this kind of process analysis that they have got together with a chemical company and a computer manufacturer to produce this excellent result. I consider that this is an important textbook not only because of its useful contents but also because it in effect suggests that this subject, up to the present time the preserve of specialists, should now become a familiar procedure to all chemical engineers.

W. SMITH

Strengthened Solids

Strengthening Methods in Crystals. (Elsevier Science Series.) By A. Kelly and R. B. Nicholson. Pp. 627. (Elsevier: Amsterdam, London and New York, 1971.) £12.50.

MANY of us, I suspect, look at edited books with suspicion, since far too often they lack a systematic approach or seem out of balance, especially when the editors are not contributors. This book avoids these pitfalls and no doubt benefits from the fact that the editors are recognized authorities themselves in the field of strengthening mechanisms in solids. They have contributed chapters themselves and the book is given coherence by the informative introductory and summary texts that they have written, which set the theme and mark the achievements.

The book, which comprises some nine main chapters (more than 600 pages) all written by authors of considerable standing, is aimed principally at specialists in the field. The first chapter, entitled "Dislocation-Particle Interactions", which takes up one-fifth of the book and is written by L. M. Brown and the late R. K. Ham, is a clear and detailed exposition of present understanding of the ways in which hard and soft particles in a matrix can strengthen a solid. There follows a very informative account by M. F. Ashby of deformation mechanisms in two phase alloys with phases of differing yield stress. The chapter by N. S. Stoloff deals with the strength of ordered crystals and intermetallic compounds, and J. D. Embury deals with strengthening by dislocation substructures in the sixth chapter. The interesting account by J. W. Christian on "The Strength of Martensite", in the fifth chapter, reflects the advances in the knowledge of the behaviour of dislocations in alloys. Precipitation strengthening of ceramics is covered by G. W. Groves in the seventh chapter, in which, due to the nature of ceramics, the effect of particles on fracture behaviour is introduced.

During the past decade there has been a tremendous upsurge of interest in fibre reinforcement, and A. Kelly (an editor of the book) introduces this topic by dealing initially with the conditions in which fibre and matrix interaction results in matrix strength modification and leads on to the well established "mixtures rule" for strength where the interaction is less apparent and a major preoccupation is with toughness mechanisms.

The book is rounded off by two chapters by G. J. Davies and R. B. Nicholson (an editor of the book) respectively, which deal with the development of strong microstructures from the melt and the solid state. These interesting chapters show in some measure the extent to which understanding and experience (technology) can be rationalized.

The emphasis in the book is on metals, ceramics and their alloys; polymers get only a brief mention. One is tempted to say that a chapter on polymers would have been attractive, but its absence in no way detracts from the scientific value of the book. The individual authors cover their subjects comprehensively and in depth, perhaps inspired by the editors' own efforts. The book demonstrates very strikingly, I feel, the tremendous advances in our knowledge in this area that have taken place during the past fifteen years or so; this progress has been facilitated by the development of electron microscope techniques, which have led to such fruitful microstructural investigations. These advances have also brought maturity into the subject insofar that discussions of strengthening mechanisms are less polarized, as demonstrated, for example, in the conclusions to the chapter by Brown and Ham, where it is made clear that the contribution of various mechanisms, such as mechanical strengthening, order strengthening