

difficult to manage. It is to be hoped that they will not be scared into proceeding no further; this would be a pity because such readers will find, if they go on, that later chapters are very useful indeed.

One could not say, with all honesty, that one welcomed all the books that had been written on valence theory, quantum theory for chemists, etc. However, with *Valence Theory*, it is possible to say with sincerity that it is a most welcome book. It provides a reasonable coverage in a reasonable space starting with the elements of the subject and proceeding well on into the more difficult parts. It does this clearly and is well produced. The authors must be congratulated on producing a book which has so much of value in it and which is so well suited to the needs of chemistry students in many British and other universities.

J. W. LINNETT

ASPECTS OF POLYMER CHEMISTRY

Analysis and Fractionation of Polymers

Edited by John Mitchell, jun., and Fred W. Billmeyer, jun. (American Chemical Society Symposia held at Chicago, September 2-3, 1964. *Journal of Polymer Science*, Part C, Polymer Symposia, No. 8.) Pp. vi + 314. (New York: Interscience Publishers, a Division of John Wiley and Sons, Inc., 1965.) 96s.

ANALYSIS and Fractionation of Polymers contains papers presented at symposia on "Analysis of High Polymers" and "Characterization and Fractionation of Polymers", held at the American Chemical Society meeting in Chicago in September 1964. Some of the papers are written in general form and may be regarded as being in the nature of reviews; other papers are devoted to new information on specific polymer systems. Pyrolysis gives information on polymer composition as well as on kinetics of polymer degradation, and the first group of papers describe pyrolytic techniques, with emphasis on methods of detection of products. This is followed by a description of the use of high-resolution differential thermal analysis and the new technique of dynamic electro-thermal analysis. The next series of papers is devoted to recent applications of infra-red spectroscopy and, in particular, to fluorine-containing polymers and polyacrolein. Other papers describe the use of tritium or carbon-14, and viscosity methods in the study of polyacrolein. The application of high-resolution nuclear magnetic resonance spectroscopy to the investigation of fluorine-containing polymers, polypropylenes and relaxation phenomena are described in detail in succeeding papers.

The second half of the volume is devoted to the topic of the fractionation of polymers and their characterization in terms of molecular weight. The first two papers on molecular weight distribution and methods of fractionation provide valuable and up-to-date reviews of these subjects. The following papers deal with different aspects of solution-gradient electron fractionation and the theory, practice and instruments for gel-permeation chromatography. The remaining papers cover various topics such as the interpretation of molecular weight distribution data, the bulk fractionation of linear polyethylene, the determination of molecular weight distribution by sedimentation velocity, ultracentrifugation and the use of light-scattering techniques.

The papers not only summarize 'the state of the art' regarding the more familiar methods but also describe some of the newer techniques of analysis, characterization and fractionation. The volume will be of considerable interest and usefulness to those interested in these subjects.

C. E. H. BAWN

LIGNIN BIOCHEMISTRY

Lignin Biochemistry

By Walter J. Schubert. Pp. ix + 131. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1965.) 8 dollars.

NATURE has defied chemists in their attempts to write a single structural formula for the lignin molecule, and present-day ideas on the structure are usually related to a 'statistical' model incorporating a variety of phenyl-propane derived units linked together in different ways to take account of the known analytical data. The pulp and paper industries have been even less successful in their efforts to find profitable outlets for the vast quantities of lignin-derived waste which at present only represents an often embarrassingly large disposal problem. The microbiological utilization of lignin and its derivatives would appear to be a worth-while field of study for both chemists interested in lignin structure and for industries faced with the problem of its disposal. However, to date, such research has provided little other than corroborative information on lignin structure and no practical help to engineers concerned with the disposal of pulping wastes.

Dr. Schubert and his colleagues have been studying the biosynthesis and the fungal degradation of lignin for several years and *Lignin Biochemistry* is based largely on the work of the Fordham University school.

The book is arranged in four chapters. Chapter 1, occupying approximately one-third of the book, deals with the chemistry of lignin, a knowledge of which is essential to an understanding of its biosynthesis and degradation. The field is covered quite comprehensively and some of the more valuable techniques and many of the difficulties facing the lignin chemist are described.

Chapter 2 discusses aromatization in micro-organisms and is a much less full treatment of the subject than that given to the chemistry of lignin. The shikimic acid pathway in bacteria is briefly dealt with and its application to the biosynthesis of tyrosine and phenylalanine described. The biosynthesis of aromatic metabolites by wood-destroying fungi is then discussed in detail. However, the significance of this to the aromatization process in plants and to lignin biosynthesis is not obvious and could have been dealt with much more briefly.

The biosynthesis of lignin in plants is covered in Chapter 3. Tracer studies have established the biosynthetic routes to the lignin 'building stones' but the final stage in lignin synthesis, the polymerization of these precursors within the plant cell wall, is still a matter for conjecture. Freudenberg's hypothesis that soft-wood lignin is synthesized from coniferyl alcohol by dehydrogenation and free radical polymerization is discussed and its limitations pointed out.

The final chapter deals with the microbiological degradation of lignin. The emphasis is very much on the part played in the lignin cycle by wood-destroying fungi, other organisms being almost entirely ignored. Lignin degradation by these fungi is considered to be an oxidative process and the difference between laccase and phenolase, the two commonest oxidative enzymes associated with these fungi, is clearly described. However, while the importance of laccase and phenolase in the classification of wood-destroying fungi is emphasized, their over-riding importance in lignin degradation has yet to be established, a point which is not so clearly brought out.

The book is very well produced, but at 8 dollars for 111 pages of text and eight of references, it is expensive and the cost may well limit its appeal. To the non-specialist it offers an introduction in some depth to a complex subject but the specialist reader may find that as a review it suffers from being too personal an account with a consequent imbalance and incompleteness in places.

N. J. KING