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Book review

Cellulose and Cellulose Derivatives, Second Edition, Parts IV and V, edited by N. BIKALES and L. SEGAL, Wiley–Interscience, New York, 1971, xix+1411 pages, $60.00.

Since its first appearance in 1943, as Volume V of Interscience's High Polymer Series, this monograph has been recognized as the definitive reference text in the field of cellulose chemistry. The second revised and augmented text appeared in three parts in 1954–1955 under the editorship of Emil Ott, Harold M. Spurlin, and Mildred W. Grafflin. The scientific community is now in debt to the present editors for incorporating modern developments into this important intellectual resource and bringing it up to date. Their choice of collaborators was excellent. In virtually all cases, the individual authors are outstanding experts, and in many cases were primarily responsible for the developments described.

The intent of the editors was to supplement the preceding three parts of the second edition rather than revise them, and the authors generally restrict their subject matter to the newer developments from about 1950. Some references are dated as late as 1971, but for the most part the text appears to be based on developments up to about 1968. It would be useful for the reader to recognize these two books as a modern symposium of new advances in cellulose chemistry; to some extent the topics are treated by different authors with different tools, viewpoints, and biases.

The first chapter in Part IV (Chapter 13, 325 pp.) is written by twelve authors and describes investigations in supermolecular structure, order and disorder, accessibility, and swelling phenomena. The material is divided essentially into sections relating to different methodologies; infrared spectroscopy with deuteration, X-ray and electron diffraction, nuclear magnetic resonance spectroscopy (high-resolution and wide-line), microscopy, and electron microscopy; there are subsequent sections on crystallinity and swelling. As the authors for the most part are describing supermolecular structure as defined by different methods, the chapter should be read as a whole. The first use of Raman spectroscopy in the field (1970), an important advance, is briefly reported. Scanning electron microscopy, which had some of its first applications at the Pulp and Paper Research Institute of Canada many years ago is treated inadequately, I believe. Also, more good work has appeared on wood-fiber morphology than is apparent in this chapter.

The second chapter (222 pp.) covers some aspects of the theory of dilute and concentrated solutions, some practical aspects of concentrated solutions, and the application of light scattering, osmometry (little), viscosity, and fractionation methods, as they relate to cellulose and cellulose derivatives. The emphasis is on technical cellulose and cellulosics, and not on native cellulose. Throughout most of this chapter,

methodology and results are both discussed, but in the section on fractionation, even newer techniques are not compared; rather the results obtained are emphasized. Differences in fractionation according to degree of polymerization, composition, morphology, and degree of substitution are, however, described quite thoroughly.

Seventy six pages are next devoted to the mechanical behavior of fibers and fiber networks (paper), and thirty seven to the biosynthesis of cell-wall polysaccharides and the organization of cellulose into elementary and microfibrils. This is the first significant reference to the biosynthesis of cellulose to appear in this monograph and reflects the current interest and recent advances in the subject area. The formation of the microfibril is treated lucidly by Colvin from one controversial point of view. He criticizes and rejects an interpretation of Marx–Figini, that is accepted and used by Tønnesen and Ellefsen in their section on submicroscopic investigations (Chapter 13). These current disagreements should be recognized in reading these sections. Much of the interest in microfibril formation derives from the belief that interpretation of supermolecular structure will be more accurate when the natural mode of fibrillar organization is known. The recent advances in our knowledge of polymer morphology and texture has initiated a complete re-evaluation of the supermolecular structure of cellulose, and this is also reflected in this text.

Part V is more cohesive, treating recent advances in cellulose derivatives, crosslinking and grafting, the effect of high-energy radiation, the degradation of cellulosics by acidic, alkaline, thermal, photochemical, and enzymic methods, and newer developments in the technology of cellulose and its derivatives. The chapter on technology is in effect a discussion of ultimate products—newer fiber and textile applications such as durable-press treatments, flame-resistant textiles, high wet-modulus and high-tenacity rayons, and cellulose triacetate fibers; there are concise sections on film and membrane technology and on specialty products—microcrystalline cellulose, ion-exchange celluloses, cellulosics for biological applications, and papers from modified cellulose. It also includes a well balanced review of newer developments in pulping technology, not including the currently active field of oxygen pulping. Considering the extraordinary scope of subject matter ably covered in the five volumes of this edition, it is unrealistic to expect, that, in addition, the chemical technology and modification of solid wood and wood products can be adequately treated. In the 1954 series, this topic appeared as a brief afterthought, and the eleven pages devoted to dimensional stabilization of solid wood in this section are not adequate for the purpose either. The subject should be treated in a separate text on chemical wood-technology, which, one could hope, would be of comparable excellence to the volumes at hand.

The price of these two volumes is equivalent to three nights' lodging at a New York City meeting of the American Chemical Society.

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