

Book reviews

The Polysaccharides: Volume 2, edited by GERALD O. ASPINALL, Academic Press, New York, 1983, xiv + 490 pages + Subject Index, \$67.50.

This volume follows a companion* that was devoted to techniques used in the isolation and study of polysaccharides. The major part of the present book provides a description of the occurrence and nature of polysaccharides, arranged in five main chapters. The first such chapter (85 pages) deals with cellulose, and is followed by three others of comparable length describing polysaccharides excluding starches from higher land-plants, algae, and bacteria, and by a shorter chapter on polysaccharides from fungi and lichens. (Starches, glycogens, chitins, and mammalian polysaccharides are scheduled for treatment in a final volume.)

The primary aim of the editor, G. O. Aspinall, was to fill a currently vacant gap in the specialized literature by providing a much needed, authoritative compilation on the polysaccharides, primarily for the benefit of chemists and biochemists, but with the hope that it would also prove of use to the many others who increasingly find themselves in need of a clear, modern, and competent guide. The two volumes that have now been published succeed admirably in their objective. In a brief, introductory chapter, the editor amplifies comments in Vol. 1 on the considerable, and incompletely resolved, problems of classifying and naming the polysaccharides. There is an (apparently slight) inconsistency in the use of infixes “furan” and “pyran” in the naming of glycans, but, where employed, there is clarification and, even where they are avoided, the names used are unambiguous in the context.

R. H. Marchessault and P. R. Sundararajan have provided an attractively written and detailed, but uncluttered, chapter on native cellulose, its polymorphs, and two of its main groups of derivatives (the acetates and nitrates). Other cellulosic derivatives of commercial interest are described in a final chapter on the industrial uses of polysaccharides. The historical, industrial, and biological backgrounds of cellulose are brought to the reader's attention, as is the abundance of cellulose in the potentially exploitable land biomass. Studies on native cellulose, on cellulose I, cellulose II, and, to a lesser extent, the other polymorphs, are well described. The problems of elucidating certain aspects of structures, including even those relating to the unit cell of cellulose I, are admirably tackled and, among many topics covered, the polymorphic “dance” of the cellulose molecules during mercerization is outlined and a visual justification given, in two of the excellent plates, to the whimsical, “shishkebab” terminology. Because of the nature of cellulose, most of the studies described had been made by physical means (infrared and n.m.r. spec-

*For a review of Vol. 1, see *Carbohydr. Res.*, 123 (1983) c35–c36.

troscopy, X-ray crystallography, and contrast electron-microscopy), and the main conclusions relate to conformation of chains, chain packing, and unit-cell dimensions. The text delimits what is certain and what remains in dispute. It is incisive and, while being selective, is fair, without falling into the common trap of weakening, by indiscriminating reportage, the authoritative assessments of what constitutes the best present knowledge of cellulose.

A. M. Stephen had the daunting, but successfully accomplished, task of describing "Other Plant Polysaccharides", leaving the starches for the forthcoming, and final, volume. It is to be hoped that the D-fructans will also be included therein. The chapter deals with land-plant glucans, mannans, galactomannans, arabinans, galactans, arabinogalactans, galacturonans, rhamnogalacturonans, xylans, and gums. The text details their botanical distribution, and, to a certain extent, their functions in the plants, before proceeding to consideration of structural aspects. Although the land-plant polysaccharides have been frequently examined, polysaccharides from less than half of the orders of angiosperms and gymnosperms have thus far been studied, and consequently, from a taxonomic point of view, there are, in the investigations, considerable gaps that can only be partially filled by speculation based upon considerations of taxonomy, plant growth, and anatomy. Most of the studies have been conducted on plants of economic and commercial interest. The artificiality of the divisions of classes of polysaccharides (e.g., mannans and galactomannans) is mentioned, and it is remarked that "there is a continuity between the structures of unsubstituted (glycans) . . . and the extremely complex pectic materials and gums". Clear pictures of each of the many polysaccharides are presented within the bounds of the limited clarity that the results of investigations at present afford. The exposition is sound, concise, and well documented.

T. J. Painter gives shape and perspective to a chapter on "Algal Polysaccharides" by using an evolutionary thread to interrelate comments and information on the very varied polysaccharides of algae and diatoms. The intriguing plants of the *Cyanophyta* (blue-green algae) are ancient in origin, but less accessible for study than those of several other phyla. The polysaccharides from these algae are of evolutionary interest, and, indeed, the title of "World's Oldest Glycan" is tentatively given to the blue-green, algal, glycogen-like material. There is particularly extensive comment on the commercially important carrageenans and alginates, and on mucilaginous polysaccharides similar in structure to pectic materials. Adequate, but more limited, coverage is given to their less commercially successful companions, namely, the laminarans, fucoidans, and xylans. The polysaccharides most reported on derive mainly from the *Rhodophyta* (red algae), the *Chlorophyta* (green algae), and the *Phaeophyta* (brown algae), but informative sections also deal with polysaccharides from the *Cryptophyta*, *Pyrrhophyta* (Dinoflagellates), *Euglenophyta* (green algae), and *Xanthophyta* (yellow-green algae), and from the diatoms belonging to the *Bacillariophyta*. The chapter ends with an index to the

species mentioned. The author's extensive experience illuminates all of his remarks.

In a truly outstanding chapter on "Bacterial Polysaccharides", L. Kenne and B. Lindberg present a vast amount of information, without loss of clarity or readability, on bacterial glycans, lipopolysaccharides, proteoglycans, peptidoglycans, and teichoic acids. This is a compendium, but is very far from being a boring catalog. One of the great attractions of the bacterial polysaccharides, certainly to anyone working on the polysaccharides of higher land-plants, is that the former have in their structure regularities commonly involving quite small, oligosaccharide repeating-units. Despite, and, indeed, in some senses, because of, the unusually wide range and variety of units and linkages within the oligosaccharide building-blocks, the structures of bacterial polysaccharides are less likely to elude structural interpretation than those of glycans having fewer types of unit and glycosidic linkage. In the major section, on specific polysaccharides, details are given of "all polysaccharides published until early 1982", and these include the repeating units of the O-antigens of several strains of *Klebsiella*, the capsular antigens of *Klebsiella*, *Escherichia coli*, and *Neisseria meningitidis*, and the type-specific antigens of *Streptococcus pneumoniae*. Much of the excellent work in this field has been conducted within recent years by the authors and their colleagues. The chapter concludes with shorter sections on nonspecific polysaccharides, including dextrans, D-fructans, (1→3)-linked D-glucans, and teichoic acids.

P. A. J. Gorin and E. Barreto-Bergter describe "The Chemistry of Polysaccharides of Fungi and Lichens", and, in doing so, concentrate their attention on those polysaccharides, glycoproteins, and phosphonoglycans for which "detailed chemical structures have been elucidated". The very varied mannans and related glycans are dealt with in considerable detail, and other sections outline information on a variety of α - and β -D-glucans, galactans, and phosphonogalactans, with brief comments on bacterial chitin and other little-studied glycans.

The volume concludes with a chapter on "The Industrial Utilization of Polysaccharides" by P. A. Sandford and J. Baird. This chapter clearly differs in intent from the other chapters, but serves to complement both them and sections in the forthcoming volume by describing the availability and commercial exploitation of polysaccharides and modified polysaccharides. There is some duplication of the structural information given in earlier chapters, but this chapter may be read more easily, without cross-referencing, by non-specialists, including industrialists. It is, however, a pity that important cross-references are not included in the text. One of the major uses of polysaccharides is as water-modifiers. In different countries, the same objective may be met by different compounds. Here, the main emphasis is on the US industry. There is much tabulation, again mainly related to the US, but often of general value, and sometimes in reference to World statistics, although it is occasionally unclear whether a point made relates to the US or to the World. The text clarifies technical and industrial terms, and, in the Tables, outlines applications, consumption, and varieties of polysaccharides. The main section, on

polysaccharides of commercial interest, deals with algal polysaccharides, plant gums, cellulose derivatives, and microbial polysaccharides, including xanthan gum and dextran.

The book is well produced, tidily laid out, well and clearly printed, and provided with excellently drafted diagrams and structures. There are few typographical slips. The Figures and Tables clarify the text, and do not merely decorate the pages.

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Mucopolysaccharides—Glycosaminoglycans—of Body Fluids in Health and Disease, by RAJENDRA VARMA AND RANBIR S. VARMA, Walter de Gruyter, Berlin and New York, 1983, xv + 622 pages + Subject Index, DM 290.00

As explained in the Preface, this monograph attempts to bring together, for the first time in one volume, information concerning a diverse group of macromolecules, the glycosaminoglycans (GAG) and their degradation products, from a variety of biological sources, for the benefit of scientists and physicians. The result of this endeavor is a massive survey of the qualitative and quantitative occurrence of GAG in tissues and body fluids in normal and diseased states. The material is organized in terms of systems and organs, with intentional overlap resulting from the ubiquitous occurrence of these compounds. The book is intended as a reference volume, and there is no attempt to integrate the facts into a unifying hypothesis of GAG function. When appropriate, the occurrence of related classes of glycoconjugates, such as glycoproteins, is included in the discussion. However, theories to explain the significance of this common occurrence are not presented. Each chapter is followed by an extensive bibliography of references, which are titled, numbered, and arranged in alphabetical order. Thus, Chapter Two, on methods of isolation and analysis, has 21 pages of text, and is followed by 15 pages of bibliography. Usually, the authors have chosen to refer to the name of the first author and the date of publication. However, occasionally, the numbers of the references are cited instead.

The major achievement of the authors has been an ambitious compilation of data surveying the types of GAG found in body fluids, their composition in terms of neutral sugars, hexosamines, sulfate, and protein (percentages or ratios), co-occurrence of sialic acids, and relative proportions of the major classes of GAG, together with the methods of extraction and analysis employed in each case. Often, the authors have included useful, brief reviews of the associated physiology or pathology, with ideas about the probable function of the GAG. Good examples of the latter are found in the sections on the eye (Chapter 7) and ear (Chapter 10; see discussion of hypothyroidism and hearing loss).