Book Review

CSIRO PUBLISHING

Aust. J. Chem. **2009**, *62*, 600–601

www.publish.csiro.au/journals/ajc

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Carbohydrates: the Essential Molecules of Life

by Robert Stick and Spencer J. Williams
Elsevier, Oxford, 2009, 474 pp.,
ISBN: 978–0–240–52118–3;
USD 89.95

The rapidly emerging field of glycomics has revealed the importance of carbohydrates in a myriad of cellular processes including metastasis, inflammation, signal transduction, and infection. As we begin to unravel and elucidate the intimate roles of carbohydrates in biological systems, there is an increased demand on synthetic chemists and biologists to discover viable avenues of producing significant quantities of these biomolecules in pure form. In recent years, we have witnessed a dramatic rise in the number of synthetic and biological methods available for the production of complex oligosaccharides and glycoconjugates in a rapid and efficient manner for biological study. The chemistry and biology of carbohydrates are intimately linked and feed into the interdisciplinary field of glycobiology, which has received increased attention over recent times. It is therefore timely that a text is released that offers a stimulating and current take on the burgeoning areas of carbohydrate chemistry and glycobiology. *Carbohydrates: the Essential Molecules of Life* by Robert Stick and Spencer J. Williams serves this role by offering a clear and concise guide to the chemistry, biochemistry, and biology of carbohydrates. Although a second edition, this book represents more than an updated version of the previous text (*Carbohydrates: the Sweet Molecules of Life* by Robert Stick). Indeed, the current book includes several new chapters, especially in the area of glycobiology.

The book consists of 12 logically and clearly organized chapters, each beginning with a broad introduction to the topic of discussion before providing a detailed account of the area. The authors use clear and concise language, which allows new and potentially difficult concepts to be easily understood. Recent examples from the literature are appropriately incorporated and are complemented with figures and schemes that are well produced and easy to follow. Each chapter culminates in comprehensive reference sections that not only contain seminal reports but also numerous publications from the past decade. The subject index is very thorough and allows one to navigate to a topic of interest quickly. Several key features incorporated in this text are also worth mentioning. The authors' clever use of footnotes throughout the book provides the reader with several informative snippets relating to the main text. Examples include short biographies on leading researchers whose work is under discussion and nomenclature clarification. Overall, this book provides a broad account of the topics under discussion. As can be expected for a book of its length (474 pp.), some sections lack detail; however, the authors use appendices to provide the reader with references to a plethora of detailed monographs on individual topics.

Chapter 1 begins with a rather detailed, but necessary, introduction to the field of carbohydrate chemistry. The authors provide a historical perspective to outline the foundations of carbohydrate chemistry and acknowledges the enormous contributions made by the pioneers of the field. The next four chapters are dedicated to synthetic aspects of carbohydrate chemistry. Chapter 2 provides the reader with an excellent account of the common protecting groups that are implemented in carbohydrate chemistry. Several recent examples from the literature are provided to outline how one might undertake the selective protection of a monosaccharide. It is worth noting that this chapter is as an extremely reliable source of information for protecting groups in carbohydrate chemistry. As such, it should serve as a useful resource, alongside other widely used protecting group texts (e.g. those authored by Wuts and Greene and Kocienski). In addition to the information provided in Chapter 2, Appendix 1 presents tables of conditions for the removal of *O*- and *N*-protecting groups, serving as a rough guide for anyone working in the area of synthetic carbohydrate chemistry. Chapters 3 and 4 outline the reactions of monosaccharides and the formation of glycosidic linkages, culminating in the construction of oligosaccharides in Chapter 5. These sections are structured in more or less the same manner as those presented in the first edition of the book; however, several additional subsections have been added, together with some pertinent literature examples.

Chapter 6 diverges from the structure, reactivity, and synthetic transformations of carbohydrates to the metabolism of monosaccharides. This section represents a new addition to the book and provides an essential prelude to the chapters on carbohydrate enzymology and glycobiology. The authors admit that the chapter is by no means a full account of the area, and aptly direct the reader to relevant texts with more detailed reviews of the biosynthetic pathways included in, and absent from, the chapter. Chapters 7 and 8 present a comprehensive discussion of Nature's synthetic machinery for making and breaking glycosidic linkages, namely glycoside hydrolases and glycosyltransferases, respectively. The authors place particular emphasis on mechanistic understanding of the aforementioned enzymes at the molecular level. This sets the scene perfectly for an excellent discussion on the mechanism-based design of inhibitors of therapeutic value and for the use of these enzymes in the synthesis of complex carbohydrates. Although brief, Chapter 9 provides an excellent overview of several common disaccharides, oligosaccharides, and polysaccharides in Nature. The authors touch on the biosynthesis of these biomolecules as well as describing the biological role in the organism and their wide applicability in industry. Common modifications of glycans and glyconjugates are discussed in Chapter 10 with a particular focus on sulfation, phosphorylation, and esterification processes. Again, the authors use contemporary examples and references throughout this section. Chapter 11 provides an excellent overview of glycoproteins and proteoglycans, with particular focus on the biosynthesis of these complex molecules. The sections on *N*- and *O*-linked glycosylation and glycosylphosphatidylinositol anchors are pitched at the perfect level for the first-time reader; however, the authors again identify more detailed monographs where appropriate.

The final chapter, entitled 'Classics in Carbohydrate Chemistry and Glycobiology' presents four case studies that nicely demonstrate the synergy that exists between chemistry and

10.1071/CH09202_BR 0004-9425/09/060600

biology to facilitate groundbreaking glycobiology research. This is a superb ending to this book, touching on numerous concepts in synthetic carbohydrate chemistry, biochemistry, and biology outlined in the preceding 11 chapters.

In summary, this is an excellent book, recommended unreservedly for anyone interested in the chemistry, biochemistry, and biology of carbohydrates. The well-organized nature of the text and the use of clear language makes it a must have for those looking to enter into the fascinating arena of carbohydrate chemistry and glycobiology. The level of the material is suitable for advanced undergraduate students, graduate students, or research groups already engaged in these interdisciplinary fields. I would also strongly recommend that this book be added to the resource collections of University Libraries.

Dr Richard Payne is a lecturer in organic chemistry and chemical biology at the University of Sydney. His research interests include the development of new peptide ligation strategies, glycopeptide and glycoprotein synthesis, carbohydrate chemistry, and tuberculosis drug discovery.