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Modern Methods in Carbohydrate Synthesis. by Shaheer H. Khan, Roger A. O'Neill Eds., Harwood Academic Publishers, Amsterdam, The Netherlands, 1996, 558 pp index. \$65.00. Paperback ISBN 3-7186-5921-2.

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BOOK REVIEW

Modern Methods in Carbohydrate Synthesis. By Shaheer H. Khan, Roger A. O'Neill Eds., Harwood Academic Publishers, Amsterdam, The Netherlands, 1996, 558 pp +index. \$ 65.00. Paperback ISBN 3-7186-5921-2.

Only rarely does a book come along which comprehensively draws all the new developments in the fast-growing field of synthetic carbohydrate medicinal chemistry together. Shaheer H. Kahn and Roger A. O'Neill have done just that in Volume 1 of a new series entitled *Frontiers in Natural Product Research Series*. The editors invited over thirty academic and industrial contributors to write the twenty-one chapters in this volume and must be congratulated in compiling an authoritative volume; an apt reference for anyone with interests in carbohydrate chemistry.

To introduce the book, Paulsen writes in Chapter 1 on "Twenty Five Years of Carbohydrate Chemistry; Overview of Oligosaccharide Synthesis" including all the modern methods of glycosylation. This introductory chapter familiarizes readers with a chronological history of the discovery of glycosylation methods for oligosaccharide synthesis and hints at strategies for future developments.

"The Anomeric Alkylation and the Trichloroacetimidate Method-Versatile Strategies for Glycoside Bond Formation", outlined in Chapter 2 by Schmidt, deals with the application of trichloroacetimidate methodology to the synthesis of glycosphingolipids, glycopeptides, glycopeptidolipids, saponins, and antibiotics.

Chapter 3, contributed by Kováč, describes the "Synthesis of Glycosyl Halides for Oligosaccharide Synthesis Using Dihalogenomethyl Methyl Ethers". The author reviews various application techniques of this methodology and provides experimental details of typical experimental procedures.

"Glycosylation Properties and Reactivity of Thioglycosides, Sulfoxides and other S-Glycosides: Current Scope and Future Prospects" is the subject of Chapter 4, written by Norberg. The chapter specifically focuses on the reactivity of thioglycosides and sulfoxides as glycosylating agents in oligosaccharide synthesis.

Mehta and Pinto outline "Phenyl Selenoglycosides as Versatile Glycosylating Agents in Oligosaccharide Synthesis and the Chemical Synthesis of Disaccharides Containing Sulfur and Selenium" in Chapter 5. The authors describe highly specific and elegant glycosylation methods using selenoglycosides as glycosyl donors and acceptors.

Chapter 6, contributed by Sinay and Mallet and titled "Synthesis and use of S-Xanthates, Carbohydrate Enol Ethers and Related Derivatives in the Field of Glycosylation", provides information on the use of S-xanthates and enol ethers for glycosylation reactions. The approaches presented are well-selected for specific targets of biologically important oligosaccharides, such as dermatan sulfate.

"*n*-Pentenyl Glycosides in Oligosaccharide Synthesis" are described in Chapter 7 by Madsen and Fraser-Reid. The chapter summarizes all the applications of *n*-pentenyl glycosides in oligosaccharide assembly and synthesis of orthoesters and glycopeptides, while using different combinations of promoters.

Bilodeau and Danishefsky write in Chapter 8 on "Coupling of Glycals: A New Strategy for the Rapid Assembly of Oligosaccharides." The authors give an excellent overview of all the available methodologies of protected glycals to the synthesis of 2-deoxyglycosides, 2-amino-2-deoxyglycosides and solid supported synthesis of oligosaccharides such as Le^b.

"Advances in Polymer-Supported Solution Synthesis of Oligosaccharides" are presented by Krepinsky in Chapter 9. This chapter provides extremely detailed descriptions and useful information on oligosaccharide synthesis using poly(ethyleneglycol) monomethyl ether (MPEG) and employing the succinoyl linker and the α,α -DiOxyXylyldiethyl (DOX) linker.

"Protecting Groups in Oligosaccharide Synthesis" are reviewed in Chapter 10 by Grindley. This chapter provides precise details of various protecting groups including orthoesters, silyl acetals, benzyl, *p*-methoxybenzyl, allyl, and silyl ethers, esters, such as pivaloates, cyclic carbonates and others.

Perhaps one of the most important contributions to the book is Chapter 11 by Baressi and Hindsgaul, which deals with various techniques of "Synthesis of β -D-Mannose Containing Oligosaccharides". This review illustrates the specifics of constructing oligosaccharides through intramolecular aglycon delivery. The insoluble promoter strategy and oxidation-reduction methods are also reviewed.

Chapter 12, written by the late Professor Hasegawa, details the "Synthesis of Sialoglycoconjugates". Newly included information in this chapter is from the area of α -sialyl-(2-8)-sialic acid derivative synthesis by use of suitably protected methyl or phenyl 2-thioglycosides as glycosyl donors.

"Synthetic Studies on Cell-Surface Glycans: An Approach to O-linked Sialoglycoprotein" compose Chapter 13, contributed by Nakahara, Iijima and Ogawa, which describes the synthesis of O-linked sialoglycoprotein fragments containing trimeric sialosyl Tn epitope and N-terminal heptapeptide fragments of glycoporin AM.

An intensely informative and interesting chapter (Chapter 14) entitled "Synthesis of C-Glycosides; Stable Mimics of O-Glycosidic Linkages" contributed by Bertozzi and Bednarski, portrays pioneering studies on synthetic approaches to C-glycosides. These derivatives are well-suited for carbohydrate binding proteins that evolved to recognize ground state O-linked structures, such as cell-surface receptors and regulatory protein.

New aspects of glycopeptide synthesis are discussed in Chapter 15 by Peters, Meldal and Bock. "Recent Development in Glycopeptide Synthesis" are covered, although the chapter also deals with the solid phase glycopeptide synthesis. The use of pentafluorophenyl esters as protecting groups and an activating group during glycopeptide assembly is emphasized and presented throughout the seven page experimental section, present only in this chapter.

An exceptionally interesting contribution by Roy (Chapter 16) entitled, "Design and Synthesis of Glycoconjugates," illustrates basic and new strategies for development and application of various classes of glycoconjugates, including neoglycoproteins and glycopolymers such as carbohydrate telomers and dendritic glycosides.

Sulfated and phosphorylated oligosaccharides are the subject of Chapter 17, contributed by Haque and Ippolito and entitled "Synthesis of Biologically Active Sulfated and Phosphorylated Oligosaccharides". Various aspects of synthetic approaches to the above class of oligosaccharides are reviewed with only a few, selected representatives from heparin and chondroitin sulfates, sulfolipids, selectin ligands, phosphorylated mannose derivatives and inositol and galactose phosphates.

The study of glycosyltransferases is the subject of Chapter 18 contributed by Matta and entitled "Synthetic Glycosyltransferase Acceptors and Inhibitors: Useful Tools in Glycobiology". The main emphasis of this particular chapter is on β -N-acetylglucosaminyltransferases, selected α -L-fucosyltransferases and sialyltransferases activities.

Chapter 19, written by Wong, offers "Practical Synthesis of Oligosaccharides based on Glycosyltransferases and Glycosyl Phosphites". A mixed compilation of previously reported excerpts from the author's review articles, the chapter has a small addition of modified new developments in the field.

Crawley and Palcic present new developments in "Use of Glycosyltransferases in the Synthesis of Unnatural Oligosaccharide Analogues" in Chapter 20. This extremely useful compilation of published information on the use of modified sugar-nucleotide donor precursors and glycosyl transferases as catalysts and their flexibility in their donor specifications warrants expansion of the synthetic utility of these enzymes for the synthesis of new oligosaccharide targets.

The final chapter (Chapter 21) titled "Synthesis with Glycosidases," is well-written by Nilsson. It is a detailed, 27 page compilation of basic enzymatic methodologies for the formation of the C-O glycosidic bond under a broad range of reaction conditions. This informative review serves as a fundamental introduction to the chemistry of this fascinating group of enzymes.

Concluding with an extensive subject index of eleven pages, the volume is well-organized and clearly presented. Overall, the book is well-produced and meticulously edited, making it free of any obvious errors and a pleasure to read.

Providing fundamental knowledge of various aspects of synthetic carbohydrate chemistry, this volume will be an indispensable reference source for any researcher in this field. The volume will be a valuable and essential addition to any institutional, as well as any personal library, serving as a handy reference. Organic and medicinal chemists and all scientists engaged in research on the biochemistry and chemistry of carbohydrates, especially in the emerging field of biologically active oligosaccharides as potential new therapeutics, should pay special attention to this volume.

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