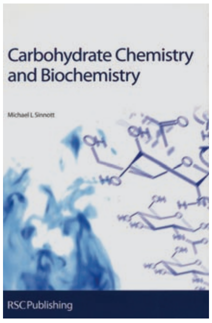
Carbohydrate Chemistry and Biochemistry



By *Michael L. Sinnott*. Royal Society of Chemistry, Cambridge 2007. 748 pp., hardcover £ 59.00.—ISBN 978-0-85404-256-2

Carbohydrates in the form of glycoconjugates communicate with their inter- and intracellular environments through a multitude of molecular interactions. Many of these interactions are involved in events such as infection, metastasis, inflammation, and signal transduction, and they have recently become the subject of intensive medical and biological research. On the other hand, polymeric carbohydrates provide raw materials for many carbohydrate-processing industries, such as pulp and paper, textiles, food, cosmetics, and biofuels. The increasing importance of carbohydrates in biology, medicine, and industry has generated a strong desire to learn about carbohydrate chemistry and biochemistry. In this book, Michael L. Sinnott, who is a professor at the School of Applied Sciences, University of Huddersfield, UK, and was formerly Professor of Chemistry at the University of Illinois, Chicago, provides an advanced understanding of carbohydrate structure and mechanisms. Structure is not defined narrowly as the disposition of covalent bonds, but also includes conformation at the small-molecule and macromolecular levels, while mechanisms here relate to reactive intermediates and transition states. As a result, the book emphasizes the physical-organic principles of carbohydrate chemistry and biochemistry.

The book is comprised of seven chapters. The first two chapters focus on monosaccharide-based reducing sugars and glycosides. Here the author introduces the basic principles that govern structure and conformation of monosaccharides, including anomeric effects, gauche effects, and mutarotation, and also include the mechanisms for glycoside formation. These two chapters are essential reading for a newcomer to the field, but more advanced readers can go directly to chapters or subject areas of particular interest without any problem. A comprehensive subject index helps one to easily identify the relevant sections in the book. Consequently, the book can serve both as a textbook and as a reference book.

From the beginning and throughout the book, the use of relevant spectroscopic and kinetic methods and other physical chemistry tools to study carbohydrates is emphasized and presented in an integrated manner. The chapters on monosaccharide structures are followed in Chapter 4 by a detailed discussion of the primary structures and conformations of oligosaccharides and polysaccharides. A description of the classical methods used for the determination of structures and sequences is followed by a comprehensive review of the use of advanced spectroscopic methods and tools to study oligosaccharides and polysaccharides in solution and in the solid state. These tools include (but are not limited to) mass spectrometry, X-ray diffraction, advanced NMR spectroscopy, atomic force microscopy, laser light scattering, and chiro-optical methods. The remainder of this chapter is devoted to a broad discussion of naturally-occurring plant- and animal-derived polysaccharides. Readers interested in mechanistic descriptions of synthetic or enzymatic carbohydrate (bio)chemistry will not be disappointed, since 4 out of 7 chapters are dedicated to this aspect.

Chapter 3, which is the introductory chapter on carbohydrate mechanisms, focuses on chemical hydrolysis of glycosides, and discusses aspects such as stability and lifetimes of oxo-carbenium ions, acidic and electrophilic catalysis and hydrolysis of glycosides, participation by neighboring groups, and also hydrolysis of other classes of glycosides, including thioglycosides and ketosides. A relatively small section is devoted to the chemical synthesis of glycosides. In contrast, Chapter 5 deals with mechanistic studies of carbohydrate-processing enzymes. Very importantly, Professor Sinnott introduces the relevant physical chemistry tools for studying enzyme mechanisms, including enzyme kinetics, kinetic isotope effects, structure–activity correlations, the use and misuse of X-ray crystallographic data, and mutation of catalytic groups, before providing a comprehensive overview of the various classes of glycosidases and glycosyl transferases.

Chapters 6 and 7 deal with mechanistic aspects of carbohydrate chemistry, mainly concerned with synthesis. First, Chapter 6 covers many aspects of classical carbohydrate chemistry, including protecting groups, rearrangements, hydroxyl group chemistry, oxidation, elimination, and addition reactions. Chapter 7 is devoted to the free-radical- and one-electron chemistry of carbohydrates. Here, as in the previous chapters, the author emphasizes the physical-organic principles and spectroscopic methods for studying structures and mechanisms of carbohydrate-based radicals in important chemical and biochemical processes. This chapter concludes with a discussion of carbohydrate-based carbenes.

In summary, the book provides an excellent and authoritative reference resource for beginning and established researchers interested in structural and mechanistic aspects of carbohydrate (bio)chemistry. However, the book does not cover the weak, non-covalent, and polyvalent interactions of carbohydrates in binding to proteins, and therefore it will be of only limited value for people mainly interested in glycobiology. Besides being well-referenced and well-structured, one of the real strengths of this book lies in its treatment and integration of the important physical-chemical principles and methods, and of kinetic and spectroscopic tools relevant to carbohydrate (bio)chemistry, which are rarely found in books in this subject

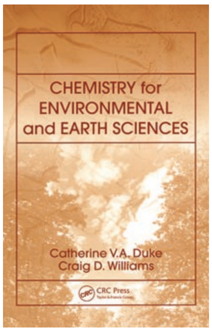
 WILEY InterScience DISCOVER SOMETHING GREAT © 2008 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim

category. This will be of great benefit to people who are not familiar with these tools, since otherwise they would need to refer to other books or companion volumes. As such, the book will attract a broad readership with diverse backgrounds and interests, including chemists, biochemists, food scientists, and technologists involved with the processing of polysaccharides, in the paper, textile, cosmetics, biofuels, and other industries.

Frank Schweizer
Department of Chemistry
University of Manitoba (Canada)

DOI: 10.1002/anie.200785580

Chemistry for Environmental and Earth Sciences



By *Catherine V. A. Duke* and *Craig D. Williams*. CRC/ Taylor & Francis, Boca Raton 2007. 230 pp., softcover £ 24.99.—ISBN 978-0-8493-3934-9

Chemistry serves an enabling science for many other scientific disciplines. In this textbook, the authors have set out to provide students of environmental and earth sciences with a basic knowledge of chemistry. The book has been written with a refreshing degree of elan and didactic skill, and on the whole it succeeds well in its aim, except for a few faults. The main emphasis is on the fundamentals of inorganic chemistry, which are covered in four main chapters. Each of the subchapters contains "self-assessment questions" to enable the student to test his or her learning of the material, and answers are given in the appendix.

The first chapter has the rather strange title "Fire", and contains seven sections dealing with the basic principles of inorganic and organic chemistry, such as the concepts of the atom and elements. The student learns something about phase equilibria and phase diagrams, the chemical bond and its structure, and chemical reactions and equilibria. The chapter also gives a good survey of applications, including, for example, determining the age of minerals from the relative abundances of radioactive isotopes for certain elements, and the age of biological materials from the proportions of the three carbon isotopes. All this is covered at breakneck speed, and sometimes accuracy falls by the wayside as a result: for example, the description of 2,3′,4,5,5′-pentachlorobiphenyl is wrong, and a carbon atom with four different groups attached is only one case of chirality in organic compounds. Unfortunately, this carelessness is a general fault of the book. How did the authors arrive at the rather strange dumbbell representation of p-orbitals?

In the chapter on "Earth", the reader learns about important rocks and minerals in the earth's mantle, including the different silicate minerals, the difference between eruptive and sedimentary rocks, and also metamorphic rocks. That is followed by a short survey of soil and soil contamination, and the three types of weathering of rocks.

In the chapter on "Water", the student learns about all the important phenomena of the chemistry of aqueous systems, such as the pH-value, acid and base strengths, and redox reactions. Here there is also a short subchapter on water pollution, but organic pollutants are not covered.

Finally, in the chapter on "Air", the student learns about the relationships that influence the composition of the atmosphere, including trace gases and important gas-phase reactions, for example those that cause depletion of the ozone layer. Currently important themes such as global warming by the greenhouse effect, and the causes and effects of air pollution, in the particular case of Great Britain, are discussed.

I recommend the book for first-year students of geosciences, although with some reservations. It provides students with a relatively easy way of learning about the subject, but later in their course they must cover the ground more thoroughly by using a more detailed book, such as one of the textbooks by Atkins. The fundamentals of physical chemistry are only treated in a rudimentary way, with the exception of phase diagrams, and also the treatment of organic chemistry is neither sufficiently detailed nor properly presented: some of the structures, for example those of cellulose and of chlorophyll *a*, are incorrect. Perhaps these weaknesses of the book can be remedied in a future edition. Some of the tables of data on aqueous and atmospheric pollution could also be updated.

Dieter Lenoir
Institut für Ökologische Chemie
GSF Forschungszentrum, Neuherberg (Germany)

© 2008 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim