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Book review

Essentials of Carbohydrate Chemistry By John F. Robyt, Springer-Verlag, New York, 1998. ISBN 0-387-94951-8, 399 pp, $54.95, hardback.

When I was asked to review this book, I agreed willingly, knowing that it had been written by a veteran carbohydrate scientist at Iowa State University, a great center for carbohydrate research, and that it is part of the prestigious series of the Springer Advanced Texts in Chemistry. It was also my hope that the book would fulfill a pressing need, especially for students entering the fast-developing field of the chemistry and biology of carbohydrates, with its increasing impact on biotechnology and medicine. My expectations were raised when I learned from the author's introduction that the book is based on a graduate course on the subject that he has been teaching for several decades. However, on several counts, it falls short of these expectations.

On the positive side, the book is well written, and requires only basic knowledge of chemistry and biochemistry to follow. It is profusely illustrated with numerous clear figures, is nicely produced and is reasonably priced. The coverage is broad, with a wealth of material that includes many biochemical aspects of carbohydrates, as well as nutritional and technological ones, with frequent emphasis on the historical picture. The didactic approach is apparent from the organization of the book. In the two introductory chapters (''Beginnings'' and ''Developments'') the importance of carbohydrates is reviewed and considerable space is devoted to the classical work of Emil Fischer on the basic structures of the monosaccharides. Then come two longish chapters on the chemical reactions of carbohydrates, and one on sweetness. They are followed by two on polysaccharides, and one each on cyclodextrins (a subject to which the Iowa group made seminal contributions, starting with the work of Dexter French, the author's mentor) and on glycoconjugates. Two other chapters deal with biosynthesis and with biodegradation, and a final one with analytical and structural techniques. The book ends with two appendices on nomenclature of carbohydrates and of enzymes. There is, perhaps unavoidably, some overlap between the different chapters. For instance, qualitative and quantitative determinations of carbohydrates are described in considerable detail already in chapter 3 on transformations. This may, however, be advantageous for teaching purposes.

Many of the chapters are heavily referenced, in most cases with between 30 and 60 literature citations, although a few have well over 100. There is in addition a list of reviews and books for further study. Unfortunately, most of the references are dated, as are the reviews and books cited. For instance, in chapter 4 dealing with chemical modifications, the ''literature cited'' lists close to 140 articles, all but about 10 of which are over a decade old; the situation is not much better in the accompanying 33 references recommended for further study. In the chapter on glycoconjugates, a subject in which major strides have been made during recent years, out of some 60 primary articles cited, only two are from the 1980s and none of the 1990s! In the references for further study given in the same chapter the latest is from 1989, and no attention is drawn to any of the very recent excellent reviews on the subject (e.g. in *Annual Reviews of Biochemistry, Glycobiology, Glycoconjugate Journal*, and *Current Opinion in Structural Biology*, sources not cited at all in the book), nor of the several new advanced texts dealing with those topics. Another example is the chapter on analytical techniques, where all the articles and reviews listed (except one, from the author's laboratory) are at least 10 years old, with quite a few published more than 30 years ago. Here, too, there are

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up-to-date sources, both in the serials and journals just mentioned, in different volumes of *Methods in Enzymology* which contain many chemical techniques, and in other new books.

Even more disappointing is that *Essentials of Carbohydrate Chemistry*, the writing and production of which certainly took considerable effort, is marred with numerous misprints and errors, and is amiss in some other respects as well. Many of these faults could have been rectified by a highly qualified professional copy editor. Others, quite a number of which are substantial, are the sole responsibility of the author. Here are examples, mainly of the latter kind: thus, contrary to the statement on p. 18, rhamnosamine and fucosamine (either D-or L-) have never been found in glycoproteins; glycogen is described solely as a polysaccharide (p. 187–188) and no mention is made of the recent exciting discovery that it is a glycoprotein, nor of the presence of proteoglycans (p. 189–191) in cell membranes, where some of them function in cell adhesion and in the binding and activation of growth factors; heparan sulfate contains not only D-glucuronic but also L-iduronic acid, which is of the same configuration (not D-) in heparin (incorrectly referred to as ''heparin sulfate'') (p. 191); although the latter glycosaminoglycan is widely employed as an anticoagulant, it is uncertain whether this is its role under physiological conditions; the use of the terms ''murein'' (for the bacterial cell-wall glycosaminoglycan), ''peptidomurein'' for (peptidoglycan) and the acronyms NAG (for *N*-acetylglucosamine which should be spelled as one word, not two) and NAM (for *N*-acetylmuramic acid) (p. 193 and elsewhere in text) is inappropriate and does not conform to the recommendations of the Joint Commission of Biochemical Nomenclature of IUPAC and IUB, which both authors and copy editors should follow; the old reports on the presence in glycoproteins of glucose *S*-linked to cysteine and of *N*-acetylneuraminic acid *O*-linked to tyrosine have never been confirmed, and their inclusion in this book (p. 267) is not justified; the structures of IgE and IgM oligosaccharides with a modified pentasaccharide core are old and now known to be mistaken, since this core is highly conserved (p. 271); the structures of the ovalbumin oligosaccharides are wrong (several are depicted as containing glucose instead of *N*-acetylglucosamine; p. 273), as are those of the *O*-linked (p. 277) and *N*-linked oligosaccharide of glycophorin A (p. 278), of poly-*N*-acetylneuraminic (not ''poly-a-D-neuraminic'') acid derivative from *Meningococcus* sp. (p. 280) and of the incorrectly named ''glycosphingosine'' glycolipids (p. 283); the number of glycospingolipids now known is over 300, not ''over 50'' and galactocerebrosides do not occur in ''neuronal cell membranes of the brain'' but in the myelin sheath (p. 281); the cause of multiple sclerosis is not ''antibodies against the carbohydrate of brain and nerve tissue gangliosides'' (p. 282); the biosynthetic scheme on p. 322 is misleading, since the pentasaccharide core never occurs as a discrete intermediate; potato lectin is specific for $(GlcNAc)_3$, not for $(GalNAc)_3$ (p. 360); and in the section on determination of carbohydrate structures by NMR (p. 355–359) only C-13 spectroscopy is discussed while proton NMR, so useful for this purpose, is not considered at all.

Experts in the field who would be alert to such errors may find the book useful in certain respects, but I would hesitate to recommend it to the graduate students taking my course on the molecular biology of glycoproteins and glycolipids.

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