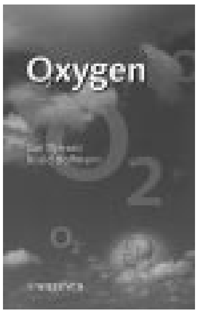
Oxygen—A Play Not Just For Chemists?

Oxygen. By *Carl Djerassi* and *Roald Hoffmann.* Wiley-VCH, Weinheim 2001. viii + 120 pp., Paperback DM 29.80 (ca. € 15).—ISBN 3-527-30413-4



This year marks the one-hundredth anniversary of the awarding of Nobel Prizes by the Nobel Foundation. Imagine that to mark this centennial, the foundation decides to award a "retro-Nobel Prize" for those great discoveries in chemistry that occurred before the first prize was given. The task of making this award is the context of the play "Oxygen", which had its world premiere on April 2, 2001 at the San Diego Repertory Theater. This date coincided with the opening of the national spring meeting of the American Chemical Society in San Diego on the occasion of its 125th anniversary, and the audience was packed with members of that field. "Oxygen" was written by two world-famous chemists, Carl Djerassi of Stanford University and Roald Hoffmann of Cornell University; both have increasingly pursued literary work after receiving almost all the accolades possible in their respective research fields. The play concentrates on finding the first retro-Nobel in chemistry.

Of course, many choices are possible for this great honor. One candidate that springs to my mind is Amedeo Avogadro (1776–1856), who in 1811 put forward the hypothesis that equal volumes of gas at the same temperature and pressure contain equal numbers of atoms or molecules. Indeed, Avogadro first coined the word "molecule" and introduced the concept that substances could be polyatomic. Another most worthy candidate is Jöns Jacob Berzelius (1779–1848), noted for his determination of atomic weights, the development of modern chemical symbols, his electrochemical theory, the discovery and isolation of several elements, the development of classical analytical techniques, and his investigations of isomerism and catalysis (both named by him). But then you would not have a play! Instead, the retro-Nobel committee struggles with making the award for the discovery of oxygen. There are three contenders. The first is Carl Wilhelm Scheele (1742–1786), the Swedish apothecary who is the first to discover "fire-air" but fails to publish this discovery until 1777. The second is Joseph Priestley (1733–1804), the English Unitarian minister who discovers oxygen but clings dogmatically to the theory of phlogiston, which says that all flammable materials contain an odorless, colorless, weightless substance (phlogiston) that escapes upon burning. Hence, Priestley fails to understand the true significance of what he has found. The third candidate is the French chemist and tax collector Antoine Laurent de Lavoisier (1743–1794), who was the first to recognize that combustion involved oxidation. By denying the existence of phlogiston, Lavoisier was able to establish the principle of conservation of mass in chemical reactions.

The play skillfully jumps back and forth between the time periods of the 1770s and the present as the Nobel Prize committee grapples with this choice. At first, the task seems to be an easy one, with Lavoisier the first choice as the father of modern chemistry. But the plot thickens when it is revealed that he had the benefit of much knowledge of the work of his competitors. In 1774 Priestley, a guest in Lavoisier's home in Paris, told him how he had made what he called dephlogisticated air. At approximately the same time, Scheele wrote Lavoisier a letter detailing his discovery of fire-air and how to make it. Both Priestley and Scheele believed in phlogiston, but Lavoisier was able to comprehend the true significance of oxygen in combustion. As they say, the rest is history—but do we really know the true story? Djerassi and Hoffmann capture and amplify the moral dilemma of whether Lavoisier gave sufficient credit to those whose work he used to overthrow the theory of phlogiston.

Ask someone what "oxygen" means. To scientists the answer is obvious, and the only clarification needed is an answer to the question, Atomic or molecular? But to many, oxygen has other meanings than simply the life-giving stuff of air. If you doubt this, check this address: http://www.oxygen.com/. You will find a Web site devoted to a woman's view of the world. This site connects you to what is one of the most audacious entertainment start-ups in decades. Oxygen is the first online and on-air network for women by women; it is now on cable TV in the United States. Its slogan is "Another Great Reason to Be a Woman," and its special spokesperson and salesperson is Oprah Winfrey, perhaps the world's best known, most influential, and richest TV personality. Djerassi and Hoffmann's "Oxygen" plays on this association of the word. Throughout their play, what women have to say takes on more significance than what is said by men.

The chair of the retro-Nobel Prize Committee is Astrid Rosenqvist, an outstanding theoretical chemist who had some past romantic involvement with another committee member, Bengt Hjalmarsson. A lovers' quarrel runs through-

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out the dialogue. Two other distinguished men complete the committee. Rosenqvist introduces Ulla Zorn, who is supposed to be present only to record the meeting. But Zorn is more than an amanuensis; it unfolds that she is pursuing a doctorate on the role of women in the history of science. As the wrangling over the candidates for the prize intensifies, her role changes, and she tells the men that to select properly among the three contenders it is necessary to ask the women most closely associated with them. We are treated to a steamy scene in a sauna that involves the fictional encounter of the prim 35-year-old Mary Priestley, wife of Joseph Priestley; the 26-year-old Sara Margaretha Pohl, Scheele's devoted housekeeper whom he would marry on his deathbed; and the worldly 19-year-old Marie-Anne Pierrette Pauize Lavoisier, whom Lavoisier married when she was 13. The play argues that these three women were much more than bystanders to the scientific accomplishments of their male partners. For example, did Madame Lavoisier intercept Scheele's letter to her husband and keep it secret from him? In view of the many complications concerning the discovery of oxygen, what was the final choice of the retro-Nobel committee? Djerassi and Hoffmann resolve the conflict brilliantly, but I will not give away the ending.

Having served on and chaired several prize committees, I felt that the carping remarks of the members of the retro-Nobel committee resembled more a faculty appointment process gone terribly awry than the serious deliberations of a prize selection. I asked Sture Forsén of Lund University, a member of the Chemistry Nobel Prize Committee for 19 years, what his impressions were. He agreed with me that the play shows more a caricature than a picture of what transpires in such deliberations. Of course, playwrights are allowed to take liberties, and "Oxygen" does just that. It provides a most diverting and entertaining evening for chemists and those who ponder the nature of discovery and the attribution of discovery to individuals.

Djerassi is well known for his work in the synthesis of steroid oral contraceptives and for the development of mass-spectrometric techniques. He wrote more than 1,200 articles in the area of chemistry before turning to what he calls "science in fiction." He is the author of several novels, including "Cantor's Dilemma", "The Bourbaki Gambit", "NO", "Marx, Deceased", and "Menachem's Seed", as well as a play based on that novel, "An Immaculate Misconception". He has also written his memoirs and two autobiographies, "Steroids Made It Possible" (for chemists) and "The Pill, Pygmy Chimps & Degas' Horse" (for nonscientists). Awards and honors received by Djerassi include the National Medal of Science in 1973, and the American Chemical Society's highest honor, the Priestley Medal, in 1992.

Hoffmann won the 1981 Nobel Prize in chemistry for theories concerning the course of chemical reactions. He shared the prize with the late Kenichi Fukui. Hoffmann's literary works include books of poems, "The Metamict State" (1987) and "Gaps and Verges" (1990); "Chemistry Imagined" (1993), a book about art, science, and literature written with the artist Vivian Torrence; "The Same and Not the Same" (1995), an account of the dualities in chemistry; and "Old Wine, New Flasks: Reflections on Science and Jewish Tradition" (1997), a book he coauthored in an intertwining of voices of science and religion. He is also a recipient of the National Medal of Science (1983) and the Priestley Medal (1990).

Science in theater is emerging as an exciting new art form. It can be seen in such plays as Tom Stoppard's *Arcadia*, which revolves around a 13-year-old math prodigy, Thomasina Coverly, who baffles her tutor by asking if God is a Newtonian, and Michael Frayn's *Copenhagen*, which is based on the uncertainties surrounding the 1941 meeting between the physicists Niels Bohr and Werner Heisenberg in German-occupied Copenhagen.

We are indebted to Carl Djerassi and Roald Hoffmann for showing the world that chemistry can also be theater. The premiere audience, almost a Who's Who in chemistry, was greatly amused by the play; it remains to be seen whether it will also appeal to a less knowledgeable audience.

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Chemical Synthesis of Natural Products. Edited by *Karl J. Hale.* Sheffield Academic Press, Sheffield 2000. xiii+429 pp., hardcover £ 99.00.—ISBN 1-84127-039-3

Natural products have long played an important role in organic chemistry. On one hand they present challenges for chemists involved in determining their structures, while on the other hand synthetic chemists devote their efforts to the rewarding and satisfying task of constructing these fascinating structures, which are often associated with useful biological effects, by the most elegant route. This latter area of endeavor is the subject of this book, in which Karl J. Hale, assisted by 19 co-authors, sets out to report on developments in recent years. The work is intended for established researchers in industry and universities with interests in the synthesis of natural products. Everyone within this intended readership is likely to find something useful in the book's 12 chapters, although it is not possible for it to cover the subject exhaustively in a little over 400 pages, nor does it claim to do so.

In Chapter 1 (39 pp.) J. M. Gardiner describes strategies for the synthesis of complex carbohydrates, including both chemical glycosylation methods and enzymatic methods. Developments in the area of solid-phase syntheses of oligosaccharides and oligosaccharide libraries are also described, and the chapter ends with syntheses of oligosaccharide analogues and glycomimetics. In Chapter 2 (23 pp.) J. W. Bode and E. M. Carriera discuss the synthesis of some macrolides, namely oleandolide, fluvirucin B1, macrolactin A, and lankacidin. For each of these, several methods of synthesis are outlined, and important key steps are discussed in detail.

Chapter 3, by A. N. Hulme (33 pp.), is concerned with the total synthesis of polyether antibiotics. After briefly surveying the most important compounds and their properties, the author discusses biomimetic syntheses of polyether antibiotics in greater detail. Next, as in the previous chapter, syntheses of some individual compounds of this class are described, namely salinomycin, spongistatine, parviflorin, asimicin, and brevetoxin A, the last of these being only briefly outlined in three pages.

In Chapter 4 (30 pp.) J. Robertson reports on important developments in the total synthesis of alkaloids. Syntheses of reserpin, daphniphyllum alkaloids, dendrobin, gelsemin, strychnine, morphine, roseophyllin, and many others are described.

Chapter 5 (16 pp.), by G. A. Sulikowski and M. M. Sulikowski, is devoted to the synthesis of heteroaromatic natural products, including durocarmycin A, mitomycin K, and camptothecin. In Chapter 6 (36 pp.) R. S. Coleman and M. L. Madras are concerned with aromatic natural products, including no less than 87 (!) compounds. Some of these receive no more than a mention, but others chosen as representative of types of compounds are treated in thorough detail. Some worth noting are michellamines, dibenzocyclooctadiene-lignans, podophyllotoxins, quinones such as conocurvone or dynemicin A, and chromanes such as calanolid A, calanolid B, and angucyclins, to mention only a few.

In Chapter 7 (18 pp.) E. Tyrell gives a short survey of developments in the area of terpene syntheses, but includes only a few sesquiterpenes (e.g., seychelles, longifoles, α-cedrene, quadrone, and triquinanes) and some diterpenes (clerodans, labdans, vinigrol, kaurane, etc.).

Chapter 8 (30 pp., C. M. Marson) describes new developments in the synthesis and modification of steroids, beginning with reactions involving the steroid skeleton, followed by approaches to total and partial syntheses. Polyene cyclizations, electrocyclic reactions, and free radical cyclizations are described, and the chapter ends with syntheses of heterocyclic steroids, in particular cephalostatins. In Chapter 9 (35 pp.) S. Caddick, S. Shanmugathasan, and N. J. Smith discuss syntheses of enediynes and dienediynes. Research projects on syntheses of calicheammicines, esperamicines, dynemicines, and neocarcinostatin chromophores, including model studies, are described in detail.

Chapter 10 (36 pp., C. M. Bladon and P. B. Wyatt) is concerned with the synthesis of amino acids and linear peptides. Various strategies for solid-phase synthesis are described, including the use of resins, linkers, and coupling reagents, and methods based on fragment condensations and chemoselective coupling by Kent's method. This is followed by a brief excursion into combinatorial peptide chemistry, and finally a very detailed description of methods for the stereoselective synthesis of α-, β-, and γ-amino acids.

In Chapter 11 (36 pp.) A. B. Tabor reviews recent developments in the synthesis of cyclic peptides, then focuses on individual examples of these compounds, giving most space (10 pp.) to vancomycin. In the final chapter (57 pp.) K. J. Hale, G. S. Bhatia, and M. Frigerio present a survey of work on syntheses of cyclodepsipeptides. Those on which they report include arenastatin A, dolastatin D, himastatin, sanglifehrin A, and didemnin A, to name only a few.

Most of the reaction schemes give all steps of the synthesis in a concise form. However, a few of them concentrate only on one or two key steps, indicating the others merely by a sequence of arrows labeled as "steps" (an unsatisfactory practice in my view). Scheme 2.28 fails to include the reaction conditions and the reagents, and Scheme 7.24 appears to have been produced with different parameter settings of the graphics program, as becomes immediately obvious on turning the pages. Otherwise the editorial work has been done with great care (with one exception mentioned below), so that one finds very few printing errors. However, a glossary of abbreviations would have been a useful improvement. The legends to the reaction schemes contain many abbreviations which are seldom explained in the text. Often the index offers no help with these, for example in Scheme 1.1 with the abbreviation DTBMP. It is only by accident that one discovers, from the legend to Scheme 1.2, that this must mean di-*tert*-butyl-4-methylpyridine. There are many similar examples in every chapter.

However, these criticisms do not detract significantly from the good overall impression. Altogether the book offers a great wealth of information for those working in the field. Nonspecialists too will benefit from the excellent overviews of compounds with interesting structures and important biological and/or pharmaceutical activity, and of syntheses achieved during the past ten years. The chapters cover the literature up to 1998, and wherever possible they refer the reader to up-to-date review articles, especially on aspects that had to be omitted or only touched on briefly in the book. Everyone active in this area of research in industry or academia will certainly find new and stimulating ideas in at least one or other of the chapters, and from the literature references provided (over 1500 in the book as a whole) should be able to go directly to the library to read the relevant original publications. Those involved in teaching will likewise find the book useful and stimulating, and will be able to incorporate some of the syntheses into their lectures and laboratory exercises.

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Ligand Field Theory and its Applications. By *Brian N. Figgis* and *Michael A. Hitchman*. Wiley-VCH, New York 2000. xviii + 354 pp., hardcover £ 51.95.—ISBN 0-471-31776-4

This book is the first of a planned series of one-volume introductions to important areas of inorganic chemistry. Compared with its predecessor of 1966, *Introduction to Ligand Fields* by Brian N. Figgis, two chapters have been removed and replaced by new ones. The authors have removed the chapters on group theory and molecular orbital theory, assuming that readers are already familiar with these topics, and have introduced chapters on the angular overlap model and on the origin and calculation of splitting of the d-electron energy levels in cubic ligand fields. The contents of all the other chapters are unchanged in principle, but they have been updated, rearranged to some extent, and given new titles.

The book is divided into eleven chapters. The first four are concerned with a common theme, which can be defined as the description of the ligand field effect on the basis of models. Chapter 1 is devoted to the ligand field concept and its application to the interpretation of the physical properties of complexes (stability, structure, spectroscopy, magnetic properties). Chapter 2 gives a detailed description of the parametrization scheme based on the point charge model, as applied to d ions with octahedral and tetrahedral coordination, including variants with tetragonal and trigonal distortion. Other parametrization schemes for d- and f-electron systems are mentioned, and the limitations of the electrostatic model are discussed. Chapter 3 introduces the angular overlap model (AOM) and discusses its special characteristics. Energy expressions for common types of complex symmetries are derived. Examples of typical AOM parameter values are given, the advantages of the model compared with the electrostatic approach are explained, and attention is drawn to some computer programs for calculating spectroscopic and magnetic properties. Chapter 4, on the origin and calculation of splitting of the d-electron energy levels in cubic ligand fields, presents results from point charge and molecular orbital calculations of the ligand field splitting and compares them with experimental data.

The next two chapters form a second theme: perturbations of d electrons. Chapters 5 and 6 briefly discuss some important aspects of the theory of free ions and that for ions in complexes (perturbation of the d-electron system by interelectronic interactions, spin–orbit coupling, and ligands). Perturbations of the latter type are subdivided into effects of weak, intermediate, and strong ligand fields, and are discussed on the basis of correlation diagrams and Tanabe–Sugano diagrams.

The third subject group, Chapters 7–9, is concerned with the physical properties of complexes, beginning with the influence of the d-electron configuration on structure and stability (Jahn–Teller effect, bond lengths, enthalpy of hydration, kinetics). Chapter 8 then moves on to electronic spectra (intensities, selection rules, band broadening, temperature effects), with typical examples from the 3d, 4d, and 5d element series (including the spectrochemical and nephelauxetic series, charge transfer, and luminescence). Lastly, Chapter 9 deals with the magnetic properties of free and complex-bound ions, the latter being classified according to the ground-state term (A, E, or T) in a cubic ligand field. The topic is completed by brief discussions of spin-crossover compounds and polynuclear exchange-coupled compounds.

Chapters 10 and 11 are concerned with the EPR spectra of complexes (characteristics of the spectra, spin operators, interpretation of EPR parameters) and with actinide compounds (ligand field effect in f-electron systems, UV/Vis spectra, magnetic properties). Finally there is an appendix with sections listing spherical harmonics, matrix elements, alternative ligand field parameters, energy terms, orbital angular momentum operators, and other data.

One of the favorable impressions gained from reading this book results from the authors' treatment of the various aspects of ligand field theory under well defined and self-contained subject areas. Chapters 7, 8, and 10, perhaps the most important in the book, succeed well in their concise, systematic, and informative description of the physical properties, including 1) the influence of the d-electron configuration on structure, stability, and kinetics, 2) the intensity, width, and shape of absorption bands, including temperature effects, and 3) EPR spectra. Here readers are provided with important and useful criteria for interpreting their own research results.

Nevertheless, the overall impressions are mixed. It is essential for the reader to gain a clear understanding of many other areas of theory treated in the text (such as angular momentum operators), but that is hindered to some extent by misprints in important formulas, a lack of mathematical strictness, and poor typography in some of the mathematical equations. In transfering passages from the earlier volume, the publishers have not only carried over some existing printing errors (e.g., in Equations 1.31, 2.62, 5.7, 8.12, 9.12, and 9.14) but have introduced some additional ones (e.g., in Equations 7.16, 9.83, and 9.95). Some confusion results from the use of at least four different notations for the angular- and spin-dependent state functions, where it would have been better to use the Dirac formalism throughout. Moreover, for the reader it is almost impossible to identify an operator as such, and the use of bold-type symbols is not systematic. In equations involving the magnetic susceptibility (in SI units), the magnetic field constant is missing. Occasionally the reader is left without help where symbols are not explained (e.g., in Chapter 3, Table 3.1), and appropriate literature references are not given. Some of the figures are unclear and incomplete (e.g., Figs. 6.11, 6.15, and 9.1). Finally, the authors have omitted some important results that are essential for an up-to-date monograph on ligand field effects, such as the application of the angular overlap model to lanthanide compounds, the LIESST effect in spin-crossover compounds, and quantum-mechanical calculations of exchange parameters for dinuclear copper complexes. Although all these are comparatively minor weaknesses, they are annoying for readers with only a limited knowledge of the subject. Were it not for these shortcomings, one could recommend this as a well balanced, practical, and readable monograph on an attractive area of inorganic chemistry.

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Molecular Catenanes, Rotaxanes and Knots. Edited by *Jean-Pierre Sauvage* and *Christiane Dietrich-Buchecker*. Wiley-VCH, Weinheim 1999. xiv + 368 pp., 302 figs., 5 tabs., hardcover DM 248.00 (ca. € 127).—ISBN 3-527-29572-0

This well crafted book on interlocked molecules is an indispensable guide to a vibrant area of modern chemical research.

Chapters by Sauvage, Stoddart, and Vögtle cover high-yield synthetic approaches to catenanes, rotaxanes, and knots. Raymo and Stoddart review pseudorotaxane formation from crown ethers threaded with alkyl ammonium molecules and the attachment of bulky groups or "molecular stoppers" to create rotaxanes. Multiple binding sites on threading

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groups are also covered, showing how molecular switches and shuttles may be constructed. Macrocycles and threading molecules containing paraquat moieties are also given as examples of rotaxane- and catenane-forming systems utilizing $\pi-\pi$ stacking for self assembly. Use of amide hydrogen bonding is examined, and a final section on cyclodextrins and their application to rotaxane and catenane formation completes this chapter. The chapter by Heim, Udelhofen, and Vögtle expands on amide-based catenanes and rotaxanes touched on by Stoddart's chapter. The relationship between structure and catenane or rotaxane yield is discussed in depth. Post-interlocking derivatization of catenanes and rotaxanes is discussed and the properties of these new molecular topologies are reviewed.

Dietrich-Buchecker, Rapenne, and Sauvage concentrate on the trefoil knot and the use of copper(I) complexes as templates for the molecular knotting process. The last section of this chapter is quite fascinating, as it describes how the enantiomerically pure molecular trefoil knot was prepared. The trefoil knot is topologically chiral, and this section shows how the topology fundamentally dictates the physical properties.

Particularly pleasing is the inclusion of a theoretical chapter on knot theory and chirality by Flapan that tackles the subject in a concise and simple manner. Judicious use of diagrams makes this chapter much easier to understand than many books that cater for the more mathematically minded scientists.

Polymer chemistry makes an appearance in three chapters, where polymer entanglements and knotting, polycatenanes, and polyrotaxane synthesis are covered in some detail. The chapter "Polymer Chains in Constraining Environments" by J. E. Mark will be of interest to those wanting some idea of what physical properties catenane- and rotaxane-derived materials might have. Catenane polymers are introduced in a chapter by Geerts with the topology of interlocked structures that may be incorporated into polymers. Larger structures formed by the catenation of cyclic polymers are also discussed. Nomenclature, topology, and synthesis of polyrotaxanes are covered in a chapter by Gong and Gibson. The chapter is conveniently divided according to the dominant force that drives the self-assembly process which includes statistical threading, hydrophilic–hydrophobic interactions, hydrogen bonding, metal templates, and $\pi-\pi$ stacking. The final section on properties and potential applications will be of interest to supramolecular chemists and polymer chemists alike.

A glimpse of biological aspects of interlocked molecules can be seen in "Synthetic DNA Topology", by Seeman.

Although this book's principal attraction is the way it covers a wide range of topics, perhaps the inclusion of chapters on coordination polymers and molecular-based magnets widens the subject matter too far. Having said this, it does no harm to see how crystal engineering and materials science are related to interlocked structures.

In summary the book has clear, well laid out figures, the chapters do not unduly suffer from repetiton of material, and the index compilation is thorough. The book will be well received, not only by those actively researching in this area, but also for people simply curious about knotting, threading, or weaving on a molecular scale.

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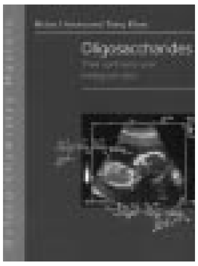
Oligosaccharides. By *Helen Osborn* and *Tariq Khan*. Oxford University Press, Oxford 2000. 112 pp., paperback £ 16.99.—ISBN 0-19-850260-5



The selective linking of monosaccharides to form complex carbohydrates is one of the most interesting areas of natural-products synthesis. Although the synthesis of oligosaccharides is still a long way from being a routine method comparable to the synthesis of peptides or nucleotides, there is still much scope for further development of the techniques. Moreover, it enables one to develop protecting groups and strategies for "taming" highly functionalized monosaccharide building blocks, thus making important contributions to other areas of organic chemistry research.

This book is an easily readable introduction to the present state of knowledge on the synthesis of oligosaccharides. The authors lead the reader gently, step-by-step, into the complex subject of carbohydrate chemistry. Beginning with the regioselective attachment of protecting groups onto the monosaccharide building block, they show how one can produce protected glycosyl acceptors. There then follows a chapter on donors, in other words on the activation of the anomeric site. Next comes a discussion of the linking of donors and acceptors, and a survey of the latest synthetic strategies for achieving it. Now one comes to the real art of oligosaccharide synthesis, involving the selective removal of protecting groups, anomeric activation, and stereoselective bond formation, to which an entire chapter is devoted. The applications of enzymatic methods are then reviewed. The book concludes with a survey of the capabilities and limitations of solid-phase synthesis of oligosaccharides.

Altogether this is an excellent book which can be recommended for students and practicing chemists who seek an overview of the current state of the synthesis of oligosaccharides. In the limited space of this little book the authors have, of course, had to omit some aspects. Thus, there is nothing about methods for linking more complex aglyca, nor about the far from trivial subject of the analysis of oligosaccharides and their protected precursors. Regrettably, many of the syntheses described end at the stage of the fully protected oligosaccharide, whereas the final deprotecting step presents the most crucial challenge in the entire synthesis.

Literature references are given at the end of each chapter, but unfortunately these are not in general mentioned explicitly in the text, which makes it difficult to go to the original publications for information about exact reaction conditions. It would have been useful to give detailed information about yields and reaction conditions, especially where different synthetic strategies are compared. Although the figures are supported by discussions in the text, it is annoying that, conversely, many of them are not referred to explicitly in the text.

Here, as in other books on carbohydrates, searching for wrongly drawn ring structures is both entertaining and instructive. No less than six different line formulas are given for *N*-acetylneuraminic acid, two of which are incorrect. The chapter on the biology of carbohydrates should be skipped, because unfortunately it fails to explain the subject. However, apart from these muddled pages, which luckily are very few, this book contains an excellent survey of the synthesis of oligosaccharides, which goes directly to the essentials of synthetic matters without a lot of unnecessary bioorganic embellishment.

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Catalysis and Zeolites. Fundamentals and Applications. Edited by *Jens Weitkamp* and *Lothar Puppe.* Springer-Verlag, Heidelberg 1999. xviii+565 pp., hardcover DM 348.00 (ca. € 178).—ISBN 3-540-63650-1

This book presents in a very clear fashion the fundamental aspects of zeolites that account for their extraordinary properties as catalysts. The book makes a trip through the areas of synthesis, modification, and characterization of zeolites, also describing other molecular sieves such as those of the ALPO, SAPO, GAPO, and MEAPO types, and ending with the applications of such materials in catalytic processes for oil refining, petrochemistry, and chemicals. The book will be extremely useful, not only for newcomers to the field of zeolite catalysis, but also for researchers and university teachers who will find here the basic principles needed to understand the catalytic behavior of zeolites and the commercial (and potential) catalytic processes in which they are used.

Readers more interested in zeolite synthesis will find in the first chapter a lucid theoretical treatment of nucleation and crystallization. Unfortunately, though, the book does not give a more in-depth discussion of the formation of the primary nuclei and the techniques available for studying them experimentally. I also regretted that I found no discussion of the role and design of organic structure directing agents (SDAs). This limitation is probably due to the fact that most of the references given by the authors do not go beyond 1991, and consequently all the new SDAs developed for synthesizing SSZ and CIT zeolites are not covered. In the second chapter, on phosphate-based zeolites and molecular sieves, the fundamentals are well described, but I expected to find also a discussion of the catalytic reactivity of such materials, especially in view of the fact that they receive very little treatment in the following chapters.

The book contains an excellent and informative Chapter 3 on zeolite modifications, which gives a clear idea about the further gains that can be achieved by post-synthesis treatments of zeolites. The number of references given by the authors is outstanding, although it is a pity that most of them correspond to work published before 1993. Chapter 4 is also an excellent chapter that will be very useful to readers who wish to learn the techniques available for zeolite characterization, with their advantages and limitations.

The catalytic part of the book has been rationally divided according to zeolites for organic synthesis and those for oil refining and petrochemical processes, with special emphasis on shape selectivity in catalysis. This issue of zeolite shape selectivity is very well described with up-to-date literature references. The two chapters on organic catalysis and zeolites for industrial processes give a very good overview, especially when used in conjunction with the references given there.

The book has been carefully edited. I detected only two citation errors in Chapters 1 and 6. The printing is of good quality and very comfortable to read. In conclusion, I have enjoyed reading the book and strongly recommend it to students, postdocs, university teachers, and researchers interested in the field of zeolite catalysis.

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Practical Capillary Electrophoresis. 2nd Edition. By *Robert Weinberger*. Academic Press, San Diego 2000. 642 pp., hardcover $ 99.95.—ISBN 0-12-742356-7

Capillary electrophoresis has found a place among instrumental methods of analysis, even if not gaining such widespread acceptance as the optimistic forecasts of market analysts led one to expect. It is a fast microanalytical method, and has become indispensable in certain fields, while in others it is found in a different guise within analytical systems for analyzing proteins and DNA. Several monographs on capillary electrophoresis appeared a few years ago, and now we have a revised and considerably enlarged version of a classic work, with 642 pages compared with 310 in the first edition. The well-proven structure of the first edition has mainly been retained, although some chapters and sections have been moved to take account of new developments and changes of emphasis.

The book is based on lecture courses on capillary electrophoresis which the author has given many times. The benefits of that are evident in the descriptions of the various separation techniques, in the many tables, and in the very instructive figures and examples, together with the discussions accompanying these. The introductory chapters have only been extended slightly, whereas the most drastic, but well justified, changes have occurred in the description of the fundamentals of MEKC (micellar electrokinetic chromatography), and in the use of cyclodextrins for enantiomer separation in the chapter on “Secondary Equilibrium, Micelles, Cyclodextrins, and Related Reagents”. The chapter on isotachophoresis from the first edition has been added instead to the section on “Injection”, being the only practical application of this technique as a stacking method for preconcentration of trace components. The chapters on “Size Separations in Capillary Gels and Polymer Networks” and “Capillary Isoelectric Focusing” have also been considerably enlarged, taking into account the practical applications of capillary electrophoresis in DNA and protein analysis.

In addition to these extensions, the individual chapters have been improved by the inclusion of many new results from a very wide variety of applications of capillary electrophoresis. In many of these examples the author also discusses possible sources of error.

To summarize, this second edition reinforces the good impression created by its predecessor. Because of its highly instructive, textbook-style character it can be recommended for newcomers to capillary electrophoresis. The experienced practitioner may also benefit from leafing through the book, which should yield useful ideas bearing on everyday problems, and information about possible sources of error and ways of avoiding them. The comprehensive lists of references (up to and including 1998) provide a good route into the original literature.

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Seminars in Organic Synthesis. 25th Summer School "A. Corbella". (Series: Seminars in Organic Chemistry, Vol. 10.) Edited by *Franco Cozzi*. Royal Society of Chemistry, London 2000. 583 pp., softcover ca. € 50.— ISBN 99-86208-15-4

This volume is based on the proceedings of the 25th A. Corbella Summer School, held at Villa Feltrinell, Gargagno, Italy, on 12–16 June 2000, and is the work of F. Cozzi (seminar chairman) assisted by a team of Italian authors. The preface consists of the text of the Giancarlo Jommi Memorial Lecture, which was given by Professor A. Hoveyda (Boston College, USA).

The first main part of the book contains the edited texts of the lectures, and is divided into four sections. The first section, led by P. Scrimin, contains reports by three authors on some new classes of compounds with pharmacological activity. These begin with the discovery and development of α-reductase inhibitors for the treatment of androgen-related diseases, followed by a description of the synthesis and therapeutic potential of glycine antagonists. The section ends with a report on the antitumor activity of certain natural products related to taxol.

The second section, under the leadership of M. Taddei, discusses new developments in the area of organometallic chemistry, beginning with the use of cerium(III) chloride as an important reagent for organic syntheses. This is followed by synthetic applications of chromium carbene complexes.

The third section, led by F. Cozzi, presents reports on new developments in the area of free-radical chemistry applied to organic synthesis, beginning with a general discussion of the topic, then focusing on the use of organoselenium compounds in free-radical reactions. Next is a description of some industrial applications of free-radical reactions, then the section concludes with a report of new results in the important area of stereoselective free-radical reactions.

The fourth section, led by G. Sodano, is concerned with stereoselective syntheses of natural products. The first contribution reports on new routes to 2-aminoalcohols and hydroxylated 2-aminoacids, and their use as intermediates for the synthesis of nogalamycin analogues and other compounds. It continues with an account of new methods for the synthesis of bicyclo[3.2.0]hept-3-en-6-ones and their applications in natural-products syntheses. A second article describes the use of epoxides as building blocks for the synthesis of natural products, and a third reports on total syntheses of polyene macrolide antibiotics.

The second main part of the book contains reviews of topical themes in organic chemistry. First T. Benincori reports on applications of organometallic compounds in organic chemistry, compiled under a list of topic headings. He begins with a very detailed treatment of Heck reactions, devoting special attention to stereoselectivity in enantioselective variants, to domino reactions, and to new catalysts. This is followed by a list of the titles of some papers published during 1999, classified according to the metals. Only the correspondence author is named for each publication. C. Nativi reviews methods for introducing or modifying functional groups, with commentaries on 22 original publications. Topics receiving particular attention include the Baylis–Hillman reaction, nonenzymatic kinetic methods for separating racemates of epoxides, the development of new reaction conditions for improving long-established reactions, and applications of catalysts other than organometallic. A very comprehensive survey, classified according to reaction types, lists the titles of publications that appeared in 1999. Next C. De Risi, P. Marchetti, and V. Zanirato contribute a useful review of total syntheses of natural products achieved in 1999. E. Magistris presents a review of work published in the area of solid-phase chemistry during 1999. As in the preceding chapters, some of the publications are discussed in detail, then a more wide-ranging survey of recent work is given in the form of a list classified according to topics.

Considered altogether, this conference report by F. Cozzi and his team of authors for the current year provides a very useful survey of new developments in organic chemistry during 1999.

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Handbook of Molecular Descriptors. By *Roberto Todeschini* and *Viviana Consonni*. WILEY-VCH, Weinheim 2000. xxi + 667 pp., hardcover DM 498.00 (ca. € 255).— ISBN 3-527-29913-0

This book is the first to present a systematic survey of the many molecular descriptors that are used in structure–activity (QSAR) and structure–properties correlation analysis. All the many different types of descriptors are included: physicochemical descriptors describing electronic, lipophilic, and steric substituent effects, the manifold of different topological indices, and molecular descriptors used in three-dimensional QSAR analyses. The structure of the book is on dictionary lines, treating descriptors of molecular properties in alphabetical order.

The many cross-references make it easy to find the relevant entry for a particular topic, starting from any one of the commonly used synonyms; however, some of the cross-references are redundant. The strict alphabetical sequence has advantages and drawbacks. It makes it easy to find the keyword that one is looking for, but is only of limited help if one wants to get a quick overview of a set of related descriptors. Fortunately, however, one finds that variants of a molecular descriptor are at least collected together under a common keyword, providing a limited means of obtaining an overview.

The handbook is very comprehensive, and contains practically all the descriptors that are used. Also the variations that different authors have developed for individual descriptors are listed. For example, under the heading "electronic substituent constants" the authors describe 46 types. However, only theoretically calculated molecular descriptors are included; experimental methods and techniques for generating molecular descriptors are not mentioned.

In addition to the above, there are brief explanations of the basic concepts underlying the statistical and mathematical procedures used to derive molecular descriptors. The descriptions of the individual descriptors are complete and thorough, without being too long-winded. The theoretical principles are explained in an understandable way, and in some cases worked numerical examples are also given to help in understanding the method of calculation. The treatment of each molecular descriptor is accompanied by references to relevant original literature. The literature references are very comprehensive, and occupy almost a third of the book.

Values of physicochemical descriptors are only given for a few substituents, and there are no tables giving factors that can be used for calculating descriptors. To include these would make the handbook even more useful. Unfortunately the authors also do not direct one to published tables listing such data, and consequently the reader seeking values of particular descriptors to use in his or her own correlations has to search in the original publications that are cited. For the reasons mentioned above, the book is only of limited value for choosing descriptors to use in one's own analyses. Its main value is likely to be for understanding the descriptors that have been used by other authors, in cases where the exact meaning is unclear to the reader.

In addition to the book's usefulness as a reference source, one could also benefit from simply browsing through it. Through the cross-references the reader will often discover interesting and previously unnoticed aspects of the molecular descriptors treated.

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