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BOOK REVIEWS

Carotenoids, Volume 4: Natural Functions. Edited by George Britton (University of Liverpool, U.K.), Synnøve Liaaen-Jensen (Norwegian University of Science and Technology, Trondheim, Norway), and Hanspeter Pfander (CaroteNature GmbH, Bern, Switzerland). Birkhäuser Verlag (part of Springer-Science + Business Media): Basel. 2008. xxx + 370 pp. $119.00. ISBN: 978-3-7643-7498-3.

Carotenoids are polyisoprenoids that are invaluable for photoprotection during oxygenic photosynthesis and as antioxidants. They are responsible for the orange color of carrots and oranges, the red color of tomato, and many of the bright yellow and orange hues in flowers and serve as precursors of Vitamin A and the plant hormone abscisic acid. Because of these important functions in nature, there has been a great deal of investigation into their chemistry and biology. The *Carotenoids* series presents knowledge of various aspects of carotenoid science current at the time of publication, with each volume containing information about certain subject areas; e.g., Volumes 1A and 1B cover the isolation, analysis, and spectroscopy of carotenoids. This volume concerns the natural functions of carotenoids.

Its first part, Chapters 1−9, contains a wealth of information on structural, chemical, and electrochemical properties of carotenoids necessary for biological function. Chapter 6 by Britton and Helliwell integrates chemistry and molecular biological information to explain color changes of carotenoids due to protein−carotenoid interactions. Particularly relevant information on the antioxidant properties of carotenoids is given in Chapter 7, "*Carotenoid Radicals and Radical Ions*".

Chapters 10−17 make up the second part of Volume 4 and contain the bulk of information available on actual functioning of carotenoids in nature. Britton has written two excellent but brief overview chapters, 10 and 15, in this section that cover the function of intact carotenoids and the function of carotenoid breakdown products and metabolites, respectively. Carotenoids as signals in plants and animals are discussed in Chapter 11, and carotenoids in aquaculture and poultry feeding are reviewed in Chapters 12 and 13, respectively. The cleavage of carotenoids to form retinal in the eye, flavor molecules in fruits, and abscisic acid is explained in Chapters 16 and 17. Carotenoid cleavage enzymes (CCDs) are utilized by plants to form abscisic acid and a number of unknown signal molecules in plants. Although abscisic acid has been known for some time, these other molecules—strigolactones and other unknowns—remain to be fully elucidated. This is a new and very interesting field in carotenoid research. Although some detail on abscisic acid formation and function is provided in Chapter 17, the discussion of CCD8 involvement in the formation of a signal molecule regulating shoot branching in pea and petunia could have been expanded. By far, the most extensively covered subject in the book is the function of carotenoids in photosynthetic systems in Chapter 14. Here, Telfer, Pascal, and Gall explain in detail, using text and excellent graphics, current information on photoprotection in oxygenic photosynthesis, perhaps the most important function of carotenoids.

This book is an important addition to this series of volumes on carotenoids. It fits well in the series and would also be useful as a stand-alone book. The information contained is vital to biologists, nutritionists, and biochemists working in the field.

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Iron Catalysis in Organic Chemistry: Reactions and Applications. Edited by Bernd Plietker (Universität Stuttgart, Germany). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2008. xvi + 280 pp. $190. ISBN 978-3-527-31927-5.

Iron catalysis is an area of synthetic chemistry that has undergone an explosive revival in the past five years. Although compounds such as $Fe(CO)_5$ and ferrocene are recognized by most chemists as the signature molecules of organotransition metal chemistry, coordination and organometallic compounds of iron have played a lesser role in homogeneous catalysis as compared to precious metals, especially as applied to organic methodology. This book is a timely and authoritative review of this reemerging area of chemistry. As noted in the Preface by Plietker, increased attention to sustainability has resulted in a resurrection of interest in iron compounds. Given the ubiquity of iron in biology and its role in heterogeneous catalysis, particularly industrial nitrogen fixation, it should not be surprising that iron should exhibit a rich catalytic chemistry in the realm of organic synthesis.

This multiauthored book comprises nine independent chapters. Whether by intention, circumstance, or coincidence, all of the authors are from German institutions and many are leading practitioners in this ever-expanding field. Following a general overview of iron complexes in organic chemistry in Chapter 1, each of the subsequent chapters is largely characterized by the type of transformation being considered. Müller focuses on iron in biological processes in Chapter 2, with specific emphasis on non-heme compounds. The chapter begins with vignettes on mononuclear iron proteins, such as taurine dioxygenase and homoprotocatechuate 2,3-dioxygenase, and is followed by a section on recent and very exciting developments with model compounds. A second part of Chapter 2, written by Bröring, deals with organic reactions catalyzed by heme proteins. These sections are nicely illustrated and amply cited, including recent references. One of the strengths of this chapter, and many throughout the book, is the concise writing style. Although the text is too specialized for adoption in a course, much of it reads like an educational volume rather than a monograph or review article that tries to cover every experiment ever conducted in the field. The lack of minutia, however, does not diminish from

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the book's value as a reference source—the references are complete and up-to-date and will direct the curious reader to the appropriate primary literature.

The remaining chapters focus more on applications to synthetic organic chemistry. Chapter 3 by Mayer and Bolm segues between biological and synthetically useful oxidation chemistry. One notable highlight is the section on so-called "Gif chemistry", a class of iron-catalyzed oxidations that have been the subject of considerable controversy. As is true to the style of the book, the presentation is thorough yet efficient. It nicely covers both the historic and scientific aspects of the story, something that the casual reader may find appealing. The second and third sections of this chapter, each written by different authors, focus on allylic, nitrogen, and sulfur oxidations, respectively. The section on allylic oxidations is presented as a practical compendium for readers interested in the "best" catalyst for a particular transformation.

Chapters 4−9 focus on iron-catalyzed reductions, including hydrogenation and hydrosilylation, various aspects of substitution chemistry, conjugate addition, ring expansions, and cycloadditions. Overall the selection of topics is representative and covers just about every major class of iron-catalyzed reaction. Chapter 5 is particularly notable. In it, Leitner presents a well-organized, well-written narrative outlining developments, both historical and recent, in iron-catalyzed cross coupling. This chapter may be one of the most valuable in the book, as this subject area has undergone explosive growth in the past few years. Readers will be pleased with the interweaving of tables highlighting the scope of the iron-catalyzed reactions along with mechanistic postulates. The author correctly notes in several instances that mechanistic understanding severely lags behind that for palladium-mediated cross coupling and much work needs to be done to elucidate some of the active iron species responsible for turnover. One minor drawback is a small typographic error in one of the schemes—all of the atoms are not accounted for—although this should not prove overly burdensome to the astute reader.

Although excellent overall, this volume does have a few minor shortcomings. As indicated by the title, the focus of the book is clearly on applications of iron catalysis to organic chemistry. Nevertheless, catalysis with first-row, e.g., base, metals does present unique challenges not typically encountered with traditional precious metal compounds. Harnessing radical chemistry, contending with multiple oxidation states, and coping with paramagnetic compounds are all potential obstacles when entering the field of iron chemistry. Organic chemists in particular may find some of these challenges especially daunting and beyond their area of expertise. In some chapters, these areas are mentioned sporadically with different degrees of rigor and thoroughness. A separate section, or perhaps even better, a full chapter devoted specifically to these topics would have been valuable, especially if it was written in the accessible and attractive style found throughout the book.

In summary, *Iron Catalysis in Organic Chemistry: Reactions and Applications* is a timely, efficient, and valuable overview of the resurging field of iron catalysis. The combination of historical perspective, recent references, and educational writing style makes this book a useful entry point for the novice seeking to enter or appreciate this expanding field. Experts seeking a nimble compendium of the latest advances will also wish to add this book to their personal collection or institutional library.

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Standardization and Quality Assurance in Fluorescence Measurements I: Techniques. Edited by Ute Resch-Genger (Bundesanstalt für Materialforschung und -prüfung, Berlin). From the Springer Series on Fluorescence, 05. Edited by O. S. Wolfbeis. Springer-Verlag: Berlin, Heidelberg. 2008. xvi + 496 pp. $299.00. ISBN 978-3-540-75206-6.

The first sentence of this book commands one's attention: "Over the last three decades, fluorescence has become the most widely used signal in biomedical science." Indeed, Chapter 1 and several others in the volume are concerned completely or primarily with cell counting, drug discovery, and various types of biosensors. However, there are other significant areas of great importance to modern society where fluorescence plays or will play a key role. The inclusion of chapters on colorimetry, drinking water analysis, wind-tunnel testing, and the nuclear waste from electrical power generation—diverse fields of application that rely on the integrity of quantitative fluorescence measurement—effectively illustrates the great importance of fluorescence measurements in today's world.

The aim of this book is to cover in considerable detail the general principles of standardization of fluorescence measurements as well as the application of these principles to both mature and cutting-edge applications. The editor has done an outstanding job of selecting authors and topics to accomplish these goals.

The book is divided into six coherent parts: I. Need for Standardization of Fluorescence-Based Measurements (two articles); II. Steady State Fluorometry (four articles); III. Time Resolved Fluorometry (four articles); IV. Fluorescence Polarization Techniques: Applications in the Material and the Life Sciences (two articles); V. Fluorescent Chemical Sensors: Principles, Problems, and Need for Quality Assurance (five articles); and VI. Fluorescence Analysis of Actinides (one article). Part I functions as an introduction to what impresses me as the heart of the book, Parts II and III, which focus on standardization and quality assurance for well-established fluorescence techniques: steady-state and lifetime measurements. The first two articles of Part I together put the reader through a consciousness-raising process. If you were under the impression, based on the extensive use of fluorescence-based measurements, that the quantitative aspects were well understood, you would be quite wrong: there are demons around every corner, in every component of your instrument, in the sample itself, and in their interaction waiting to confound you.

The first article in Part II briefly reviews instrumental problems in photoluminescence measurements and gives recommendations for characterization procedures. The next chapter covers standards for fluorescence quantum yields, determined using absolute and relative optical methods. At the end of this article, the author, Rurak, discusses "how few things have changed since the last authoritative review on the measurement of fluorescence quantum yields appeared in 1982." In his words, "Data presentation is still one of the major problems in truly

judging the quality and reliability of the values listed in the tables." He then presents, in full, a list of 19 recommendations taken directly from the 1982 review that are at least as valuable to today's workers as they were when first published. Part II is rounded out by articles on the growing importance of the red and near-infrared regions of the spectrum and on standardization and quality assurance of surface fluorescence measurements in colorimetry.

Part III, Time Resolved Fluorometry, exemplifies the effectiveness of the editor's strategy of covering a topic using complementary approaches. The first article is an excellent introduction to time-resolved techniques, especially time-correlated single photon counting. Although it does not address calibration or standardization, the next chapter covers these issues in detail and contains another of those invaluable tables: Mean lifetime and sample standard uncertainty of fluorescent lifetime standards in fluid solution at 20 °C. The next article gives a very mathematical discussion of fitting of experimental lifetime data, and the section is nicely rounded out with a chapter on recent advances in light sources and detectors for lifetime measurements. As a whole, this section provides exactly the kind of foundation needed by graduate students embarking on research projects in the field as well as a rich set of literature references to take them beyond that foundation.

Parts IV through VI contain articles that could be organized under the general heading "Reviews of Novel Applications". Issues of importance to standardization are discussed fully at the level of both design and implementation, but detailed quantitation of performance specifications and experimental uncertainties comparable to those presented in Parts II and III are generally unavailable, with the chapter on European drinking water analysis being the exception. In each case, the authors show a high degree of familiarity with their fields, and the up-to-date references should provide effective entry to the larger literature.

This book is highly recommended for those who develop or utilize fluorescence-based techniques and want their measurements to be as accurate, as meaningful, and as traceable as possible.

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