Book Reviews

Medicinal and Aromatic Plants—Industrial Profiles, Volume 5. Neem, the Divine Tree *Azadirachta indica*. By H. S. Puri (Herba Indica, India). Harwood Academic Publishers, Amsterdam, The Netherlands. 1999. xi + 183 pp. 17 × 24.5 cm. $70.00. ISBN 90-5702-348-2.

The revived interest in herbal remedies and the rise of alternate treatments such as aromatherapy have created a need for sources of information on plant composition and uses, so this series on Medicinal and Aromatic Plants is very timely. This is the fifth volume published in the series; the first four are Valerian, Perrila, Poppy, and Cannabis. Twenty eight others are in preparation, including Allium, Artemisia, Basil, Caraway, Cardamom, etc. Even with the inclusion of cannabis, it is a bit surprising to find neem included among aromatic (which it is not) and medicinal plants. It is much better known as a source of a natural pesticide, but various parts of the neem tree have been used in traditional Indian herbal medicine (known as Ayurveda), and it is its many uses in different ways that have earned it the "divine tree" appellation among Indian people. These are discussed, along with its use against pests, its veterinary applications, and its use as timber, soil mulch, and animal feed and for hair and bodycare. The author has tried hard to cover many aspects, the chapters on each aspect being fairly short, averaging five pages of text. The longest is on cultivation. The author is most at ease with botanical description. Unfortunately there is very little of the author's view on the information gathered. The book tends to be a list of references, with one to three sentences devoted to each reference.

The best aspect of the book is that it provides a very complete list of Indian work on neem. The few illustrations are of poor quality and the diagrams primitive. These are errors. The discovery of azadirachtin is given correctly on p 24 and the incorrectly on p 122. *The Neem Tree* by H. Schmutterer (1995) remains a better source on all aspects except its use as a herbal medicine for this remarkable plant of great utility.

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Frontiers in Natural Products Research: Indole Alkaloids. By Atta-ur-Rahman and Anwer Basha (H.E.J. Research Institute of Chemistry, University of Karachi, and Abbott Laboratories, Abbott Park, IL). Harwood Academic Publishers, Amsterdam 1998. xix + 324 pp. 17 × 24.5 cm. $85.00. ISBN 90-5702-268-0.

Indole alkaloids have been of central interest in natural products chemistry for many years, owing to their biological properties, therapeutic utility, and the challenges they pose to synthetic efforts. Among the many reviews and monographs that exist, the purpose of this book cannot be divined from its title. It is, in fact, a compilation of synthetic schemes used in indole alkaloid synthesis since 1950, given graphically and clearly, but with the minimum of pedagogic or analytical commentary. I see its greatest use as a source book for a graduate-level synthesis course in which design and methodology are taught by study of some of the landmark syntheses in the field. This being the case, the instructor will have to furnish all the analysis and set the syntheses in the framework of the field.

Not all the syntheses one might look for are here. For example, there is only the classic Woodward synthesis of strychnine; not all of the synthesis relevant to vinblastine and related molecules are here; and gelsemine and the macroline alkaloids are not discussed. Also, there are a number of typographical errors that need scrutiny. However, if I were preparing a course along the lines mentioned above, I would find this book quite helpful.

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Comprehensive Natural Products Chemistry, Volumes 1−9. Edited by Sir Derek Barton (Texas A&M University) and Koji Nakanishi (Columbia University); Executive Editor Otto Meth-Cohn. Elsevier Science, Inc., New York, NY. 1999. 19.5 × 28 cm. $3744.00. ISBN 0-08-042709-X.

This ambitious set of volumes covers the whole field of natural products chemistry, interpreted broadly to include enzymes, DNA, and RNA and similar biomolecules in addition to the classic classes of secondary metabolites such as alkaloids and terpenoids. Each volume is a self-contained unit including indexes, and the series concludes with a final index volume (not reviewed) containing comprehensive molecular formula, subject, and author indexes. Taken together, these volumes represent a definitive summary of the state of natural products chemistry at the end of the 20th century.

Each volume begins with a highly readable "Historical Perspective of Natural Products Chemistry" written by Koji Nakanishi. This chapter, which would have been written by Sir Derek Barton except for his untimely death in 1998, is a fascinating blend of historical perspective and personal anecdote. We learn for example that Sir Derek would wake at 4 a.m. to read the literature and regarded sleep as a waste of time, while Tetsuo Nozoe, the discoverer of the troponoids, worked on them until the night before his death at age 94. The chapter thus provides a powerful incentive to emulate these indefatigable pioneers as well as an excellent overview of the history of natural products, and it is warmly recommended, although it is not clear why the publishers chose to include it in each volume.

Reviews of individual volumes of the series by experts in the area of the volume are provided in the following pages.

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Volume 1. Polyketides and Other Secondary Metabolites Including Fatty Acids and Their Derivatives. Edited by Ushio Sankawa (Toyama Medical and Pharmaceutical University, Japan). xl + 1007 pp.

Volume 1 of *Comprehensive Natural Products Chemistry* is a superlative contribution to the natural products literature, and it provides a superb overview of polyketides and related compounds. This book surely sets the tone for the remaining volumes in the set in terms of its breadth and depth of coverage. The material presented throughout this volume describes aspects of biosynthesis, chemotaxonomy, enzymology, molecular biology, organic synthesis, and structural chemistry and emphasizes the need for contemporary natural products investigators to be competent in both the chemical and biological aspects of their subject. Indeed, one of the major strengths of this volume is the integrated presentation of structural and biological information on each topic.

The overall objective of this book series is stated by the series editors to answer the underlying question of how molecules are produced, and therefore, the chapters in Volume 1 are arranged from a biosynthetic vantage point. After the profound and personal historical perspective of natural products by Koji Nakanishi there is a helpful overview chapter on polyketide biosynthesis by the volume editor, Ushio Sankawa. This is followed by 30 chapters covering more specific topics, coauthored by an international group of altogether 50 authorities in their respective fields. Treatments, in turn, are provided on the following: the biosynthesis and degradation of fatty acids (A. Kawaguchi, A. Iwamoto-Kihara, and N. Sato); the biosynthesis of carbocyclic fatty acids (B. S. Moore and H. G. Floss); the biosynthesis of C_6 alcohols and aldehydes responsible for the "green odor" of leaves (A. Hatanaka); the biosynthesis and functions of jasmonoids (T. Yoshihara and F. Gruelich); the biosynthesis of virginiae butanolide A from *Streptomyces* spp. and the chitinase inhibitor allosamidin, formed by aldol condensation (S. Sakuda and Y. Yamada); eicosanoids in mammals (N. Hamanaka); eicosanoids in nonmammals (W. H. Gerwick); the biosynthesis and metabolism of eicosanoids (S. Yamamoto); the molecular evolution of proteins involved in the arachidonic acid cascade (R. Kikuno, H. Daiyasu, and H. Toh); the biosynthesis of the phospholipid platelet-aggregating factor (PAF) and related substances (T. Sugiura and K. Waku); the biosynthesis of cyclic bromoethers from red algae (A. Murai); the biosynthesis of lipo-chitin oligosaccharides elicited by rhizobial bacteria (T. Ritsema, B. J. J. Lugtenberg, and H. P. Spaink); the biosynthesis of 6-methylsalicyclic acid, a precursor of patulin (P. M. Shoolingin-Jordan and I. D. G. Campuzano); the Diels−Alder reaction in the biosynthesis of polyketide phytotoxins (A. Ichiara and H. Oikawa); polyketide synthesis in filamentous fungi (I. Fujii); the biosynthesis of aflatoxin (C. A. Townsend and R. E. Minto); the structure, function, and engineering of bacterial aromatic polyketide synthases (M. Richardson and C. Khosla); the biosynthesis of erythromycin and related macrolides (J. Staunton and B. Wilkinson); cyclosporin biosynthesis (H. von Döhren and H. Kleinkauf); the biosynthesis of enediyne antibiotics (S. Iwasaki); the enzymology and molecular biology of the skikimate pathway (C. Abell); the role of isochorismic acid in bacterial and plant metabolism (E. Leistner); coumarin biosynthesis (U. Matern, P. Lüer, and D. Kreusch); the biosynthesis and functions of lignans (N. G. Lewis and L. B. Lavin); flavonoid biosynthesis (G. Forkmann and W. Heller); the chalcone/stilbene synthase group of condensing enzymes (J. Schröder); the biochemistry, molecular biology, and biological functions of isoflavonoids (R. A. Dixon); the biosynthesis of sulfur-containing natural products (i.e., enzyme cofactors and certain antibiotics) (R. J. Parry); the biosynthesis of the natural carbon−phosphorus compounds, bialophos and fosfomycin (H. Seto); and the biosynthesis and degradation of cyanogenic glycosides (M. A. Hughes). Since some topics are not as broad as others, the chapters are not all of equal length, with the longest being 73 pages and the shortest only 13. One gets the distinct impression that the chapter authors have given their very best efforts in the writing of their contributions. The individual topics are written in a comprehensible fashion and will be of great value to both specialists and beginning researchers in the areas represented. The chapters are well constructed, amply illustrated by key structures and informative schemes, and appropriately referenced with updated literature citations. While the series editors point out that this book set is not intended to be comprehensive, the present volume could perhaps have benefited from a chapter on the acetogenins of the Annonaceae, which are currently of wide biological, structural, and synthetic interest.

From a production point of view, the book is well organized and provides clear illustrations with structures presented in a uniform style throughout. However, one shortcoming is the small font size chosen, which quickly leads to eyestrain, but this was presumably necessary to contain the cost of this book set. A helpful list of abbreviations precedes the chapters, and there is an extremely detailed Subject Index (prepared by P. and L. Aslett), with chemical names standardized in accordance with IUPAC recommendations and liberal cross-referencing of terms. There is also an ingenious Author Index (reading rather like a natural products *Who's Who*!), which makes it easy to locate the contributions of a given author cited in the text or bibliography of each chapter. The volume seems to be free from typographical errors, but one or two were noted.

In summary, Volume 1 of the *Comprehensive Natural Products Chemistry* is a magnificent book providing an unparalleled coverage of polyketides, fatty acids, and related compounds and has been produced in a meticulous fashion. The timing of the publication to coincide with the new millennium and the end of the 20th century seems auspicious, and it is to be expected that this will become a standard reference text for years to come. Many will indeed benefit by reading this book, which will be a very valuable resource for researchers in the subject areas represented as well as for graduate-level instruction. While the cost of this book set is far beyond the means of most individual purchasers, it can be confidently recommended for institutional purchase, because it will be a durable resource. The individual chapter authors, the volume editor, and the series editors are all to be congratulated for offering the

scientific community at large this wonderful volume on natural products.

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Volume 2. Isoprenoids Including Carotenoids and Steroids. Edited by David E. Cane (Brown University). xxxviii + 400 pp.

Volume 2 of the series *Comprehensive Natural Products Chemistry* focuses on the isoprenoids, whose importance to our science has been recognized by the awarding of 19 Nobel Prizes to scientists working in areas related to isoprenoid natural products.

Although the chemistry of isoprenoid natural products spans an enormous range, this volume focuses on the biosynthesis of these compounds. In fact, the "Comprehensive" part of the title could be taken as misleading until one reads the short Introduction, wherein the goals are stated clearly: to give a comprehensive account of how "Nature makes all these molecules of life". And the editor and his author-colleagues succeed admirably.

One could well view the chemical investigations of natural products as coming in waves. This volume is particularly timely since the biosynthesis "waves" of the 1950s−1980s, driven first by the use of radiolabeled compounds and then by advances in NMR spectroscopy that allowed for the use of deuterium and ^{13}C stable isotopes, has been followed in this past decade by the remarkable advances in molecular and structural biology. In the past five years, there have been a flurry of reports on both the X-ray crystallographic structures of terpene synthases and on the genomic organizations of gene clusters encoding terpenoids and other natural products. Thus, we are now beginning to think of natural products in the larger context of protein structure and genomic organization as they relate to the biosynthesis of natural products.

This volume is organized into 14 chapters, roughly following the order of increasing prenylation: C_5 to C_{10} to C_{15}, etc. After an overview of isoprenoid biosynthesis, the next three chapters deal with the biosynthetic origins of the universal C_5 "starter unit" isopentenyl diphosphate (isopentenyl pyrophosphate, IPP) and the isomerization to its allylic isomer, dimethylallyl diphosphate and the subsequent chain elongations catalyzed by prenyl transferases. Next comes the chapter on monoterpene biosynthesis, the longest chapter in the volume, followed by a chapter on the sesquiterpene cyclases and then a chapter on "The Cloning and Expression of Terpene Synthase Genes", which is mercifully devoid of molecular biology jargon but furnishes the reader with a very useful discussion of the techniques employed by molecular biologists. Chapter 8 takes up diterpene biosynthesis, and Chapters 9−11 deal with triterpene biosyntheses: squalene synthase (9), squalene epoxidase/oxidosqualene cyclase (10), and cycloartenol and other triterpene cyclases (11). Chapter 12 focuses on the genetics and biochemistry of carotenoids, and Chapter 13, post-translational protein prenylation, an important biochemical process that has been recognized as a general phenomenon for only about a decade. The last chapter, 14, is a *tour de force* that features the best that natural product chemists have to offer: deep insights into the workings of nature coming about as a result of clear thinking coupled to extraordinary and challenging experimental techniques. This chapter should be required reading for any graduate student wishing to pursue organic chemistry, and not just natural products chemistry. It is too bad that this work, which describes the biosynthesis of the ginkgolides, has not appeared in the primary literature. This chapter as well as Chapters 3 and 5 provides fascinating accounts of the newly discovered mevalonate-independent route to IPP and its importance in the evolution and biosynthesis of terpenoids.

The chapters are very even in quality, no doubt a reflection of the uniformly high caliber of the researchers who wrote them. Some of the chapters are a bit choppy, but all are chock full of useful information from the literature through 1997. Factual and typographical errors are few, though sometimes notable: "Bacteria - - do not synthesize secondary metabolites" (p 73); 1,2-radical shifts as depicted on pages 234 and 237 most certainly will not occur. But without doubt, at least for the next decade, those interested in both the general background as well as the specifics of terpene biosynthesis will be heading off to their library to pick up a copy of this volume.

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Volume 3. Carbohydrates and Their Derivatives Including Tannins, Cellulose, and Related Lignins. Edited by B. Mario Pinto (Simon Fraser University). xl + 939 pp.

Interest in carbohydrates has expanded in recent years. Concurrently, new terms have been coined. These include glycoscience, glycochemistry, glycobiology, and glycoconjugates. The greatest growth in interest, both from an academic and a commercial point of view, has been in glycobiology as the greatly varied and tremendously important roles of carbohydrates and the saccharide components of glycoconjugates have been uncovered. Rapid advances in this area have been aided significantly by advances in analytical methods.

Carbohydrates are, of course, natural substances and belong in a treatise on natural products, although they are not always included in this area. Because carbohydrates and carbohydrate-containing substances comprise such a huge field, are a very chemically diverse group of substances, and exhibit a diversity of biological roles, choices must be made in putting together a volume of this type, which as the title indicates contains tannins and lignins in addition to carbohydrates. The emphasis of this book is on the biosynthesis of carbohydrates above the monosaccharide level. There are exceptions in the 20 chapters in this large-page-size, 939-page volume. A chapter on condensed tannins is presented from a structural perspective, and the chapter on celluloses is largely structural, even though there is much available information on its biosynthesis in various organisms. And there are two chapters on biosynthesis of certain specific monosaccharides: one deals with the occurrence, genetics, and biosynthesis of deoxysugars; the other is a comprehensive survey of the action of aldolases. Overall, the chemistry referred to in the series title is largely biological chemistry.

The primary focus is the biosyntheses of glycoproteins (both *N*- and *O*-linked structures), proteoglycans and their constituent glycosaminoglycans, lipopolysaccharides, peptidoglycans, glycosphingolipids, and phosphatidylinositols. Emphasized are saccharide-containing biopolymers of animals, protozoa, and microorganisms. Coverage is also given to biosynthesis of certain plant polysaccharides, viz., hemicelluloses, pectins, galactomannans, and those of starch, and to glycogen. Two other chapters discuss the nature and biosynthesis of lignins (a large chapter of 129 pages) and biosynthesis of hydrolyzable tannins. Attention is given to inhibitors of glycohydrolases and glycosyltransferases and other inhibitors of biosynthesis where applicable.

Each topic covered is important and contemporary. The reviews are comprehensive, and the chapters, like almost all areas of glycoscience, bridge biology and chemistry, function and structure. Because polymeric carbohydrates are not biosynthesized on templates as are proteins and nucleic acids, the enzymes involved in their synthesis are more specific and play a more crucial role. These enzymes are covered thoroughly for the specific substances discussed from a biosynthetic point of view. With lignins, production of the monomeric building blocks plays a major role in determining final structure and properties.

Not all naturally occurring carbohydrates are covered. Among topics not included are *C*-glycosyl compounds, *S*-glycosyl compounds, oligosaccharides, a great number of glycosides of a variety of substances that are found in algae and higher plants (other than those involved in lignin biosynthesis), a large number of polysaccharides of algae and higher plants (the most abundant carbohydrates on earth), bacterial polysaccharides (other than lipopolysaccharides), plant protein-polysaccharides, teichoic acids, chitin, lipochitin oligosaccharides, and many naturally occurring monosaccharides. Neither does the book contain much synthetic chemistry.

What the volume presents thoroughly and well are lignins, tannins, and selected aspects of carbohydrates, particularly those related to contemporary topics in glycobiology. It is a monumental work and will be a valuable reference work both for those working in these areas and for those wanting to learn more about the topics and areas covered. Chapters are presented in an attractive style with consistency from chapter to chapter. The book is recommended as a reference for carbohydrate and lignin researchers, whether or not they are working in one of the areas covered, and for other chemists and biologists that want to learn about the biosynthesis and roles of lignins and those carbohydrates covered in this volume.

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Volume 4. Amino Acids, Peptides, Porphyrins, and Alkaloids. Edited by Jeffery W. Kelly (Scripps Research Institute). xl + 429 pp.

When I saw the title for this series, I was optimistic that this would finally be a series that natural product chemists could cherish as defining the field in a moment of time. Somehow I thought that it would indeed be (a) "comprehensive" and (b) about "natural product chemistry". As far as Volume 4 is concerned, it is not. In this volume, and from the descriptions of the other volumes in the series, there is very little chemistry (or biology) presented and there are significant gaps in coverage.

Volume 4 in this series is comprised of 14 chapters: two of the chapters review selected aspects of alkaloid biosynthesis, and two the formation of heme and vitamin B_{12}. Five chapters focus on peptide and antibiotic biosynthesis, with a related chapter on the genetics of antibiotic biosynthesis. The biosynthesis of the aromatic amino acids is discussed, with a separate chapter on the 21st natural amino acid, selenocysteine. Two chapters on the biosynthetic modification of proteins with either glycosylphosphatidylinositol or palmitoyl groups are also presented. There is an author index for the references cited in the various chapters and also a subject index. Overall, the presentation is very good, with a very readable typeface and good diagrams. Although the editors of this ambitious project are to be commended for their well-intentioned efforts, several issues with aspects of this particular volume unfortunately detract significantly from its value.

For example, the chapter sequence seems to be almost random. One would expect the chapters on alkaloid and strictosidine biosynthesis to follow the chapter on the biosynthesis of amino acids; they do not. And shouldn't the two chapters on heme and vitamin B_{12} biosynthesis follow each other? And shouldn't the separate chapters on penicillins and β-lactams and those on protein palmitoylation and GPI-anchor biosynthesis also be sequential?

Although I read all of the chapters, I confess to focusing on the two chapters on alkaloid biosynthesis and the chapter on the biosynthesis of vitamin B_{12}. As in any multiauthored work, the quality, the coverage, and the accuracy of what is presented is very uneven. The chapter by Scott and colleagues on the enzymology of vitamin B_{12} biosynthesis is outstanding, and the chapter by Stöckigt and Ruppert on strictosidine and its involvement in the biosynthesis of the monoterpene indole alkaloids is also very good, with only a few errors.

However, the chapter on alkaloid biosynthesis has a plethora of errors and is written in the "staccato" style of *Natural Product Reports*, which makes coherent reading difficult, and from which explanatory detail useful for teaching purposes is absent. Surprisingly, there are significant sections that overlap with the Stöckigt/Ruppert chapter on monoterpenoid indole alkaloid biosynthesis. The condensation of information is such that references to the synthesis, biosynthesis, and structure elucidation of very different alkaloids are presented in the same paragraph (p 50). Errors occur in the typographical names of alkaloids, in the structures of the compounds (lycorine, erysovine, vindoline, haemanthamine, *N*,*p*′-*O*-demethylnorbelladine, cinnamic acid, mevalonic acid (!), and several of the structures in Scheme 24, to name only a few), and on the number of alkaloids known (130 000 is claimed on p 26; 26 900 is more of a reality). A classification of alkaloids is described that disappeared about 25 years ago, and several major alkaloid groups (canthin-6-ones, carbazoles, iboga alkaloids, quinine, *Lycopodium* alkaloids, all terpenoid alkaloids, etc.) are not even mentioned. Many recent biosynthetic studies on various alkaloid groups are not discussed, such as, for example, the detailed enzymology of the conversion of tabersonine to vindoline.

The very best part of this volume—indeed it is essential reading for all natural product chemists—is the excellent "Historical Perspective of Natural Products Chemistry" by Nakanishi, which is repeated in each descriptive volume. If the volume editors had framed the volumes in the series on this marvelous outline, "Comprehensive Natural Prod-

ucts Chemistry" would be a reality. Sadly, they did not. As a result, I am unclear who is served by this series. Certainly, at its fantastic price, it is not for students or teachers. And for researchers entering a new area, there are better options for acquiring detailed background information. Unfortunately, I cannot recommend this particular volume in the series for acquisition by either an individual or even a rich library.

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Volume 5. Enzyme, Enzyme Mechanisms, Proteins and Aspects of NO Chemistry. Edited by C. Dale Poulter (University of Utah). xxxviii + 445 pp.

The chemistry of natural products has reached a new plateau whereby the enzymatic processes involved in their biosynthesis and biotransformations are being studied with increasing intensity and sophistication. This has been made possible by recent advances in molecular biology that have led to the cloning and overexpression of many of the enzymes involved which previously had been only available in vanishingly small amounts. Moreover, significant advances in analytical methodologies (e.g., X-ray crystallography, NMR spectroscopy, mass spectrometry) have contributed as well.

In this ambitious volume, "natural products" are defined rather broadly, including, for example, steroids, aromatics, halogenated hydrocarbons, leukotrienes, prostaglandins, nucleosides, nucleotides, esters, phosphates, amino acids, carbohydrates, isoprenoids, and coenzymes. The volume consists of 17 chapters, all written by authors who are both well-known and well-respected in their fields. Overall, the material in these chapters, while not comprising a complete overview of ongoing activities in the field, provides an excellent "snapshot" of the numerous types of approaches being used to study the enzymology of natural products in the late 1990s. All of the chapters are liberally referenced from the primary literature, and an Author Index at the end of the book permits the reader to identify individual citations for the literally thousands of scientists whose work has formed the basis for the book. A very thorough Subject Index is also included.

Overall, Dr. Poulter has done an excellent job of selecting lively and timely topics that are representative of the field. The quality of the individual chapters is uniformly high. This book is highly recommended for students and practitioners alike, not only those in the natural products field but those who are interested in the mechanisms of enzyme action in general.

Since technology advances inexorably, it will be interesting (for those readers who are still alive!) to see what the field of the enzymology of natural products will look like 50 years from now. Undoubtedly, many more of the enzymes that are involved will be known, and combinatorial methods, already being employed, for example, to generated "unnatural" polyketides, will permit the generation of millions of analogues of what we now know as natural products. Advances in organic synthesis will also contribute mightily to this plethora of new biologically important materials. Scientists will look back and view this book as a set of stepping stones along the way to this brave new biotechnological world.

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Volume 6. Prebiotic Chemistry, Molecular Fossils, Nucleosides, and RNA. Edited by Dieter Söll (Yale University), Susumu Nishimuar (Banyu Tsukuba Research Institute, Japan), and Peter Moore (Yale University). xxxviii + 299 pp.

The title of Volume 6 is "Prebiotic Chemistry, Molecular Fossils, Nucleosides, and RNA", but there is essentially nothing here on prebiotic chemistry and little on molecular fossils. There is some material on nucleosides, and a great deal on RNA, although not always on its chemistry. This volume is somewhat shorter than most of the others in the set, and I am left wondering whether authors were engaged but failed to deliver a chapter or two on prebiotic chemistry. This volume has the usual strengths and weaknesses of the multiauthor approach: the chapters are written by experts, but the treatment is uneven and some material appears twice.

The three editors kick off with a two-page overview of the first six chapters, which comprise the following: A Spectroscopist's View of RNA Conformation (RNA Structural Motifs); Thermodynamics of RNA Secondary Structure Formation; RNA Structures Determined by X-Ray Crystallography; Chemical and Enzymatic Probing of RNA Structure; Chemical RNA Synthesis (Including RNA with Unusual Constituents); RNA Editing. There is then another overview (five pages) that introduces the remaining seven chapters: Ribozyme Selection; Ribozyme Enzymology; Viroids; Structural Elements of Ribosomal RNA; Turnover of mRNA in Eukaryotic Cells; Ribonucleotide Analogues and Their Applications; Ribozyme Structure and Function. The chapters (as opposed to the overviews) vary from 12 pages to 34 pages; the median is 18 pages.

While the first chapter, written by one of the editors, makes interesting reading, it is in other ways atypical of the volume as a whole and perhaps should have been placed later. The initial overview had stated "each chapter has been contributed by a scientist expert in the field it covers, and is thus a reliable guide for those interested in entering the field". The first claim is uniformly true, but the initial chapter avowedly does not try to indoctrinate the would-be spectroscopist and instead "is intended to help biochemists understand what nmr structures are". This end would have been better served if the chapter had featured more and clearer structural diagrams, annotated and in stereo. A later chapter does show a couple of "straight ahead" stereo diagrams, but unfortunately one of them has the left and right images printed further apart (7.3 cm) than the distance between the eyes of this reviewer. The eyes of a normal human do not like to diverge. In contrast to most of the rest of the book, Chapter 1 introduces a touch of humor, some intentional, some not ("RNA biochemists have recognized their need for structures almost as long as protein biochemists"). I do not agree with the first sentence of the book proper, for although RNA may be between DNA and protein functionally, it is hardly so chemically. In contrast, the chapter on Thermodynamics of RNA Secondary Structure Formation is superb and should be on the desk of every RNA chemist who is

interested in structure. Not far behind are the chapters on Viroids, on Turnover of mRNA in Eukaryotic Cells, and on Ribozyme Structure and Function.

One could carp that much of this volume does not deal with natural products and is not chemistry, but this is where the study of RNA is heading, and this volume gives a good coverage of much of this burgeoning field. It is a pity that, in a field as fast-moving as this, the references to the literature could not be more up to date than 1997/98, but that is a casualty of the size of the endeavor.

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Volume 7. DNA and Aspects of Molecular Biology. Edited by Eric T. Kool (University of Rochester). xxxviii + 733 pp.

If this volume is representative of its six predecessors in the series, then the publishing venture will be counted a considerable success and will make a valuable contribution to the vast literature on natural products. Volume 7 contains 18 chapters written by acknowledged experts under the supervision of a hierarchy of distinguished editors, one of them, Sir Derek Barton, to whom the volume is dedicated. Sadly Sir Derek died just a few months before his 80th birthday, the target date for finalizing the work. One senses that he would feel justly proud of this substantial tribute surveying the subject he loved best. In addition to the 18 "proper" chapters there is an extended preface furnishing a historical perspective of natural products chemistry written by Barton's partner as editor-in-chief, Koji Nakanishi, which I found quite fascinating and warmly commend to the reader; there can be few chemists who will fail to recognize many familiar names (some still very much alive and active at the bench), and no one will fail to gain a wider appreciation of the scope and monumental advances made in the study of natural products since the birth of organic chemistry in the early nineteenth century.

The book is large and compendious, as befits its subject matter. Its 733 pages commence with a helpful overview by the volume editor, Eric Kool, which neatly summarizes the scope and layout. Kool is the author of another chapter halfway through the book on the subject of topological modifications of DNA (circles, knots, loops, and branches), which makes fascinating reading. His pictures are wonderful and representative of the high standard of illustration throughout the volume. There are bread-and-butter chapters on the physical properties of DNA (thermodynamics, kinetics, NMR, chemical probing methods) as well as lucid treatment of core topics dealing with the varied chemistry of DNA, ranging from synthetic methods to the action of DNA-damaging chemicals, many of which are anticancer drugs or mutagens. There is proper in-depth treatment of the increasingly important role played by nonnatural base, nucleoside, and backbone analogues in DNA chemistry and even therapeutic applications. Fifty pages are devoted to an excellent account of substances (mostly drugs) that bind to DNA by intercalation, and another 137 pages to diverse modes of interaction with DNA that lead to interesting and important biological consequences. I confess to having enjoyed reading several of these authoritative accounts of small molecule−DNA interaction with particular relish: Kent Gates' treatment of covalent modification of DNA by natural products is masterly, and Irving Goldberg's treatise on the ene-diynes is as amazing and thrilling as ever. Three final chapters bring us up to speed on topoisomerase inhibitors, DNA selection and amplification, and cloning as a tool for organic chemists, providing a fitting conclusion to this weighty tome which accords admirably with the assertion in the introductory preface that the study of molecular recognition in ligand−receptor interactions, being the great challenge lying ahead for natural product chemists, will demand the cooperation of chemists with biologists and biochemists. Amen to that.

The editor in his overview gently spikes the guns of any critical reviewer by explicitly itemizing topics *not* covered [in this volume], so it might appear churlish to carp at omissions. But I was genuinely sorry that there was (as is freely admitted, pp 5, 8) no coherent treatment of so-called minor groove binders—substances that lodge within the smaller of the two grooves of the double helix—not least because they include Peter Dervan's hairpin polyamides and related synthetic molecules that bind to predetermined DNA sequences with subnanomolar affinity; these have their conceptual origins in the natural products distamycin and netropsin. To my mind, Dervan's polyamides represent the brightest light on the horizon for those drug designers who see gene targeting as the next quantum leap in medicinal chemistry, cancer therapy, or whatever benefits will accrue from the human genome project.

It is of course inevitable that in a multiauthor work such as this that there will be some chapters that do not read so easily as the beautifully crafted prose written by old hands (though some new hands are impressive; see Chapters 4 and 14 for example). Would I be right in suggesting that it is often the keen young university faculty whose writing is most readily accessible? No doubt the editors expended much effort to stamp a sense of coherence on the book, and they have largely succeeded. In just a few places I wished they had enjoined a less dry, synthetic chemical treatment of a topic, such as the chapter that admirably refers to 2,6-diaminopurine as a useful base analogue but fails to tell us that it occurs naturally in cyanophage S-2L, whose DNA has it totally replacing the normal adenine. On the other hand, for some scientists there is nothing so dry as thermodynamics and kinetics, yet the superb Chapter 2 by Plum, Breslauer, and Roberts is worthy of bedtime reading and would certainly do this reviewer a power of good.

The book is furnished with a decent subject index (no mean feat for a technical work of this sort) together with an author index that will doubtless lead to dismay on the part of our colleagues who first turn there to ascertain how many times their own work has been cited. Amused to observe that the number of references to my own work appeared to exceed the number accorded to much greater men (Dervan, for instance), I did a little checking and found that where a famous individual seemed somewhat undercited in my estimation, he/she was in fact cited in practically all the places I would have expected, but lots of citations had not made it into the list. In fact, out of a dozen or so authors I found none whose citation record was correct, and some were grossly shortchanged. So our dismayed colleagues need not panic, but publishers take note.

But that does not matter, really. The bottom line is that this is a wonderful book that deserves to find a place on the shelves of every major chemical institute and will serve as an authoritative source of reference for years to come.

My copy has already been commandeered by avid research students athirst for knowledge, and I shall be lucky to get it back.

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Volume 8. Miscellaneous Natural Products Including Marine Natural Products, Pheromones, Plant Hormones, and Aspects of Ecology. Edited by Kenji Mori (Science University of Yokyo). xxxviii + 749 pp.

Although the title "Miscellaneous Natural Products" might suggest a hodgepodge of unrelated topics, the underlying theme of the final volume of this series is chemical ecology or the function of bioactive natural products in the natural environment. The volume begins with a short chapter entitled "Historical Perspective of Natural Products Chemistry" by Koji Nakanishi, which outlines some of the milestones in the development of the natural products chemistry up to about 1960 and sets the stage for the modern era, which is addressed by the authors contributing to these volumes. This is followed by a short "Overview" of Volume 8, in which Kenji Mori defines the structure of the volume and then entertains the reader with a fascinating discourse on the significance of chirality in chemical ecology.

The next chapter on "Plant Hormones" was contributed by no less than 10 authors, Noburu Murofushi, Hisakazu Yamane, Youji Sakagami, Hidemasa Imaseki, Yuji Kamiya, Hajime Iwamura, Nobuhiro Hirai, Hideo Tsuji, Takao Yokota, and Junichi Ueda, and clearly suffers from a basic lack of coordination. It essentially consists of seven subchapters on auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, and jasmonic acid and related compounds. Only the subchapter on abscisic acid used numbers to identify compounds illustrated in the text. Other subchapters require the reader to be quite familiar with the field in order to benefit from the discussions of the biological significance of each compound or class of compounds.

The chapter on "Plant Chemical Ecology" by Jeffrey Harborne concisely defines the ways in which plants use chemicals to interact with their environment and particularly with insects. The topics covered include induced chemical defense, sequestration of plant toxins by insects, plant compounds involved in insect oviposition, pollination, seed dispersal, allelopathy, symbiotic and parasitic associations, mycotoxins, phytotoxins, and phytoalexins. Each topic is carefully defined and illustrated using key examples, making the chapter particularly easy to read. The chapter on "Pheromones" by Wittko Francke and Stefan Schultz deals mainly with insect pheromones but also includes other phyla. The chapter is organized according to the biosynthetic origins of the compounds rather than phylogenetically, which, in the reviewer's opinion, is rather unfortunate since all chemotaxonomic relationships have been obscured. Nonetheless, this chapter is sure to appeal to chemists seeking synthetic targets. David Morgan and Ian Wilson have contributed an excellent chapter on "Insect Hormones and Insect Chemical Ecology". The topics covered are insect juvenile hormone, ecdysteroids, insect neuropeptides, plant substances toxic and deterrent to insects, and insect toxins. The authors have maintained a very appropriate balance between biology and chemistry in this chapter. In addition, there is just the right amount of overlap with the earlier chapter on plant chemical ecology.

The chapter on "Microbial Hormones and Microbial Chemical Ecology" by Yasuhiro Yamada and Takuya Nihira describes the regulation of microorganisms by signal substances. The topics covered include autoregulators of streptomycetes, autoinducers with N-acyl homoserine lactone skeleton in Gram-negative bacteria, and compounds regulating morphological differentiation in prokaryotes. This short chapter covers both the chemistry and molecular biology of each topic in a lucid manner and illustrates one of the new directions for natural products research.

The final chapter of this volume, constituting over a third of the book, comprises a review of "Marine Natural Products and Marine Chemical Ecology" by Jun'ichi Kobayashi and Masami Ishibashi. The topics covered include feeding attractants and stimulants, pheromones, symbiosis, biofouling, bioluminescence, chemical defense including antifeedant activity, marine toxins, and bioactive marine natural products. The coverage of these topics is very spotty, with some important new areas completely neglected and others, notably the research of the authors, described in excessive detail. Nonetheless, there are some very valuable reviews within this chapter, particularly those on biofouling, bioluminescence, and marine toxins, where Japanese scientists have made the major contributions.

I am not really sure who will use this reference volume, particularly since it is already out-of-date in some areas. Specialists will probably not need it, given the revolution in information science, the availability of both general and specialized databases, and the proliferation of reviews. The casual reader may scan structures but will probably not read the text to any extent, while the general public will find the volume a little too technical. The target audience is most probably a chemist or biologist in a closely related field who is seeking background knowledge of a specific topic or a student seeking information for a term paper. Such a reader will certainly be aided by the excellent author and subject indices and by the clear organization of the topics within the volume. The reviewer has recommended this series for inclusion in the reference section of the library but would not consider purchasing a personal copy.

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