

# Contents of all Volumes

Contributors to all Volumes	xvii
Preface	xxxvii
Introduction	xxxix
Editors-in-Chief	xliii
Volume Editors	xlvi
<b>Volume 1 Natural Products Structural Diversity-I Secondary Metabolites: Organization and Biosynthesis</b>	
01 Overview and Introduction Craig A. Townsend, <i>Johns Hopkins University, Baltimore, MD, USA</i>	1
02 Unsaturated Fatty Acids Peter H. Buist, <i>Carleton University, ON, Canada</i>	5
03 Prostaglandin Endoperoxide Synthases: Structure, Function, and Synthesis of Novel Lipid Signaling Molecules Melissa V. Turman and Lawrence J. Marnett, <i>Vanderbilt University School of Medicine, Nashville, TN, USA</i>	35
04 Mycolic Acid/Cyclopropane Fatty Acid/Fatty Acid Biosynthesis and Health Relations David B. Kastinsky, Nicholas S. McBride, Keriann M. Backus, Jason J. LeBlanc, and Clifton E. Barry, III, <i>National Institutes of Health, Bethesda, MD, USA</i>	65
05 Microbial Type III Polyketide Synthases Yohei Katsuyama and Sueharu Horinouchi, <i>The University of Tokyo, Bunkyo-ku, Tokyo, Japan</i>	147
06 Plant Type III PKS Hiroyuki Morita and Ikuro Abe, <i>The University of Tokyo, Hongo, Tokyo, Japan</i> Hiroschi Noguchi, <i>University of Shizuoka, Yada, Shizuoka, Japan</i>	171
07 Type II PKS Jürgen Rohr, <i>University of Kentucky, Lexington, KY, USA</i> Christian Hertweck, <i>Leibniz Institute for Natural Product Research and Infection Biology, HKI, Jena, Germany</i>	227
08 Structural Enzymology of Polyketide Synthase: The Structure–Sequence–Function Correlation Tyler Paz Korman, Brian Ames, and Shiou-Chuan (Sheryl) Tsai, <i>University of California, Irvine, CA, USA</i>	305
09 Fungal Type I Polyketides Russell J. Cox and Thomas J. Simpson, <i>University of Bristol, Bristol, UK</i>	347
10 Type I Modular PKS Alison M. Hill, <i>University of Exeter, Exeter, UK</i> James Staunton, <i>University of Cambridge, Cambridge, UK</i>	385

11	NRPS/PKS Hybrid Enzymes and Their Natural Products Christopher M. Rath, Jamie B. Scaglione, Jeffrey D. Kittendorf, and David H. Sherman, <i>Life Sciences Institute University of Michigan, Ann Arbor, MI, USA</i>	453
12	Mevalonate Pathway in Bacteria and Archaea Tomohisa Kuzuyama, <i>The University of Tokyo, Tokyo, Japan</i> Hisashi Hemmi, <i>Nagoya University, Nagoya, Japan</i> Shunji Takahashi, <i>RIKEN, Advanced Science Institute, Saitama, Japan</i>	493
13	Methylerythritol Phosphate Pathway Michel Rohmer, <i>Université de Strasbourg/CNRS, Strasbourg, France</i>	517
14	Prenyltransferase Hirofumi Kurokawa and Tanetoshi Koyama, <i>Toboku University, Sendai, Japan</i>	557
15	Advances in the Enzymology of Monoterpene Cyclization Reactions Edward M. Davis, <i>Washington State University, Pullman, WA, USA</i>	585
16	Sesquiterpenes Joe Chappell, <i>University of Kentucky, Lexington, KY, USA</i> Robert M. Coates, <i>University of Illinois, Urbana, IL, USA</i>	609
17	Diterpenes Tomonobu Toyomasu and Takeshi Sassa, <i>Yamagata University, Tsuruoka, Japan</i>	643
18	Triterpenes Tetsuo Kushiro and Yutaka Ebizuka, <i>The University of Tokyo, Tokyo, Japan</i>	673
19	Bacterial Squalene Cyclase Ikuro Abe, <i>The University of Tokyo, Hongo, Tokyo, Japan</i>	709
20	Carotenoids Norihiko Misawa, <i>Kirin Holdings Co. Ltd., Nonoichi-machi, Ishikawa, Japan</i>	733
21	Sterol and Steroid Biosynthesis and Metabolism in Plants and Microorganisms Hubert Schaller, <i>Université de Strasbourg and CNRS, Strasbourg, France</i>	755
22	Isoprenoid in Actinomycetes Tohru Dairi, <i>Toyama Prefectural University, Toyama, Japan</i>	789
23	Lignans (Neolignans) and Allyl/Propenyl Phenols: Biogenesis, Structural Biology, and Biological/Human Health Considerations Daniel G. Vassão, Kye-Won Kim, Laurence B. Davin, and Norman G. Lewis, <i>Washington State University, Pullman, WA, USA</i>	815
24	Plant Phenolics: Phenylpropanoids Shin-ichi Ayabe, Hiroshi Uchiyama, Toshio Aoki, and Tomoyoshi Akashi, <i>Nippon University, Fujisawa, Japan</i>	929
25	Alkaloids Sarah E. O'Connor, <i>Massachusetts Institute of Technology, Cambridge, MA, USA</i>	977
<b>Volume 2 Natural Products Structural Diversity-II Secondary Metabolites: Sources, Structures and Chemical Biology</b>		
01	Overview and Introduction Bradley S. Moore, <i>University of California at San Diego, La Jolla, CA, USA</i> Phillip Crews, <i>University of California at Santa Cruz, Santa Cruz, CA, USA</i>	1
02	Terrestrial Plants as a Source of Novel Pharmaceutical Agents Gordon M. Cragg and David J. Newman, <i>NCI-Frederick, Frederick, MD, USA</i> David G. I. Kingston, <i>Virginia Polytechnic Institute &amp; State University, Blacksburg, VA, USA</i>	5

---

03	Marine Macroalgal Natural Products E. Paige Stout and Julia Kubanek, <i>Georgia Institute of Technology, Atlanta, GA, USA</i>	41
04	Insect Natural Products Matthew Gronquist, <i>SUNY College at Fredonia, Fredonia, NY, USA</i> Frank C. Schroeder, <i>Cornell University, Ithaca, NY, USA</i>	67
05	Terrestrial Microorganisms – Filamentous Bacteria Sheo B. Singh, <i>Merck Research Laboratories, Rahway, NJ, USA</i> Olga Genilloud and Fernando Peláez, <i>CIBE, Merck Sharp &amp; Dohme de España, Madrid, Spain</i>	109
06	The Natural Products Chemistry of Cyanobacteria Kevin Tidgewell, Benjamin R. Clark, and William H. Gerwick, <i>University of California San Diego, La Jolla, CA, USA</i>	141
07	Myxobacteria – Unique Microbial Secondary Metabolite Factories Silke C. Wenzel and Rolf Müller, <i>Saarland University, Saarbrücken, Germany</i>	189
08	Natural Product Diversity from Marine Fungi Rainer Ebel, <i>University of Aberdeen, Aberdeen, UK</i>	223
09	Bioactive Metabolites from Marine Dinoflagellates Jun'ichi Kobayashi and Takaaki Kubota, <i>Hokkaido University, Sapporo, Japan</i>	263
10	Marine Invertebrates: Sponges Yoichi Nakao, <i>Waseda University, Tokyo, Japan</i> Nobuhiro Fusetani, <i>Hokkaido University, Hakodate, Japan</i>	327
11	The Natural Products Chemistry of the Gorgonian Genus Pseudopterogorgia (Octocorallia: Gorgoniidae) Jeffrey Marrero, Ileana I. Rodríguez, and Abimael D. Rodríguez, <i>University of Puerto Rico, San Juan, PR, USA</i>	363
12	Exploiting Genomics for New Natural Product Discovery in Prokaryotes Christophe Corre and Gregory L. Challis, <i>University of Warwick, Coventry, UK</i>	429
13	Unlocking Environmental DNA Derived Gene Clusters Using a Metagenomics Approach Jeffrey H. Kim, T. Luke Simmons, and Sean F. Brady, <i>The Rockefeller University, New York, NY, USA</i>	455
14	The Chemistry of Symbiotic Interactions Jörn Piel, <i>University of Bonn, Bonn, Germany</i>	475
15	Natural Peptide Toxins Frank Mari, <i>Florida Atlantic University, Boca Raton, FL, USA</i> Jan Tytgat, <i>University of Leuven, Leuven, Belgium</i>	511
16	Cyanobactins – Ubiquitous Cyanobacterial Ribosomal Peptide Metabolites Mohamed S. Donia and Eric W. Schmidt, <i>University of Utah, Salt Lake City, UT, USA</i>	539
17	The Role of Synthesis and Biosynthetic Logic Yousong Ding and David H. Sherman, <i>The University of Michigan, Ann Arbor, MI, USA</i>	559
18	Missassigned Structures: Case Examples from the Past Decade Taro Amagata, <i>San Francisco State University, San Francisco, CA, USA</i>	581
19	Natural Products of Therapeutic Importance David J. Newman and Gordon M. Cragg, <i>NCI-Frederick, Frederick, MD, USA</i>	623
20	Natural Products as Probes of Selected Targets in Tumor Cell Biology and Hypoxic Signaling Dale G. Nagle and Yu-Dong Zhou, <i>University of Mississippi, University, MS, USA</i>	651

**Volume 3 Development & Modification of Bioactivity**

01	Overview and Introduction Rob Verpoorte, <i>Leiden University, Leiden, The Netherlands</i>	1
02	Natural Products as Lead Sources for Drug Development Stefan Wetzler, Hugo Lachance, and Herbert Waldmann, <i>Max Planck Institute of Molecular Physiology, Dortmund, Germany</i>	5
03	Topical Chemical Space Relation to Biological Space Anders Backlund, <i>Uppsala University, Uppsala, Sweden</i>	47
04	The NAPRALERT Database as an Aid for Discovery of Novel Bioactive Compounds James G. Graham and Norman R. Farnsworth, <i>University of Illinois at Chicago, Chicago, IL, USA</i>	81
05	Plant Diversity from Brazilian Cerrado and Atlantic Forest as a Tool for Prospecting Potential Therapeutic Drugs Dulce Helena Siqueira Silva, Ian Castro-Gamboa, and Vanderlan Da Silva Bolzani, <i>São Paulo State University, Araraquara, São Paulo, Brazil</i>	95
06	Nature as Source of Medicines; Novel Drugs from Nature; Screening for Antitumor Activity Gordon M. Cragg and David J. Newman, <i>NCI-Frederick, Frederick, MD, USA</i>	135
07	The Identification of Bioactive Natural Products by High Throughput Screening (HTS) Vicky M. Avery, David Camp, Anthony R. Carroll, Ian D. Jenkins, and Ronald J. Quinn, <i>Griffith University, Brisbane, QLD, Australia</i>	177
08	Natural Products Drug Discovery Giovanni Appendino, <i>Università del Piemonte Orientale, Novara, Italy</i> Gabriele Fontana, <i>Indena S.p.A., Milano, Italy</i> Federica Pollastro, <i>Università del Piemonte Orientale, Novara, Italy</i>	205
09	Natural Product-Based Biopesticides for Insect Control Azucena Gonzalez-Coloma, <i>Instituto de Ciencias Agrarias-CCMA, Madrid, Spain</i> Matias Reina, Carmen E. Diaz, and Braulio M. Fraga, <i>Instituto de Productos Naturales y Agrobiologia, Tenerife, Spain</i>	237
10	Natural Products as Sweeteners and Sweetness Modifiers A. Douglas Kinghorn, Young-Won Chin, and Li Pan, <i>The Ohio State University, Columbus, OH, USA</i> Zhonghua Jia, <i>Givaudan Flavors Corporation, Cincinnati, OH, USA</i>	269
11	Chemistry of Cosmetics Masahiro Ota and Mineyuki Yokoyama, <i>Shiseido Co., Ltd., Yokohama, Japan</i>	317
12	Ethnopharmacology and Drug Discovery Michael Heinrich, <i>University of London, London, UK</i>	351
13	Chinese Traditional Medicine Min Yang, Sijia Tao, Shuhong Guan, Xiaohui Wu, Pingping Xu, and De-an Guo, <i>Shanghai Institute of Materia Medica, Shanghai, China</i>	383
14	Ayurveda in Modern Medicine: Development and Modification of Bioactivity Pulok K. Mukherjee, M. Venkatesh, and Arunava Gantait, <i>Jadavpur University, Kolkata, India</i>	479
15	Biologically Active Compounds in Food Products and Their Effects on Obesity and Diabetes Renger F. Witkamp, <i>Wageningen University and TNO Quality of Life, Wageningen, The Netherlands</i>	509
16	Chemistry of Flavonoid-Based Colors in Plants Øyvind M. Andersen and Monica Jordheim, <i>University of Bergen, Bergen, Norway</i>	547
17	Production of Pharmaceuticals by Plant Tissue Cultures Toshiya Muranaka, <i>Yokohama City University, Yokohama, Japan, RIKEN Plant Science Center, Yokohama, Japan</i> Kazuki Saito, <i>Chiba University, Chiba, Japan, RIKEN Plant Science Center, Yokohama, Japan</i>	615

18	Plant Secondary Metabolism Engineering: Methods, Strategies, Advances, and Omics Rafael Zárata, <i>The University of La Laguna, Tenerife, Spain</i>	629
19	Biotransformation of Monoterpenoids Yoshiaki Noma and Yoshinori Asakawa, <i>Tokushima Bunri University, Yamashiro-cho, Tokushima, Japan</i>	669
20	Biotransformation of Sesquiterpenoids Yoshinori Asakawa and Yoshiaki Noma, <i>Tokushima Bunri University, Yamashiro-cho, Tokushima, Japan</i>	803
21	Biotransformation of Di- and Triterpenoids, Steroids, and Miscellaneous Synthetic Substrates Yoshinori Asakawa and Yoshiaki Noma, <i>Tokushima Bunri University, Yamashiro-cho, Tokushima, Japan</i>	893
22	Beer Flavor Leen C. Verhagen, <i>University of Leiden, Leiden, The Netherlands</i>	967
23	Chemistry of Tea Ulrich H. Engelhardt, <i>Institut für Lebensmittelchemie, Braunschweig, Germany</i>	999
24	Chemistry of Cannabis Arno Hazekamp, Justin T. Fishedick, Mónica Llano Díez, Andrea Lubbe, and Renee L. Ruhaak, <i>Leiden University, Leiden, The Netherlands</i>	1033
25	Chemistry of Coffee S. Oestreich-Janzen, <i>CAFEA GmbH, Hamburg, Germany</i>	1085
26	Chemistry of Wine Véronique Cheynier, Rémi Schneider, Jean-Michel Salmon, and Hélène Fulcrand, <i>Montpellier Research Centre, Montpellier, France</i>	1119
27	Trees: A Remarkable Biochemical Bounty Ann M. Patten, Daniel G. Vassão, Michael P. Wolcott, Laurence B. Davin, and Norman G. Lewis, <i>Washington State University, Pullman, WA, USA</i>	1173
28	The Chemistry of <i>Arabidopsis thaliana</i> M. Soledade, C. Pedras and Qingan Zheng, <i>University of Saskatchewan, Saskatoon, SK, Canada</i>	1297
<b>Volume 4 Chemical Ecology</b>		
01	Overview and Introduction Kenji Mori, <i>The University of Tokyo, Tokyo, Japan</i>	1
02	Plant Hormones Isomaro Yamaguchi, <i>Maebashi Institute of Technology, Gunma, Japan</i> Jerry D. Cohen and Angela H. Culler, <i>University of Minnesota, Minneapolis, USA</i> Marcel Quint, <i>Leibniz Institute of Plant Biochemistry, Halle, Germany</i> Janet P. Slovin, <i>United States Department of Agriculture, Washington, DC, USA</i> Masatoshi Nakajima, <i>The University of Tokyo, Tokyo, Japan</i> Shinjiro Yamaguchi, Hitoshi Sakakibara, and Takeshi Kuroha, <i>RIKEN Plant Science Center, Kanagawa, Japan</i> Nobuhiro Hirai, <i>Kyoto University, Kyoto, Japan</i> Takao Yokota, <i>Teikyo University, Utsunomiya, Japan</i> Hiroyuki Ohta and Yuichi Kobayashi, <i>Tokyo Institute of Technology, Tokyo, Japan</i> Hitoshi Mori and Yoji Sakagami, <i>Nagoya University, Nagoya, Japan</i>	9
03	Insect Hormones E. David Morgan, <i>Keele University, Staffordshire, UK</i>	127
04	Pheromones of Terrestrial Invertebrates Wittko Francke, <i>University of Hamburg, Hamburg, Germany</i> Stefan Schulz, <i>Technische Universität Braunschweig, Braunschweig, Germany</i>	153

05	Pheromones in Vertebrates Peter W. Sorensen and Thomas R. Hoye, <i>University of Minnesota, Minneapolis, MN, USA</i>	225
06	Pheromones of Marine Invertebrates and Algae Masaki Kita, <i>University of Tsukuba, Tsukuba, Japan</i> Makoto Kitamura and Daisuke Uemura, <i>Keio University, Yokohama, Japan</i>	263
07	Cell-to-Cell Communications among Microorganisms Sueharu Horinouchi, <i>The University of Tokyo, Tokyo, Japan</i> Kenji Ueda, <i>Nihon University, Kanagawa, Japan</i> Jiro Nakayama, <i>Kyushu University, Fukuoka, Japan</i> Tsukasa Ikeda, <i>Utsunomiya University, Tochigi, Japan</i>	283
08	Chemical Defence and Toxins of Plants Hisakazu Yamane, <i>The University of Tokyo, Tokyo, Japan</i> Kotaro Konno, <i>National Institute of Agrobiological Sciences, Tsukuba, Ibaraki, Japan</i> Maurice Sabelis, <i>University of Amsterdam, Amsterdam, The Netherlands</i> Junji Takabayashi, <i>Kyoto University, Otsu, Shiga, Japan</i> Takeshi Sassa, <i>Yamagata University, Tsuruoka, Japan</i> Hideaki Oikawa, <i>Hokkaido University, Sapporo, Japan</i>	339
09	Chemical Defense and Toxins of Lower Terrestrial and Freshwater Animals Konrad Dettner, <i>University of Bayreuth, Bayreuth, Germany</i>	387
10	Toxins of Microorganisms Shohei Sakuda, <i>University of Tokyo, Tokyo, Japan</i> Makoto Kimura, <i>RIKEN, Saitama, Japan</i>	411
11	Terrestrial Natural Products as Antifeedants Falko P. Drijfhout and E. David Morgan, <i>Keele University, Staffordshire, UK</i>	457
12	Marine Natural Products as Antifeedants Mary J. Garson, <i>The University of Queensland, Brisbane, QLD, Australia</i>	503
13	Allelochemicals for Plant–Plant and Plant–Microbe Interactions Koichi Yoneyama, <i>Utsunomiya University, Utsunomiya, Japan</i> Masahiro Natsume, <i>Tokyo University of Agriculture and Technology, Tokyo, Japan</i>	539
14	Allelochemicals in Plant–Insect Interactions Keiichi Honda and Hisashi Ômura, <i>Hiroshima University, Higashibiroshima, Japan</i> Masatoshi Hori, <i>Toboku University, Sendai, Japan</i> Yooichi Kainoh, <i>University of Tsukuba, Tsukuba, Japan</i>	563
15	Human–Environment Interactions (1): Flavor and Fragrance Masashi Ishikawa, Yasuhiro Warita, Eisuke Takahisa, and Yasutaka Ohkubo, <i>T. Hasegawa Co., Ltd., Tokyo, Japan</i>	595
16	Human–Environment Interactions – Taste Kunisuke Izawa, Yusuke Amino, Masanori Kohmura, Yoichi Ueda, and Motonaka Kuroda, <i>Ajinomoto Co., Inc., Kawasaki, Japan</i>	631

**Volume 5 Amino Acids, Peptides and Proteins**

01	Overview and Introduction John C. Vederas, <i>University of Alberta, Edmonton, AB, Canada</i>	1
02	Nonprotein L-Amino Acids Sabesan Yoganathan and John C. Vederas, <i>University of Alberta, Edmonton, AB, Canada</i>	5
03	Novel Enzymes for Biotransformation and Resolution of Alpha-Amino Acids Paul C. Engel and Francesca Paradisi, <i>University College Dublin, Dublin, Ireland</i>	71



04	1-Aminocyclopropane-1-Carboxylate Synthase, an Enzyme of Ethylene Biosynthesis Małgorzata Jakubowicz and Witold Nowak, <i>Adam Mickiewicz University, Poznan, Poland</i>	91
05	Specific and Nonspecific Incorporation of Selenium into Macromolecules William T. Self, <i>University of Central Florida, Orlando, FL, USA</i>	121
06	Protein Toxins from Bacteria Holger Barth, <i>University of Ulm Medical Center, Ulm, Germany</i> Bradley G. Stiles, <i>Wilson College, Chambersburg, PA, USA; US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD, USA</i>	149
07	Host Defense Peptides: Bridging Antimicrobial and Immunomodulatory Activities Jason Kindrachuk, Anastasia Nijnik, and R. E. W. Hancock, <i>University of British Columbia, Vancouver, BC, Canada</i>	175
08	Biosynthesis and Mode of Action of Lantibiotics Lisa E. Cooper, Bo Li, and Wilfred A. van der Donk, <i>University of Illinois at Urbana-Champaign, Urbana, IL, USA</i>	217
09	Plant Peptide Toxins from Nonmarine Environments Jan-Christoph Westermann and David J. Craik, <i>University of Queensland, Brisbane, QLD, Australia</i>	257
10	Therapeutic Value of Peptides from Animal Venoms Nicolas Andreotti, Bisma Jouirou, Stephanie Mouhat, Ludovic Mouhat, and Jean-Marc Sabatier, <i>Université de la Méditerranée – Ambrilia Biopharma Inc., Marseille Cedex, France</i>	287
11	Signal Transduction in Gram-Positive Bacteria by Bacterial Peptides Ingolf F. Nes, Ola Johnsborg, and Dzung Bao Diep, <i>Norwegian University of Life Sciences, Aas, Norway</i>	305
12	A New Generation of Artificial Enzymes: Catalytic Antibodies or ‘Abzymes’ Rémy Ricoux and Jean-Pierre Mahy, <i>Université de Paris-sud 11, Orsay Cedex, France</i>	323
13	Recent Progress on Understanding Ribosomal Protein Synthesis Ute Kothe, <i>University of Lethbridge, Lethbridge, AB, Canada</i>	353
14	Glutaminyl-tRNA and AsparaginytRNA Biosynthetic Pathways Jonathan L. Huot, Jacques Lapointe, and Robert Chênevert, <i>Université Laval, Québec, QC, Canada</i> Marc Bailly and Daniel Kern, <i>Institut de Biologie Moléculaire et Cellulaire, Strasbourg, France</i>	383
15	Posttranslational Modification of Proteins Keith D. Green and Sylvie Garneau-Tsodikova, <i>University of Michigan, Ann Arbor, MI, USA</i>	433
16	Collagen Formation and Structure Hans Peter Bächinger, Kazunori Mizuno, Janice A. Vranka, and Sergei P. Boudko, <i>Oregon Health &amp; Science University, Portland, OR, USA</i>	469
17	Lipidation of Peptides and Proteins Kristina Görmer and Herbert Waldmann, <i>Max Planck Institute of Molecular Physiology and Technische Universität Dortmund, Dortmund, Germany</i> Luc Brunsveld, <i>Max Planck Institute of Molecular Physiology and Chemical Genomics Centre of the Max Planck Society, Dortmund, Germany</i>	531
18	Genetic Incorporation of Unnatural Amino Acids into Proteins Angela R. Parrish and Lei Wang, <i>The Salk Institute for Biological Studies, La Jolla, CA, USA</i>	587
19	Nonribosomal Peptide Synthetases Timothy J. Montavon and Steven D. Bruner, <i>University of Florida, Gainesville, FL, USA</i>	619
20	The Properties, Formation, and Biological Activity of 2,5-Diketopiperazines P. J. Milne and G. Kilian, <i>Nelson Mandela Metropolitan University, Port Elizabeth, South Africa</i>	657

- 21 Ubiquitin-Dependent Protein Degradation 699  
Ashok N. Hegde, *Wake Forest University Health Sciences, Winston Salem, NC, USA*

### **Volume 6 Carbohydrates, Nucleosides & Nucleic Acids**

- 01 Overview and Introduction 1  
Robert Woodward and Peng George Wang, *The Ohio State University, Columbus, OH, USA*
- 02 Enzymatic Synthesis of Complex Carbohydrates 5  
Wei Zhao and Tiehai Li, *Nankai University, Tianjin, China*  
Robert Woodward, Chengfeng Xia, and Peng George Wang, *The Ohio State University, Columbus, OH, USA*  
Wanyi Guan, *Shandong University, Shandong, China*
- 03 New Strategies for Glycopeptide, Neoglycopeptide, and Glycoprotein Synthesis 55  
Ashraf Brik, *Ben-Gurion University of the Negev, Beer Sheva, Israel*
- 04 Carbohydrate Vaccines 91  
Qianli Wang and Zhongwu Guo, *Wayne State University, Detroit, MI, USA*
- 05 MS-Based Glycoanalysis 123  
Kay-Hooi Khoo, *Institute of Biological Chemistry, Academia Sinica, Taipei, Taiwan*
- 06 Glycoanalysis of Bacterial Glycome 157  
Chuan Wang, Camille L. A. Hamula, and Xing-Fang Li, *University of Alberta, Edmonton, AB, Canada*  
Xin Liu and Jianjun Li, *National Research Council of Canada, Ottawa, ON, Canada*
- 07 Chemical Glycobiology 175  
Chad M. Whitman and Michelle R. Bond, *Stanford University, Stanford, CA, USA*  
Jennifer J. Kohler, *University of Texas Southwestern Medical Center, Dallas, TX, USA*
- 08 Alkaloid Glycosidase Inhibitors 225  
Alan D. Elbein, *University of Arkansas for Medical Sciences, Little Rock, AR, USA*  
Russell J. Molyneux, *Western Regional Research Center, ARS-USDA, Albany, CA, USA*
- 09 Molecular Probes for Protein Glycosylation 261  
Howard C. Hang, *The Rockefeller University, New York, NY, USA*
- 10 O Antigen Biosynthesis 297  
Miguel A. Valvano, *The University of Western Ontario, London, ON, Canada*
- 11 Biosynthesis of Complex Mucin-Type O-Glycans 315  
Inka Brockhausen, *Queen's University, Kingston, ON, Canada*
- 12 Bacterial Protein Glycosylation 351  
Amirreza Faridmoayer and Mario F. Feldman, *University of Alberta, Edmonton, AB, Canada*
- 13 Structure and Biosynthesis of the Mycobacterial Cell Wall 381  
Dean C. Crick, Delphi Chatterjee, Michael S. Scherman, and Michael R. McNeil, *Colorado State University, Fort Collins, CO, USA*
- 14 Structure, Biosynthesis, and Function of Glycosaminoglycans 407  
Courtney L. Jones and Jian Liu, *University of North Carolina, Chapel Hill, NC, USA*  
Ding Xu, *University of California, San Diego, CA, USA*
- 15 Biochemistry and Molecular Biology of Glycogen Synthesis in Bacteria and Mammals and Starch Synthesis in Plants 429  
Jack Preiss, *Michigan State University, East Lansing, MI, USA*
- 16 Celluloses 493  
Rajai H. Atalla, *Cellulose Sciences International, Madison, WI, USA*  
Akira Isogai, *University of Tokyo, Tokyo, Japan*



- 17 Vascular Plant Lignification: Biochemical/Structural Biology Considerations of Upstream Aromatic Amino Acid and Monolignol Pathways 541  
Dhrubojyoti D. Laskar, Oliver R. A. Corea, Ann M. Patten, ChulHee Kang, Laurence B. Davin, and Norman G. Lewis, *Washington State University, Pullman, WA, USA*
- 18 Proanthocyanidins: Chemistry and Biology 605  
Daneel Ferreira, Jannie P. J. Marais, Christina M. Coleman, and Desmond Slade, *University of Mississippi, Oxford, MS, USA*
- 19 Nucleoside Analogues 663  
Darrell R. Davis, *The University of Utah, Salt Lake City, UT, USA*
- 20 RNA Modifying Enzymes 683  
George A. Garcia, Julie K. Hurt, and Yi-Chen Chen, *University of Michigan, Ann Arbor, MI, USA*
- 21 Riboswitches 743  
Tina M. Henkin, *The Ohio State University, Columbus, OH, USA*

## Volume 7 Cofactors

- 01 Overview and Introduction 1  
Tadhg P. Begley, *Texas A&M University, College Station, TX, USA*
- 02 Riboflavin Biosynthesis 3  
Markus Fischer, *University of Hamburg, Hamburg, Germany*  
Adelbert Bacher, *Technical University of Munich, Garching, Germany*
- 03 Flavin-Dependent Enzymes 37  
Rebecca L. Fagan and Bruce A. Palfey, *University of Michigan Medical School, Ann Arbor, MI, USA*
- 04 Biotechnology of Riboflavin Production 115  
Hans-Peter Hohmann, *DSM Nutritional Products, Kaiseraugst, Switzerland*  
Klaus-Peter Stahmann, *Fachhochschule Lausitz, Senftenberg, Germany*
- 05 The Use of Subsystems to Encode Biosynthesis of Vitamins and Cofactors 141  
Andrei L. Osterman, *Burnham Institute for Medical Research, La Jolla, CA, USA*  
Ross Overbeek, *Fellowship for Interpretation of Genomes, Burr Ridge, IL, USA*  
Dmitry A. Rodionov, *Burnham Institute for Medical Research, La Jolla, CA, USA*
- 06 Biosynthesis of Biotin 161  
Andrée Marquet, *Université Pierre et Marie Curie, Paris, France*
- 07 Lipoic Acid Biosynthesis and Enzymology 181  
Elizabeth S. Billgren, Robert M. Cicchillo, Natasha M. Nesbitt, and Squire J. Booker, *The Pennsylvania State University, University Park, PA, USA*
- 08 Genomics and Enzymology of NAD Biosynthesis 213  
Leonardo Sorci, Oleg Kurnasov, Dmitry A. Rodionov, and Andrei L. Osterman, *Burnham Institute for Medical Research, La Jolla, CA, USA*
- 09 Pyridoxal Phosphate Biosynthesis 259  
Jeremiah W. Hanes, Steven E. Ealick, and Tadhg P. Begley, *Cornell University, Ithaca, NY, USA*  
Ivo Tews, *Heidelberg University Biochemistry Center, Heidelberg, Germany*
- 10 Pyridoxal 5'-Phosphate-Dependent Enzymes: Catalysis, Conformation, and Genomics 273  
Samanta Raboni, Francesca Spyraakis, Barbara Campanini, Alessio Amadasi, Stefano Bettati, Alessio Peracchi, and Andrea Mozzarelli, *University of Parma, Parma, Italy; Present address: University of Padua, Padua, Italy*  
Roberto Contestabile, *University of Rome 'La Sapienza,' Rome, Italy*
- 11 Coenzyme A Biosynthesis and Enzymology 351  
Erick Strauss, *Stellenbosch University, Stellenbosch, South Africa*

12	Menaquinone/Ubiquinone Biosynthesis and Enzymology R. Meganathan, <i>Northern Illinois University, DeKalb, IL, USA</i>	411
13	Biosynthesis of Heme and Vitamin B <sub>12</sub> Gunhild Layer and Dieter Jahn, <i>Technical University of Braunschweig, Braunschweig, Germany</i> Evelyne Deery, Andrew D. Lawrence, and Martin J. Warren, <i>University of Kent, Kent, UK</i>	445
14	Cobalamin Coenzymes in Enzymology Perry Allen Frey, <i>University of Wisconsin-Madison, Madison, WI, USA</i>	501
15	Thiamin Biosynthesis Tadhg P. Begley and Steven E. Ealick, <i>Cornell University, Ithaca, NY, USA</i>	547
16	Thiamin Enzymology Frank Jordan, <i>Rutgers, The State University of New Jersey, Newark, NJ, USA</i>	561
17	The Biosynthesis of Folate and Pterins and Their Enzymology Markus Fischer, <i>University of Hamburg, Hamburg, Germany</i> Beat Thöny, <i>University Children's Hospital, Zürich, Switzerland</i> Silke Leimkühler, <i>University of Potsdam, Potsdam, Germany</i>	599
18	Cofactor Catabolism Tathagata Mukherjee, Kathryn M. McCulloch, Steven E. Ealick, and Tadhg P. Begley, <i>Cornell University, Ithaca, NY, USA</i>	649
19	Protein-Derived Cofactors Victor L. Davidson, <i>University of Mississippi Medical Center, Jackson, MS, USA</i>	675
20	Biosynthesis of the Methanogenic Coenzymes Laura L. Grochowski and Robert H. White, <i>Virginia Polytechnic Institute and State University, Blacksburg, VA, USA</i>	711

## **Volume 8 Enzymes and Enzyme Mechanisms**

01	Overview and Introduction Christian P. Whitman, <i>The University of Texas, Austin, TX, USA</i>	1
02	Evolution and the Enzyme Shelley D. Copley, <i>University of Colorado at Boulder, Boulder, CO, USA</i>	9
03	Enzyme Promiscuity – Evolutionary and Mechanistic Aspects Olga Khersonsky and Dan S. Tawfik, <i>Weizmann Institute of Science, Rehovot, Israel</i>	47
04	Mechanistic and Structural Studies of Microbial Dehalogenases: How Nature Cleaves a Carbon–Halogen Bond Gerrit J. Poelarends, <i>University of Groningen, Groningen, The Netherlands</i> Christian P. Whitman, <i>The University of Texas, Austin, TX, USA</i>	89
05	Guanidine-Modifying Enzymes in the Pentein Superfamily Thomas W. Linsky and Walter Fast, <i>University of Texas, Austin, TX, USA</i>	125
06	Tunnels and Intermediates in the Glutamine-Dependent Amidotransferases Nigel G. J. Richards, Robert N. Humkey, Kai Li, and Megan E. Meyer, <i>University of Florida, Gainesville, FL, USA</i> Tania C. Córdova de Sintjago, <i>Universidad Central de Venezuela, Caracas, Venezuela</i>	161
07	Fatty Acid Biosynthesis and Oxidation Huaning Zhang, Carl A. Machutta, and Peter J. Tonge, <i>Stony Brook University, Stony Brook, NY, USA</i>	231
08	Diels–Alderases Hideaki Oikawa, <i>Hokkaido University, Sapporo, Japan</i>	277

09	Phosphoryl and Sulfuryl Transfer Tiago A. S. Brandao and Alvan C. Hengge, <i>Utah State University, Logan, UT, USA</i>	315
10	Catalytic Mechanism of DNA Polymerases Michelle P. Roettger, Marina Bakhtina, and Sandeep Kumar, <i>The Ohio State University, Columbus, OH, USA</i> Ming-Daw Tsai, <i>Academia Sinica, Taipei, Taiwan</i>	349
11	Mechanisms of Enzymatic Glycosyl Transfer Ran Zhang, Vivian L.Y. Yip, and Stephen G. Withers, <i>University of British Columbia, Vancouver, BC, Canada</i>	385
12	Synthesis of Alginate in Bacteria Peter A. Tipton, <i>University of Missouri, Columbia, MO, USA</i>	423
13	Enzymology of Bacterial Resistance Jed F. Fisher and Shahriar Mobashery, <i>University of Notre Dame, IN, USA</i>	443
14	Copper Metalloenzymes Albrecht Messerschmidt, <i>Max-Planck-Institute of Biochemistry, Martinsried, Germany</i>	489
15	Mechanisms of Metal-Dependent Hydrolases in Metabolism Marcy Hernick, <i>Virginia Polytechnic Institute and State University, Blacksburg, VA, USA</i> Carol Fierke, <i>University of Michigan, Ann Arbor, MI, USA</i>	547
16	Dioxygenase Enzymes and Oxidative Cleavage Pathways Timothy D. H. Bugg, <i>University of Warwick, Coventry, UK</i>	583
17	<i>S</i> -Adenosylmethionine and Iron–Sulfur Clusters in Biological Radical Reactions: The Radical SAM Superfamily Eric M. Shepard and Joan B. Broderick, <i>Montana State University, Bozeman, MT, USA</i>	625
18	Detection of Novel Enzyme Intermediates Cristina M. Furdui, <i>Wake Forest University School of Medicine, Winston-Salem, NC, USA</i> Karen S. Anderson, <i>Yale University School of Medicine, New Haven, CT, USA</i>	663
19	Bisubstrate Analog Inhibitors Patrick A. Frantom and John S. Blanchard, <i>Albert Einstein College of Medicine, Bronx, NY, USA</i>	689
20	Quantum Chemical Modeling of Enzymatic Reactions – Applications to Epoxide-Transforming Enzymes Kathrin H. Hopmann and Fahmi Himo, <i>Royal Institute of Technology, Stockholm, Sweden</i>	719
<b>Volume 9 Modern Methods for the Investigation of Natural Products</b>		
01	Overview and Introduction Lew Mander, <i>Australia National University, Canberra, ACT, Australia</i>	1
02	High Performance Liquid Chromatographic Separation Methods Reinhard I. Boysen and Milton T. W. Hearn, <i>Monash University, Melbourne, VIC, Australia</i>	5
03	Introduction to Macromolecular X-Ray Crystallography Esko Oksanen and Adrian Goldman, <i>University of Helsinki, Helsinki, Finland</i>	51
04	Characterization by Circular Dichroism Spectroscopy Nina Berova, George A. Ellestad, and Nobuyuki Harada, <i>Columbia University, New York, NY, USA</i>	91
05	Determination of Structure including Absolute Configuration of Bioactive Natural Products Kenji Mori, <i>The University of Tokyo, Tokyo, Japan</i>	147
06	NMR – Small Molecules and Analysis of Complex Mixtures Arthur S. Edison, <i>University of Florida, Gainesville, FL, USA</i> Frank C. Schroeder, <i>Cornell University, Ithaca, NY, USA</i>	169

07	Biomolecular Recognition by Oligosaccharides and Glycopeptides: The NMR Point of View Katalin E. Kövér, László Szilágyi, and Gyula Batta, <i>University of Debrecen, Debrecen, Hungary</i> Dušan Uhrín, <i>University of Edinburgh, Edinburgh, UK</i> Jesús Jiménez-Barbero, <i>Centro de Investigaciones Biológicas, Madrid, Spain</i>	197
08	Determination of Three-Dimensional Structures of Nucleic Acids by NMR Nikolai B. Ulyanov and Thomas L. James, <i>University of California, San Francisco, San Francisco, CA, USA</i>	247
09	Derivation of Peptide and Protein Structure using NMR Spectroscopy Glenn F. King and Mehdi Mobli, <i>The University of Queensland, St. Lucia, QLD, Australia</i>	279
10	Mass Spectrometry: An Essential Tool for Trace Identification and Quantification Charles H. Hocart, <i>Australian National University, Canberra, ACT, Australia</i>	327
11	Applications of Modern Mass Spectrometry Techniques in Natural Products Chemistry Roland D. Kersten, Michael J. Meehan, and Pieter C. Dorrestein, <i>University of California, San Diego, La Jolla, CA, USA</i>	389
12	Mass Spectrometry: Structure Determination of Proteins and Peptides Chhabil Dass, <i>The University of Memphis, Memphis, TN, USA</i>	457
13	Application of Mass Spectrometry to Rapid Analysis of Bacterial Polysaccharides Jianjun Li and Eleonora Altman, <i>Institute for Biological Sciences, Ottawa, ON, Canada</i>	497
14	Modern Methods for the Isolation of Natural Product Receptors Peter Karuso, <i>Macquarie University, Sydney, NSW, Australia</i>	513
15	Bioinformatics Yi-Ping Phoebe Chen, <i>Deakin University, Melbourne, VIC, Australia</i> Elena P. Ivanova and Feng Wang, <i>Swinburne University of Technology, Melbourne, VIC, Australia</i> Paolo Carloni, <i>International School for Advanced Studies, Trieste, Italy</i>	569
16	Natural Products Research and Metabolomics V. Craige Trenerry and Simone J. Rochfort, <i>DPI-Werribee Centre, Werribee, VIC, Australia</i>	595
17	Small Molecules as Versatile Tools for Activity-Based Protein Profiling Experiments Stephan A. Sieber, Thomas Böttcher, Isabell Staub, and Ronald Orth, <i>Ludwig-Maximilians-Universität München, Munich, Germany</i>	629
18	Metabolic Studies Using the Retrobiosynthesis Concept – Theory, Technology, and Examples Adelbert Bacher and Wolfgang Eisenreich, <i>Technische Universität München, Garching, Germany</i>	675
19	Bacterial Protein Overexpression Systems and Strategies C. Kinsland, <i>Cornell University, Ithaca, NY, USA</i>	695
20	Directed Evolution of Enzymes Colin J. Jackson, <i>CSIRO Entomology, Black Mountain, ACT, Australia</i> Elizabeth M. J. Gillam, <i>University of Queensland, St. Lucia, QLD, Australia</i> David L. Ollis, <i>Australian National University, Canberra, ACT, Australia</i>	723
21	Single Molecule Fluorescence Methods in Enzymology Peng Chen and Nisha May Andoy, <i>Cornell University, Ithaca, NY, USA</i>	751