CRAIG ARTHUR TOWNSEND

Professional Experience

1969	B. A. *cum laude*, with Honors in Chemistry, Williams College, Williamstown, Massachusetts
1974	Ph.D., Organic Chemistry, Yale University, New Haven, Connecticut; Professor A. Ian Scott, Thesis Advisor
1974–1976	Postdoctoral Fellow, Eidgenössische Technische Hochschule, Zürich, Switzerland; Professor Duilio Arigoni, Advisor
1976–1982	Assistant Professor of Chemistry, The Johns Hopkins University, Baltimore, Maryland
1982–1985	Associate Professor of Chemistry, The Johns Hopkins University
1984–Present	Joint Appointment Department of Biology and The McCollum-Pratt Institute, The Johns Hopkins University
1985–Present	Professor of Chemistry, The Johns Hopkins University
1987	Visiting Professor of Chemistry, Harvard University, Cambridge, Massachusetts
1989-Present	Joint Appointment Thomas C. Jenkins Department of Biophysics, The Johns Hopkins University
1990-1994	Chairman, Department of Chemistry, The Johns Hopkins University
1997-Present	Alsoph H. Corwin Professor of Chemistry

Honors

Predoctoral Fellowship, NIH (Yale, 1970–1973); Richard L. Wolfgang Prize (Yale, 1973); International Exchange Postdoctoral Fellow, Swiss National Science Foundation (E.T.H., 1974–1976); Research Fellow of The Alfred P. Sloan Foundation (1982–1986); Camille and Henry Dreyfus Teacher-Scholar (1983–1988); Stuart Pharmaceuticals Award in Chemistry (1986); Distinguished Lecturer, University of Hawaii (1988); Robert A. Welch Foundation Lectureship (1989); H. Martin Friedman Lecture, Rutgers (1990); Boehringer-Ingelheim Lecture, Yale (1992); Maryland Chemist of the Year, Maryland Section of the ACS (1992); Arthur C. Cope Scholar Award, ACS (1995); Gomberg Lecture, University of Michigan (1997); Pfizer Distinguished Lecturer, Colorado State University (1999); University of Michgan/Pfizer Symposium (2002); University of California, Irvine/Pfizer Symposium (2003); MERIT Award, NIH (2004-2014); Fellow of the AAAS (2003); Hutchinson Lecture, Wisconsin (2011); Royal Society of Chemistry Bioorganic Chemistry Group Lecture, Nottingham, England (2012); A. I. Scott Medal for Excellence in Biological Chemistry Research, ACS (2013).

Service

N.I.H. Special Study Sections (1980–Present); *Ad hoc* member Bioorganic and Natural Products Study Section (June, 1984); Regular member Bioorganic and Natural Products Study Section (1985–1989); American Chemical Society Canvassing Committee for the Ernest Guenther Award (1985–1988, Chairman 1988); Organic Program Chairman, Middle Atlantic Regional ACS Meeting (1986); Editorial Advisory Board of *The Journal of Organic Chemistry* (1987–1991); Symposium Co-organizer, 1989 International Chemical Congress of Pacific Basin Societies (1989); Co-Chairman, NSF Workshop on Organic Synthesis and Natural Products (1989-1992); Alternate Councilor, Division of Biological Chemistry, ACS (1991-1994); Co-organizer and cofounder Bioorganic Chemistry Gordon Research Conference (1992); Advisory Panel, Office of Technology Assessment (1994-1995); Symposium Co-organizer, 1995 International Chemical Congress of Pacific Basin Societies (1995), Editorial Board of *Bioorganic Chemistry* (1998-);

Symposium Co-organizer, 2000 International Chemical Congress of Pacific Basin Societies (2000); Nominating Committee, Division of Biological Chemistry, ACS (1998-1999); Alternate Councilor, Division of Biological Chemistry, ACS (1999-2001); Council of the Gordon Research Conferences, at-large member (2001-); Editorial Board of *Chemistry & Biology* (2002-), Symposium Co-organizer, 2005 International Chemical Congress of Pacific Basin Societies (2005). Advisory Board, NIH Program Project Grant "Discovery, Design, and Development of Phosphonic Acid Antibiotics," University of Illinois (2008-), Symposium Co-organizer, 2010 International Chemical Congress of Pacific Basin Societies (2010); Chairman, Biological Chemistry Division, ACS (2017-2018).

Principal Invited Lectures (since 2000)

2000: Enzymes, Coenzymes and Metabolic Pathways Gordon Research Conference, Meriden, NH ** 6th Biennial Symposium "Frontiers in Organic Chemistry," University of Illinois, Urban, IL ** International Chemical Congress of Pacific Basin Societies (Pacifichem), "Symposium on Antibiotics," Honolulu, HI. 2001: Volcano Conference in Bioorganic Chemistry, Pack Forest, WA ** US-Japan Seminar on Biosynthesis of Natural Products, Girdwood, AK** Royal Society of Chemistry, "Polyketides III," Bristol, UK. 2002: University of Michgan/Pfizer Symposium: "Challenges in Organic Chemistry," Ann Arbor, MI ** American Society of Microbiology, Symposium: "Exploring Secondary Metabolism Using Emerging Technologies," Salt Lake City, UT. 2003: American Society of Biochemistry and MolecularBiology, Symposium: "Complex Biological Oxidations," San Diego, CA ** Heterocyclic Compounds Gordon Research Conference, Newport, RI ** University of California, Irvine/Pfizer Symposium: "Biosynthetic Pathways and Small Molecule Synthesis," Irvine, CA. 2004: Texas A & M University Symposium in honor A. Ian Scott: "Recent Advances in Bioorganic Chemistry," College Station, TX ** Division of Organic Chemistry/GlaxoSmithKline Symposium: "Frontiers in Chemistry and Medicine Symposium II," Southeast Regional ACS Meeting, Research Triangle Park, NC. 2005: "Peter Yates Memorial Lecture," University of Toronto, Toronto, Canada ** Bioorganic Chemistry Gordon Research Conference, Andover, NH ** American Society of Pharmacognosy, "Contemporary Approaches in Natural Product Biosynthesis," Corvallis, OR. 2006: 40th European Symposium on Bioorganic Chemistry (ESBOC), "Natural Products and their Cellular Targets," Gregynog, Wales ** Trends in Enzymology, "Enzymes of Secondary Metabolism," Como, Italy ** Society for Industrial Microbiology, "Fungal Proteomics in Agriculture" & "Novel Enzymology for Natural Product Biosynthesis and Engineering," Baltimore, MD ** Royal Society Symposium, Chemical Biology "Directing Biosynthesis," Cambridge, England. 2007: 15th International Conference on Cytochromes P450, Bled, Solvenia (declined) ** Enzymes, Coenzyme & Metabolic Processes Gordon Research Conference, Biddeford, ME ** Iterative Polyketide Synthase (IPKS) Conference, Banff, Alberta, Canada ** Society for Industrial Microbiology, "Fungal Polyketides–Biosynthesis, pathogenesis and Regulation," Denver, CO ** 41st IUPAC World Chemistry Congress, Turin, Italy ** International Conference on Reactive Intermediates and Unusual Molecules (ISRIUM), Ascona, Switzerland. 2008: Zing Conference "Natural Products," Antigua ** 7th U.S–Japan Seminar on the Biosynthesis of Natural Products, La Jolla, CA ** Society for Industrial Microbiology, "Natural Product Biosynthesis in Three Dimensions," San Diego, CA. 2009: Zing Conference "Natural Products," Antigua ** Society for Industrial Microbiology, "Natural Product Biosynthesis in Three Dimensions," Toronto, Canada ** 42nd International Union of Pure & Applied Chemistry (IUPAC) Congress, "Biosynthetic Pathways, " Glasgow, Scotland ** National ACS Meeting, BIOL Div. "Natural Products," Washington, DC ** Enzyme Engineering XX "Emerging Applications," Groningen, NL 2011: International Union of Microbiological Societies (IUMS) Congress 2011, Symposium: "Bioactive Microbial Products," Sapporo, Japan ** Hutchinson Lecture, University of Wisconsin ** 2012: International Conference of Natural Product Biosynthesis, 9th US–Japan Seminar: "Enzymology•Structural Biology•Drug Discovery•Genome Mining," Awaji Island, Japan ** International Union of Pure & Applied Chemistry, 9th International Symposium on Biomolecular Chemistry (ISBOC-9), Beijing, China ** Royal Society of Chemistry, "Directing Biosynthesis III," Royal Society of Chemistry Bioorganic Chemistry Group Lecture, Nottingham, England **

13th Annual Connecticut Organic Chemistry Symposium, New Haven, CT ** 2013: 6th Heron Island Conference on Reactive Intermediates and Unusual Molecules: Synthesis and Mechanism, Heron Island, Australia ** DECHEMA, 1st European Conference on Natural Products: Research and Applications, Frankfurt-am-Main, Germany ** 23rd Solvay Conference on Chemistry, Symposium: "New Chemistry and New Opportunities from the Expanding Protein Universe," Brussels, Belgium ** A. I. Scott Medal Symposium, Texas A&M University, College Station, TX ** 2014: CBI Lecture, University of Illinois, Champagne-Urbana, IL ** 2015: MiCom 2015, 5th Int'l Conference on Fungal Communication", Jena, Germany ** UniCat-Lecture, Cluster of Excellence, University of Berlin, Germany ** Beilstein Organic Chemistry Conference: Natural Products, Prien-am-Chiemsee, Germany ** PacifiChem 2015 Symposium: Natural Products, Honolulu, HI ** 2016: Bioorganic Chemistry Gordon Research Conference, Andover, NH ** 50th Anniversary Symposium, Texas A&M University, College Station, TX ** 2017: 25th Enzyme Mechanisms Conference, St. Pete Beach, FL ** Royal Society of Chemistry, "Directing Biosynthesis V," Warwick, England ** 9th U.S–Japan Seminar on the Biosynthesis of Natural Products, Lake Arrowhead, CA** 5th University of Kentucky Natural Products and COP Drug Discovery and Development Symposium, Lexington, KY ** 2018: Natural Products & Bioactive Compounds Gordon Research Conference, Andover, NH ** P. F. Leadlay Celebratory Symposium, Cambridge, England **

Publications: (but display in reverse order)

1. Scottt, A. I.; Townsend, C. A.; Okada, K.; Kajiwara, M.; Whitman, P. J.; Cushley, R. J. "Biosynthesis of Corrinoids. Concerning the Origin of the Methyl Groups in Vitamin B_{12}," *J. Am. Chem. Soc.* **1972**, *94*, 8267–8269.

2. Scott, A. I.; Townsend, C. A.; Okada, K.; Kajiwara, M.; Cushley, R. J. "Uroporphyrinogen III as a Precursor of Vitamin B_{12}," *J. Am. Chem. Soc.* **1972**, *94*, 8269–8271.

3. Scott, A. I.; Townsend, C. A.; Okada, K.; Kajiwara, M. "Concerning the Biosynthesis of Vitamin B_{12}," *Trans. N.Y. Acad. Sci., Series II* **1973**, *35*, 72–79.

4. Scott, A. I.; Townsend, C. A.; Cushley, R. J. "Stereochemistry of Methyl Group Insertion in Corrinoid Biosynthesis. Determination of Carbon Isotope Chirality by ^{13}C Nuclear Magnetic Resonance," *J. Am. Chem. Soc.* **1973**, *95*, 5759–5761.

5. Scott, A. I.; Lee, E.; Townsend, C. A. "On Corrin Biosynthesis," *Bioorg. Chem.* **1973**, *3*, 229–237.

6. Scott, A. I.; Townsend, C. A.; Okada, K.; Kajiwara, M. "Biosynthesis of Corrins I. Experiments with ^{14}C-Porphobilinogen and ^{14}C-Uroporphyrinogens," *J. Am. Chem. Soc.* **1974**, *96*, 8054–8069.

7. Scott, A. I.; Townsend, C. A.; Okada, K.; Kajiwara, M.; Cushley, R. J.; Whitman, P. J. "Biosynthesis of Corrins II. Incorporation of ^{13}C-Labeled Substrates into Vitamin B_{12}," *J. Am. Chem. Soc.* **1974**, *96*, 8069–8080.

8. Scott, A. I.; Georgopapadakou, N.; Ho, K. S.; Klioze, S.; Lee, E.; Lee, S. L.; Temme, G. H. III; Townsend, C. A.; Armitage, I. M. "Concerning the Intermediacy of Uro'gen III and of a Heptacarboxylic Uro'gen in Corrinoid Biosynthesis," *J. Am. Chem. Soc.* **1975,** *97*, 2548–4550.

9. Townsend, C. A.; Scholl, T.; Arigoni, D. "A New Synthesis of Chiral Acetic Acid," *J. Chem. Soc., Chem. Commun.* **1975**, 921–922.

10. Imfeld, M.; Townsend, C. A.; Arigoni, D. "Intact Transfer of Methyl Groups in the Biosynthesis of Vitamin B_{12}," *J. Chem. Soc., Chem. Commun.* **1976**, 541–542.

11. Townsend, C. A.; Theis, A. B. "A Method for the Transfer of Labeled Methyl Groups," *J. Org. Chem.* **1980**, *45*, 1697–1699.

12. Theis, A. B.; Townsend, C. A. "A Simple, Inexpensive Preparation of Highly Pure Copper (I) Bromide and its Dimethylsulfide Complex," *Synth. Commun.* **1981**, *11*, 157–166.

13. Townsend, C. A.; Brown, A. M. "Biosynthetic Studies of Nocardicin A," *J. Am. Chem. Soc.* **1981**, *103*, 2873–2874.

14. Townsend, C. A.; Nguyen, L. T. "Asymmetric, Biogenetically Modeled Synthesis of (-)-3-Aminonocardicinic Acid," *J. Am. Chem. Soc.* **1981**, *103*, 4582–4583.

15. Townsend, C. A.; Bloom. L. M. "Studies of Methoxymethyl-Directed Metalation," *Tetrahedron Lett.* **1981**, *22*, 3923–3924.

16. Townsend, C. A.; Davis, S. G.; Christensen, S. B.; Link, J. C.; Lewis, C. P. "Methoxymethyl-Directed Aryl Metalation. A Total Synthesis of (±)-Averufin," *J. Am. Chem. Soc.* **1981**, *103*, 6885–6888.

17. Townsend, C. A.; Neese, A. S.; Theis, A. B. "Synthesis of (3*R*,4*S*)- and (3*R*,4*R*)-[4-^{2}H,^{3}H]Valine. Preparation of Compounds Containing Chiral-Methyl Groups with an Adjacent Asymmetric Centre," *J. Chem. Soc., Chem. Commun.* **1982**, 116–118.

18. Townsend, C. A.; Brown, A. M. "Nocardicin A Biosynthesis: Stereochemical Course of Monocyclic β-Lactam Formation," *J. Am. Chem. Soc.* **1982**, *104*, 1748–1750.

19. Townsend, C. A.; Nguyen, L. T. "Improved Asymmetric Synthesis of (-)-3-Aminonocardicinic Acid and Further Observations of the Mitsunobu Reaction for β-Lactam Formation in Seryl Peptides," *Tetrahedron Lett.* **1982**, *23*, 4859–4862.

20. Townsend, C. A.; Christensen, S. B.; Davis, S. G. "Bisfuran Formation in Aflatoxin Biosynthesis: The Fate of the Averufin Side Chain," *J. Am. Chem. Soc.* **1982**, *104*, 6152–6153.

21. Townsend, C. A.; Christensen, S. B.; Davis, S. G. "Bisfuran Formation in Aflatoxin Biosynthesis: The Role of Versiconal Acetate," *J. Am. Chem. Soc.* **1982**, *104*, 6154–6155.

22. Townsend, C. A.; Brown, A. M. "Nocardicin A: Biosynthetic Experiments with Amino Acid Precursors," *J. Am. Chem. Soc.* **1983**, *105*, 913–918.

23. Townsend, C. A.; Brown, A. M.; Nguyen, L. T. "Nocardicin A: Stereochemical and Biomimetic Studies of Monocyclic □-Lactam Biosynthesis," *J. Am. Chem. Soc.* **1983**, *105*, 919–927.

24. Townsend, C. A.; Christensen, S. B. "Stable Isotope Studies of Anthraquinone Intermediates in the Aflatoxin Pathway," A Symposium-in-Print, *Tetrahedron* **1983**, *39*, 3575-3582.

25. Townsend, C. A.; Davis, S. G. "The Regiochemistry of A-Ring-labelled Averufin Incorporation into Aflatoxin B_1," *J. Chem. Soc., Chem. Commun.* **1983**, 1420–1422.

26. Townsend, C. A.; Christensen, S. B.; Trautwein, K. "Hexanoate as a Starter Unit in Polyketide Biosynthesis," *J. Am. Chem. Soc.* **1984**, *106*, 3868–3869.

27. Schwab, J. M.; Li, W.-b.; Ho, C.-k.; Townsend, C. A.; Salituro, G. M. "Direct Observation by Carbon-13 NMR Spectroscopy of the Regioselectivity and Stoichiometry of 'Suicide' Enzyme Inactivation," *J. Am. Chem. Soc.* **1984**, *106*, 7293–7294.

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29. Townsend, C. A.; Salituro, G. M. "Fate of ^{15}N-(*p*-Hydroxyphenyl)glycine in Nocardicin A Biosynthesis," *J. Chem. Soc. Chem. Commun.* **1984**, 1631–1632.

30. Townsend, C. A.; Christensen, S. B. "Concerning the Role of Nidurufin in Aflatoxin Biosynthesis," *J. Am. Chem. Soc.* **1985**, *107*, 270–271.

31. Townsend, C. A.; Ho, M.-f. "Biosynthesis of Clavulanic Acid: Origin of the C_5-Unit," *J. Am. Chem. Soc.* **1985**, *107*, 1065–1066.

32. Townsend, C. A.; Ho, M.-f. "Biosynthesis of Clavulanic Acid: Origin of the C_3-Unit," *J. Am. Chem. Soc.* **1985**, *107*, 1066–1068.

33. Townsend, C. A.; Theis, A. B.; Neese, A. S.; Barrabee, E. B.; Poland, D."Stereochemical Fate of Chiral-Methyl Valine in the Ring Expansion of Penicillin N to Deacetoxycephalosporin C," *J. Am. Chem. Soc.* **1985**, *107*, 4760–4767.

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36. Townsend, C. A.; "The Stereochemical Fate of Chiral-Methyl Valines in Cephalosporin C Biosynthesis," Plenary Lecture at the International Research Congress on Natural Products, July, 1985, *J. Nat. Prod.* **1985**, *48*, 708–724.

37. Townsend, C. A. "Progress Toward a Biosynthetic Rationale of the Aflatoxin Pathway," *Pure & Appl. Chem.* **1986**, *58*, 227–238.

38. Townsend, C. A.; Ho, M.-f.; Mao, S.-s. "The Stereochemical Fate of (2*RS*,5*R*)- and (2*RS*,5*S*)-[5-^{3}H]Ornithine in Clavulanic Acid Biosynthesis," *J. Chem. Soc., Chem. Commun.* **1986**, 639–639.

39. Townsend, C. A.; Christensen, S. B. "Stereochemical Correlation of (-)-Averantin," *Tetrahedron Lett.* **1986**, *27*, 887–888.

40. Schwab, J. M.; Ho, C.-k.; Li, W.-b.; Townsend, C. A.; Salituro, G. M. "β–Hydroxy-decanoyl Thioester Dehydrase. Complete Characterization of the Fate of the 'Suicide' Substrate, 3-Decynoyl-NAC," *J. Am. Chem. Soc.* **1986**, *108*, 5309–5316.

41. Townsend, C. A.; Salituro, G. M.; Nguyen, L. T.; DiNovi, M. J. "Biogenetically-Modelled Total Syntheses of (-)-Nocardicin A and (-)-Nocardicin G," *Tetrahedron Lett.* **1986**, *27*, 3819–3822.

42. Townsend, C. A.; Mao, S.-s. "Clavulanic Acid Biosynthesis: The Stereochemical Course of β-Lactam Formation from Chiral Glycerol," *J. Chem. Soc., Chem. Commun.* **1987**, 86–89.

43. Townsend, C. A.; Christensen, S. B.; Davis, S. G. "Synthesis of Averufin and Its Role in Aflatoxin B_1 Biosynthesis," *J. Chem. Soc., Perkin Trans. I* **1988**, 839–861.

44. Townsend, C. A.; Brobst, S. W.; Ramer, S. E.; Vederas, J. C. "Stereochemical Features of Enoyl Thioester Reductase in Averufin and Fatty Acid Biosynthesis in *Aspergillus parasiticus*," *J. Am. Chem. Soc.* **1988**, *110*, 318–319.

45. Townsend, C. A.; Plavcan, K. A.; Pal, K.; Brobst, S. W.; Irish, M. S.; Ely, Jr., E. W.; Bennett, J. W. "Hydroxyversicolorone: Isolation and Characterization of a Potential Intermediate in Aflatoxin Biosynthesis," *J. Org. Chem.* **1988**, *53*, 2472–2477.

46. Townsend, C. A.; Wilson, B. A. "The Role of Nocardicin G in Nocardicin A Biosynthesis," *J. Am. Chem. Soc.* **1988**, *110*, 3320–3321.

47. Townsend, C. A.; Whittamore, P. R. O.; Brobst, S. W. "Hydroxyversicolorone: Synthesis and Incorporation of a New Intermediate in Aflatoxin Biosynthesis," *J. Chem. Soc., Chem. Commun.* **1988**, 726–728.

48. Townsend, C. A.; Krol, W. J. "The Role of Molecular Oxygen in Clavulanic Acid Biosynthesis: Evidence for a Bacterial Oxidative Deamination," *J. Chem. Soc., Chem. Commun.* **1988**, 1234-1236.

49. Townsend, C. A.; Holbrooks, A. McE.; Salituro, G. M. "Stereochemical Fate of (2*S*,4*R*)- and (2*S*,4*S*)-[4-^{2}H]Methionine in Nocardicin A Biosynthesis," *J. Chem. Soc., Chem. Commun.* **1988**, 1579-1581.

50. Wilson, B. A.; Bantia, S.; Salituro, G. M.; Holbrooks, A. McE.; Townsend, C. A. "Cell-Free Biosynthesis of Nocardicin A from Nocardicin E and *S*-Adenosylmethionine," *J. Am. Chem. Soc*. **1988**, *100*, 8238-8239.

51. Townsend, C. A.; Isomura, Y.; Davis, S. G. "Reaction Models of the Oxidative Rearrangement of Averufin to 1'-Hydroxyversicolorone: The First Step in Dihydrobisfuran Formation in Aflatoxin Biosynthesis," A Symposium-in-Print, *Tetrahedron* **1989**, *45*, 2263-2276.

52. Krol, W. J.; Basak, A.; Salowe, S. P.; Townsend, C. A. "Oxidative Cyclization Chemistry Catalyzed by Clavaminate Synthetase," *J. Am. Chem. Soc*. **1989**, *111*, 7625-7627.

53. Graybill, T. L.; Pal, K.; McGuire, S. M.; Brobst, S. W.; Townsend, C. A. "The Timing of Aromatic Deoxygenation in Aflatoxin Biosynthesis," *J. Am. Chem. Soc.* **1989**, *111*, 8306-8308.

54. McGuire, S. M.; Brobst, S. W.; Graybill, T. L.; Pal, K.; Townsend, C. A. "Partitioning of Tetrahydro- and Dihydrobisfuran Formation in Aflatoxin Biosynthesis by Cell-Free and Direct Incorporation Experiments," *J. Am. Chem. Soc.* **1989**, *111*, 8308-8309.

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56. Basak, A.; Salowe, S. P.; Townsend, C. A. "Stereochemical Course of the Key Ring-Forming Reactions in Clavulanic Acid Biosynthesis," *J. Am. Chem. Soc*., **1990**, *112*, 1654-1656.

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58. De Voss, J. J.; Hangeland, J. J.; Townsend, C. A. "Characterization of the *in vitro* Cyclization Chemistry of Calicheamicin and its Relation to DNA Cleavage," *J. Am. Chem. Soc*., **1990**, *112*, 4554-4556.

59. De Voss, J. J.; Townsend, C. A.; Ding, W.-D.; Morton, G. O.; Ellestad, G. A.; Zein, N.; Tabor, A. B.; Schreiber, S. L. "Site-Specific Atom Transfer From DNA to a Bound Ligand Defines the Geometry of a DNA-Calicheamicin □$_1$ Complex," *J. Am. Chem. Soc*. **1990**, *112*, 9669-9670.

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61. Salowe, S. P.; Krol, W. J.; Iwata-Reuyl, D.; Townsend, C. A. "Elucidation of the Order of Oxidations and Identification of an Intermediate in the Multi-Step Clavaminate Synthase Reaction," *Biochemistry* **1991**, *30*, 2281-2292.

62. Townsend, C. A.; Basak, A. "Experiments and Speculations on the Role of Oxidative Cyclization Chemistry in Natural Product Biosynthesis," A Symposium-in-Print, *Tetrahedron* **1991**, *47*, 2591-2602.

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64. Townsend, C. A.; McGuire, S. M.; Brobst, S. W.; Graybill, T. L.; Pal, K.; Barry III, C. E. "Examination of Tetrahydro- and Dihydrobisfuran Formation in Aflatoxin Biosynthesis from Whole Cells to Purified Enzymes." In *ACS Symposium Series, Secondary-Metabolite Biosynthesis and Metabolism*; Petroski, R. J.; McCormick, S. P., Eds.; Plenum Press: New York, 1992; pp. 141-154.

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