

## Christopher Walsh

Adjunct Professor

Chemistry

### Bio

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#### BIO

Christopher Walsh is a consulting professor to the Stanford University Department of Chemistry and an advisor to the Stanford ChEM-H institute. He was the Hamilton Kuhn Professor of Biological Chemistry and Molecular Pharmacology at Harvard Medical School from 1987 to 2013, when he took emeritus status. He has had extensive academic leadership experience, including Chairmanship of the MIT Chemistry Department and of the HMS Biological Chemistry & Molecular Pharmacology Department, as well as serving as President and CEO of the Dana Farber Cancer Institute. At Stanford he has taught short courses including Posttranslational Modifications of Proteins: Expanding Nature's Inventory (Chem 187/287) and also Antibiotics: Mechanisms and Resistance.

Dr. Walsh's research has focused on enzymes and enzyme inhibitors, with specialization on antibiotics and biosynthesis of other biologically and medicinally active natural products. He and his group authored 810 research papers, and four books: Enzymatic Reaction Mechanisms (1979); Antibiotics: Origins, Actions, Resistance (2003); Posttranslational Modification of Proteins: Expanding Nature's Inventory (2005); and Antibiotics: Challenges, Mechanisms, Opportunities (2016).

Dr. Walsh is a member of the U.S. National Academy of Sciences, the U.S. National Academy of Medicine, the American Academy of Arts and Sciences, the American Philosophical Society, and a co-recipient of the 2010 Welch Prize in Chemistry. At Harvard and MIT he taught biochemistry, chemical biology, and pharmacology to medical students and graduate students and organic chemistry to undergraduates.

He has been involved in a variety of venture-based biotechnology companies since 1981, including Genzyme, Immunogen, Leukosite, Millenium, Kosan, Vicuron, Epizyme. Currently he is on the board of directors of Ironwood, and Proteostasis, and the non profits: California Institute for Biomedical Research and Ludwig Institute for Cancer Research. He is a member of the scientific advisory groups at Hua, Abide, Cidara, and Flex Pharma, an advisor to Health Care Ventures and a limited investor in Health Care Ventures, MPM bioventures, Clarus, and the Longwood Venture Funds.

Dr. Walsh is married to Diana Chapman Walsh, who was president of Wellesley College from 1993-2007 and was the founding chair of the board of the Broad Institute of MIT and Harvard. Their daughter Allison Walsh Kurian is an Associate Professor of Medicine at Stanford and co-director of the High Risk Center for women with genetic predisposition to breast and ovarian cancer.

#### ACADEMIC APPOINTMENTS

- Adjunct Professor, Chemistry

#### ADMINISTRATIVE APPOINTMENTS

- Emeritus Faculty, Harvard Medical School, (2014- present)
- Member, Stanford Chem-H, (2013- present)
- Scientific Advisory Board Member, The Stanley Center, Broad Institute of Harvard and MIT, (2010- present)

- Senior Associate Member, The Broad Institute of Harvard and MIT, (2010- present)
- President, Dana-Farber Cancer Institute, (1992-1995)
- Hamilton Kuhn Professor of Biological Chemistry and Molecular Pharmacology, Harvard Medical School, (1991-2014)
- Chairman, Department of Biological Chemistry and Molecular Pharmacology, Harvard Medical School, (1987-1987)
- Karl Taylor Compton Professor, Massachusetts Institute of Technology, (1985-1987)
- Chairman, Chemistry Department, Massachusetts Institute of Technology, (1982-1987)
- Uncas and Helen Whitaker Professor, Massachusetts Institute of Technology, (1980-1985)
- Assistant, Associate and Full Professor of Chemistry and Biology, Massachusetts Institute of Technology, (1972-1987)

## HONORS AND AWARDS

- Honorary Doctoral Degree, The Scripps Research Institute (2017)
- Benjamin Franklin Medal in Chemistry, The Franklin Institute (2014)
- Gordon Hammes Lecture, American Chemical Society Division of Biological Chemistry (2013)
- Inhoffen Medal for Natural Products Chemistry, Helmholtz Centre for Infection Research and the Technical University of Braunschweig, Germany (2013)
- Keynote Lecture, Interscience Conference on Antimicrobial Agents and Chemotherapy (2012)
- Max Tishler Prize Lecture, Harvard University Department of Chemistry and Chemical Biology (2012)
- Co-recipient, Welch Award in Chemistry, The Welch Foundation (2010)
- Pauling Medal and Lecture, Stanford University School of Medicine (2010)
- Ian Scott Medal, Texas A&M University (2009)
- Whelan Medal, University of Chicago (2008)
- Murray Goodman Award, American Chemical Society (2007)
- Fritz Lipmann Medal, American Society for Biochemistry and Molecular Biology (2005)
- Promega Award, American Society of Microbiology (2004)
- Bader Award, Bioorganic Chemistry, American Chemical Society (2003)
- Member, American Philosophical Society (2003)
- Repligen Award, Chemistry of Life Processes, American Chemical Society (1999)
- Arthur C. Cope Scholar Award, American Chemical Society (1998)
- Remsen Award, American Chemical Society, Maryland section (1993)
- Member, National Academy of Sciences (1989)
- Member, Institute of Medicine (1989)
- Member, American Academy of Arts and Sciences (1988)
- Centenary Medal & Lectureship, Royal Society of Chemistry (1987)
- Eli Lilly Award in Biochemistry, American Chemical Society Division of Biological Chemistry (1979)
- Dreyfus Teacher-Scholar Grant, Camille & Henry Dreyfus Foundation (1976)
- Sloan Fellow, Alfred P. Sloan Foundation (1975)

## BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Advisory Board Member, MPM Capital, Clarus Ventures, Health Care Ventures
- Member, Board of Directors, Leukosite, Diacrin, Critical Therapeutics, Vicuron
- Member, Board of Directors, Transform Pharmaceuticals, Kosan Biosciences, Magen Biosciences, Achaogen

- Scientific Advisory Board Member, Millennium Pharmaceuticals, Dyax, Caliper, LS9, Sirtris, Epizyme, Verastem
- Scientific Advisory Board Member, Hua, Abide, Flex Pharma, Cidara
- Scientific Advisory Board Member, Immunogen, Genzyme, Cambridge Neurosciences, Epix Medical
- Chair and Member, Board of Directors, California Institute of Biomedical Research (Calibr) Scientific Advisory Board (2012 - present)
- Member, Board of Scientific Governors, The Scripps Research Institute (2012 - 2014)
- Member, Scientific Advisory Board, The Ludwig Cancer Institute (2011 - present)
- Member, Board of Directors, Proteostasis (2009 - present)
- Consultant, Eisai (2008 - 2013)
- Editorial Board Member, ACS Chemical Biology (2005 - 2015)
- Member, Board of Directors, Ironwood Pharmaceuticals (2003 - present)
- Editorial Board Member, Editorial Board Member (2003 - 2007)
- Member, Board of Directors, Helen Hay Whitney Foundation (2001 - 2011)
- Member, Board of Reviewing Editors, Science (2001 - 2006)
- Editorial Board Member, ChemBioChem (2000 - present)
- Scientific Review Group Member, Howard Hughes Medical Institute (2000 - 2013)
- Member, Board of Directors, Whitehead Institute (1998 - 2004)
- Member, NIH General Medical Sciences Advisory Council (1996 - 1999)
- Consultant, Abbott (1996 - 1997)
- Editorial Board Member, Chemistry and Biology (1993 - present)
- Member, Board of Directors, Association of American Cancer Institutes (1993 - 1996)
- Advisory Committee Member, Cardiovascular Research Center, MGH (1991 - 1994)
- Editorial Board Member, Journal of the American Chemical Society (1991 - 1994)
- Associate Editor, Protein Science (1991 - 1992)
- Scientific Advisory Board Member, Burroughs Wellcome Fund in Experimental Therapeutics (1991 - 1992)
- Associate Editor, Annual Review of Biochemistry (1990 - 1995)
- Scientific Advisory Committee Member and Chairman, Children's Hospital (1988 - 1992)
- Member, Visiting Committee in Biological Sciences, Yale University (1985 - 1988)
- Member, Visiting Committee in Chemistry, Princeton University (1984 - 1986)
- Co-chairman, Conference on Methanogenesis (1984 - 1984)
- Consultant, Roche (1982 - 1995)
- Chair, NIH Study Section in Biochemistry (1982 - 1982)
- Panel Member, NIH Study Section in Biochemistry (1978 - 1982)
- Biology Section Editor, Annual Reports in Medicinal Chemistry (1978 - 1980)
- Editorial Board Member, Journal of Biological Chemistry (1978 - 1980)
- Co-chairman, Gordon Research Conference on Enzymes, Coenzymes, and Metabolic Pathways (1978 - 1978)
- Panel Member, NSF Research Grants Study (1977 - 1979)
- Consultant, Merck (1975 - 1982)

## PROFESSIONAL EDUCATION

- Postdoc, Brandeis University , Biochemistry (1972)

- PhD, The Rockefeller University , Life Sciences (1970)
- BA, Harvard College , Biology (1965)

## Teaching

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### STANFORD ADVISEES

#### Doctoral Dissertation Reader (NonAC)

Daniel Mokhtari

## Publications

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### PUBLICATIONS

- **Biologically generated carbon dioxide: nature's versatile chemical strategies for carboxy lyases** *NATURAL PRODUCT REPORTS*  
Walsh, C. T.  
2020; 37 (1): 100–135
- **In Vitro Reconstitution of Metabolic Pathways: Insights into Nature's Chemical Logic.** *Synlett : accounts and rapid communications in synthetic organic chemistry*  
Lowry, B., Walsh, C. T., Khosla, C.  
; 26 (8): 1008–25
- **Chemical Biology: Here to Stay?** *ISRAEL JOURNAL OF CHEMISTRY*  
Walsh, C. T.  
2019; 59 (1-2): 7–17
- **Biologically generated carbon dioxide: nature's versatile chemical strategies for carboxy lyases.** *Natural product reports*  
Walsh, C. T.  
2019
- **Propofol: Milk of Amnesia.** *Cell*  
Walsh, C. T.  
2018
- **Nature Builds Macrocycles and Heterocycles into Its Antimicrobial Frameworks: Deciphering Biosynthetic Strategy.** *ACS infectious diseases*  
Walsh, C. T.  
2018
- **Recent Advances in Enzymatic Complexity Generation: Cyclization Reactions.** *Biochemistry*  
Walsh, C. T., Tang, Y.  
2018; 57 (22): 3087–3104
- **Eight Kinetically Stable but Thermodynamically Activated Molecules that Power Cell Metabolism (vol 118, pg 1460, 2018)** *CHEMICAL REVIEWS*  
Walsh, C. T., Tu, B. P., Tang, Y.  
2018; 118 (10): 5261–63
- **Eight Kinetically Stable but Thermodynamically Activated Molecules that Power Cell Metabolism** *CHEMICAL REVIEWS*  
Walsh, C. T., Tu, B. P., Tane, Y.  
2018; 118 (4): 1460–94
- **Enzymatic Cascade Reactions in Biosynthesis.** *Angewandte Chemie (International ed. in English)*  
Walsh, C. T., Moore, B. S.  
2018
- **Are highly morphed peptide frameworks lurking silently in microbial genomes valuable as next generation antibiotic scaffolds?** *Natural product reports*  
Walsh, C. T.  
2017

- **Oxidative Cyclization in Natural Product Biosynthesis** *CHEMICAL REVIEWS*  
Tang, M., Zou, Y., Watanabe, K., Walsh, C. T., Tang, Y.  
2017; 117 (8): 5226-5333
- **Structure-Activity Relationship and Molecular Mechanics Reveal the Importance of Ring Entropy in the Biosynthesis and Activity of a Natural Product.** *Journal of the American Chemical Society*  
Tran, H. L., Lexa, K. W., Julien, O., Young, T. S., Walsh, C. T., Jacobson, M. P., Wells, J. A.  
2017; 139 (7): 2541-2544
- **At the Intersection of Chemistry, Biology, and Medicine.** *Annual review of biochemistry*  
Walsh, C. T.  
2017
- **Oxidative Cyclization in Natural Product Biosynthesis.** *Chemical reviews*  
Tang, M., Zou, Y., Watanabe, K., Walsh, C. T., Tang, Y.  
2016
- **Insights into the chemical logic and enzymatic machinery of NRPS assembly lines.** *Natural product reports*  
Walsh, C. T.  
2016; 33 (2): 127-135
- **A chemocentric view of the natural product inventory** *NATURE CHEMICAL BIOLOGY*  
Walsh, C. T.  
2015; 11 (9): 620-624
- **Minimum Information about a Biosynthetic Gene cluster** *NATURE CHEMICAL BIOLOGY*  
Medema, M. H., Kottmann, R., Yilmaz, P., Cummings, M., Biggins, J. B., Blin, K., de Bruijn, I., Chooi, Y. H., Claesen, J., Coates, R. C., Cruz-Morales, P., Duddela, S., Duesterhus, et al  
2015; 11 (9): 625-631
- **Nature loves nitrogen heterocycles** *TETRAHEDRON LETTERS*  
Walsh, C. T.  
2015; 56 (23): 3075-3081
- **In Vitro Reconstitution of Metabolic Pathways: Insights into Nature's Chemical Logic** *SYNLETT*  
Lowry, B., Walsh, C. T., Khosla, C.  
2015; 26 (8): 1008-1025
- **Biological matching of chemical reactivity: pairing indole nucleophilicity with electrophilic isoprenoids.** *ACS chemical biology*  
Walsh, C. T.  
2014; 9 (12): 2718-2728
- **Blurring the Lines between Ribosomal and Nonribosomal Peptide Scaffolds** *ACS CHEMICAL BIOLOGY*  
Walsh, C. T.  
2014; 9 (8): 1653-1661
- **Assembly line polyketide synthases: mechanistic insights and unsolved problems.** *Biochemistry*  
Khosla, C., Herschlag, D., Cane, D. E., Walsh, C. T.  
2014; 53 (18): 2875-2883
- **Prospects for new antibiotics: a molecule-centered perspective** *JOURNAL OF ANTIBIOTICS*  
Walsh, C. T., Wencewicz, T. A.  
2014; 67 (1): 7-22
- **Nonproteinogenic Amino Acid Building Blocks for Nonribosomal Peptide and Hybrid Polyketide Scaffolds** *ANGEWANDTE CHEMIE-INTERNATIONAL EDITION*  
Walsh, C. T., Brien, R. V., Khosla, C.  
2013; 52 (28): 7098-7124
- **Nonproteinogenic amino acid building blocks for nonribosomal peptide and hybrid polyketide scaffolds.** *Angewandte Chemie (International ed. in English)*

- Walsh, C. T., O'Brien, R. V., Khosla, C.  
2013; 52 (28): 7098-7124
- **Short Pathways to Complexity Generation: Fungal Peptidyl Alkaloid Multicyclic Scaffolds from Anthranilate Building Blocks** *ACS CHEMICAL BIOLOGY*  
Walsh, C. T., Haynes, S. W., Ames, B. D., Gao, X., Tang, Y.  
2013; 8 (7): 1366-1382
  - **The posttranslational modification cascade to the thiopeptide berninamycin generates linear forms and altered macrocyclic scaffolds** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Malcolmson, S. J., Young, T. S., Ruby, J. G., Skewes-Cox, P., Walsh, C. T.  
2013; 110 (21): 8483-8488
  - **Flavoenzymes: versatile catalysts in biosynthetic pathways.** *Natural product reports*  
Walsh, C. T., Wencewicz, T. A.  
2013; 30 (1): 175-200
  - **Identification and Characterization of the Echinocandin B Biosynthetic Gene Cluster from *Emericella rugulosa* NRRL 11440** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Cacho, R. A., Jiang, W., Chooi, Y., Walsh, C. T., Tang, Y.  
2012; 134 (40): 16781-16790
  - **CD and MCD of CytC3 and taurine dioxygenase: Role of the facial triad in alpha-KG-dependent oxygenases** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Neidig, M. L., Brown, C. D., Light, K. M., Fujimori, D. G., Nolan, E. M., Price, J. C., Barr, E. W., Bollinger, J. M., Krebs, C., Walsh, C. T., Solomon, E. I.  
2007; 129 (46): 14224-14231
  - **Probing intra- versus interchain kinetic preferences of L-Thr acylation on dimeric VibF with mass spectrometry** *BIOPHYSICAL JOURNAL*  
Hicks, L. M., Balibar, C. J., Walsh, C. T., Kelleher, N. L., Hillson, N. J.  
2006; 91 (7): 2609-2619
  - **Reconstitution and characterization of a new desosaminyl transferase, EryCIII, from the erythromycin biosynthetic pathway** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Lee, H. Y., Chung, H. S., Hang, C., Khosla, C., Walsh, C. T., Kahne, D., Walker, S.  
2004; 126 (32): 9924-9925
  - **A switch for the transfer of substrate between nonribosomal peptide and polyketide modules of the rifamycin synthetase assembly line** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Admiraal, S. J., Khosla, C., Walsh, C. T.  
2003; 125 (45): 13664-13665
  - **Biosynthesis of yersiniabactin, a complex polyketide-nonribosomal peptide, using *Escherichia coli* as a heterologous host** *APPLIED AND ENVIRONMENTAL MICROBIOLOGY*  
Pfeifer, B. A., Wang, C. C., Walsh, C. T., Khosla, C.  
2003; 69 (11): 6698-6702
  - **Engineered biosynthesis of an ansamycin polyketide precursor in *Escherichia coli*** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Watanabe, K., Rude, M. A., Walsh, C. T., Khosla, C.  
2003; 100 (17): 9774-9778
  - **Epothilone C macrolactonization and hydrolysis are catalyzed by the isolated thioesterase domain of epothilone polyketide synthase** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*  
Boddy, C. N., Schneider, T. L., Hotta, K., Walsh, C. T., Khosla, C.  
2003; 125 (12): 3428-3429
  - **The loading and initial elongation modules of rifamycin synthetase collaborate to produce mixed aryl ketide products-1** *BIOCHEMISTRY*  
Admiraal, S. J., Khosla, C., Walsh, C. T.  
2002; 41 (16): 5313-5324
  - **Molecular cloning and sequence analysis of the complestatin biosynthetic gene cluster** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*

Chiu, H. T., Hubbard, B. K., Shah, A. N., Eide, J., Fredenburg, R. A., Walsh, C. T., Khosla, C.  
2001; 98 (15): 8548-8553

- **The loading module of rifamycin synthetase is an adenylation-thiolation didomain with substrate tolerance for substituted benzoates** *BIOCHEMISTRY*  
Admiraal, S. J., Walsh, C. T., Khosla, C.  
2001; 40 (20): 6116-6123
- **Predicting microbial biodegradation pathways** *ASM NEWS*  
Wackett, L. P., Ellis, L. B., Speedie, S. M., Hershberger, C. D., Knackmuss, H. J., Spormann, A. M., Walsh, C. T., Forney, L. J., Punch, W. F., Kazic, T., Kanehisa, M., Berndt, D. J.  
1999; 65 (2): 87-93
- **Biochemistry - Harnessing the biosynthetic code: Combinations, permutations, and mutations** *SCIENCE*  
Cane, D. E., Walsh, C. T., Khosla, C.  
1998; 282 (5386): 63-68
- **Utilization of enzymatically phosphopantetheinylated acyl carrier proteins and acetyl-acyl carrier proteins by the actinorhodin polyketide synthase** *BIOCHEMISTRY*  
Carreras, C. W., Gehring, A. M., Walsh, C. T., Khosla, C.  
1997; 36 (39): 11757-11761
- **Ability of Streptomyces spp acyl carrier proteins and coenzyme A analogs to serve as substrates in vitro for E-coli holo-ACP synthase** *CHEMISTRY & BIOLOGY*  
Gehring, A. M., Lambalot, R. H., Vogel, K. W., Drucekhammer, D. G., Walsh, C. T.  
1997; 4 (1): 17-24