JEFFREY I. SEEMAN, B.S., Ph.D.

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Curriculum Vitae

Educational Summary

Institution	Place	Date	Degree/Position
Stevens Institute of Technology	Hoboken, NJ	1963-1967	B.S. with High Honors
University of California	Berkeley, CA	1967-1971	Ph.D., Chemistry
National Institutes of Health	Bethesda, MD	1971-1973	Staff Fellow
University of Oxford, Dyson Perrins Laboratory	Oxford, England	1983-1984	Visiting Professor

Professional Positions

2007-Present	Visiting Senior Research Scientist, Department of Chemistry, University of Richmond
1999-Present	Principal, SaddlePoint Frontiers, Richmond, VA
1999-2014	Senior Fellow, Chemical Heritage Foundation
2002-2005	Adjunct Research Associate Professor, Virginia Tech, Blacksburg, VA
1998-1999	Fellow, Worldwide Scientific Affairs, Philip Morris U.S.A.
1997-Present	Producer, Video Products for Science and Education
1996-1998	Associate Principal Scientist, Philip Morris U.S.A
1995	Leader of Technology Assessment, Philip Morris U.S.A.
1993-1995	Leader of Technology and Operational Planning, Philip Morris U.S.A.
1991-1993	Section Leader, Philip Morris U.S.A.
1979-1996	Senior Scientist, Philip Morris U.S.A.
1973-1979	Research Scientist, Philip Morris U.S.A.
Summer, 1967	International Flavors & Fragrances, Union Beach, NJ

Selected Additional Positions

2013- Present	Editorial Board, *Accountability in Research*
2012-2015	Guest Editor, *The Chemical Record*
2009-2012	Consultant to the U.S. Postal Service on stamps in the American Scientist series
2008-2014	Member, Board of Directors, Chemical Heritage Foundation
2008-2014	Chair, Heritage Council, Chemical Heritage Foundation
2007-2014	Member, Heritage Council, Chemical Heritage Foundation
2008-2009	Centennial Perspectives Editor, *Journal of Organic Chemistry*
2007-2008	Immediate Past Chair, Division of the History of Chemistry, American Chemical Society
2005-2006	Chair, Division of History of Chemistry, American Chemical Society
2003-2004	Chair Elect, Division of History of Chemistry, American Chemical Society
1997-1999	Associate, Committee on Science, American Chemical Society
1990-1996	*Journal of Organic Chemistry*, Editorial Advisory Board
1990-1996	Petroleum Research Fund, Advisory Board

Awards

2011	Fellow, American Chemical Society
2017	Wheeler Bequest Award, Historical Group, Royal Society of Chemistry, London
2017	HIST Award, Division of History of Chemistry of the American Chemical Society

Expert Witness

1999-Present

Has served as an expert and fact witness in a variety of legal proceedings. Has prepared expert reports and assisted in the development of cases and in the preparation of depositions and examinations of expert and fact witnesses. Expertise includes the following disciplines and areas of expertise in addition to the ability to communicate effectively and succinctly with attorneys and to juries.

<u>Disciplines: Organic chemistry, in general. Flavor chemistry.</u>

Areas of expertise: Consumer goods chemistry, food and flavor science (taste, odor, trigeminal), thermal and stability chemistry, pharmaceutical sciences, tobacco science, organic materials science, organic chemistry

<u>Disciplines: Responsible Conduct of Research, Ethics in Science, Scientific Integrity, Behavior of Scientists and the Practice of Science</u>

Areas of expertise: Sociology and history of science. Expertise in misconduct of science: "Fabrication, falsification plagiarism . . . or other serious deviations from accepted practices in preparing, carrying out, and reporting results from research activities . . . or retaliation of any kind against a person who reported or provided information about suspect or alleged misconduct and who has not acted in bad faith." See: *Federal Register* **56**: 22286 – 22290, May 14, 1991.

JEFFREY I. SEEMAN, Ph.D

PUBLICATIONS AND PATENTS

1. Photochemical Rearrangement of an Acyclic β,γ-Unsaturated Ketone to a Conjugated Cyclopropyl Ketone. An Oxa-di-π-methane Rearrangement, J. Am. Chem. Soc. **1970**, 92, 1786-1787 [with W. G. Dauben, M. S. Kellogg, and W. A. Spitzer].

2. Magnetic Circular Dichroism Investigations of Some Conjugated Olefins, J. Org. Chem. **1972**, 37, 1209-1212 [with W. G. Dauben, P. H. Wendschuh, G. Barth, E. Bunnenberg, and C. Djerassi].

3. Steric Aspects of the Photochemistry of Conjugated Dienes and Trienes, Pure Appl. Chem. **1973**, 33, 197-215 [with W. G. Dauben, M. S. Kellogg, N. D. Vietmeyer, and P. H. Wendschuh].

4. The Role of α-Cleavage in the Photochemistry of A-Homo-4A-cholestene-3-one. Structure Revision of Photoproducts, Tetrahedron Lett. **1973**, 4409-4412 [with H. Ziffer].

5. The Stereochemistry of the Oxa-di-π-methane Rearrangement, Tetrahedron Lett. **1973**, 4413-4416 [with H. Ziffer].

6. The Effect of α-Methyl Groups on the Photochemistry of 3,4,5,6,7,8-Hexahydronaphthalen-2(1H)-one, J. Am. Chem. Soc. **1974**, 96, 924-925 [with P. S. Engel, M. A. Schexnayder, and H. Ziffer].

7. On the Absolute Configuration of Two trans-p-Menthane-2,3-diols, J. Org. Chem. **1974**, 39, 2444-2445 [with H. Ziffer].

8. Carbon-13 Nuclear Magnetic Resonance Characteristics of 3-Methylcyclohexane-1,2-diols, J. Org. Chem. **1974**, 39, 3698-3701 [with H. Ziffer, R. J. Highet, and E. A. Sokoloski].

9. Excited State Properties of 3,4,5,6,7,8-Hexahydronaphthalen-2(1H)-one, Tetrahedron Lett. **1975**, 1157-1160 [with P. S. Engel, M. A Schexnayder, W. V. Phillips, and H. Ziffer].

10. Carbon-13 Nuclear Magnetic Resonance Relaxation in Hydrogen Bonded tert-Butyl Alcohol and Phenol, J. Phys. Chem. **1975**, 1005-1008 [with E. E. Tucker, T. R. Clem, and E. D. Becker].

11. A Synthesis and X-Ray Structure Determination of the Photoproducts of A-Homocholestan-3-one, J. Org. Chem. **1975**, 40, 3675-3680 [with T. Akiyama, D. Pedder, J. V. Silverton, and H. Ziffer].

12. The Configuration of Nicotine. A Nuclear Magnetic Resonance Study, J. Org. Chem. **1976**, 41, 1585-1590 [with J. F. Whidby].

13. Synthesis of 2,3-Disubstituted Pyridines. Ortho-Formylation and Ortho-Acylation of 2-Alkylpyridines, J. Org. Chem. **1976**, 2658-2659 [with E. B. Sanders and H. V. Secor].

14. The Iodomethylation of Nicotine. An Unusual Example of Competitive Nitrogen Alkylation, J.

Org. Chem. **1976**, 41, 3824-3826 [with J. F. Whidby].

15. Quaternary Ammonium Halides as Powerful Lanthanide Shift Donors, J. Org. Chem. **1977** 42, 2337-2339 [with R. L. Bassfield].

16. A New Pyrroline Synthesis. The Use of an N-Vinyl Moiety as an NH-Protecting Group, Synthesis, **1977**, 498-499.

17. Use of α-Cyano Amines for the Regiospecific Synthesis of Multisubstituted Pyridines. Preparation of Nicotine Analogues, J. Org. Chem. **1978**, 43, 324-330 [with E. B. Sanders and H. V. Secor].

18. Analytical Solution to the Curtin-Hammett/Winstein-Holness Kinetic System, J. Org. Chem. **1978**, 43, 1854-1864 [with W. A. Farone].

19. Menschutkin Reaction Stereoselectivities of Nicotine and Related Compounds, Tetrahedron Lett. **1978**, 1901-1904 [with H. V. Secor, J. F. Whidby, and R. L. Bassfield].

20. Assignment and Solvent Dependence of the Carbon-13 Nuclear Magnetic Resonance Spectrum of Nicotine, J. Heterocycl. Chem. **1978**, 15, 585-587 [with T. P. Pitner and J. F. Whidby].

21. Convenient Synthesis of N-CD_3 Labelled Nicotine and Nicotine Analogues, J. Labelled Compounds and Radiopharm. **1979**, 16, 387-395 [with H. V. Secor and G. Forrest].

22. 2-Alkyl Nicotinoids and Processes for their Production, U. S. Patent 4,155,909, **1979** [with E. B. Sanders and H. V. Secor].

23. Uses and Analyses of Curtin-Hammett/Winstein-Holness Systems Involving Second Order Reactions, Tetrahedron **1979**, 36, 1173-1177 [with E. B. Sanders and W. A. Farone].

24. Steric Effects in Conformationally Mobile Systems. The Iodomethylation of 1-Methyl-2-Arylpyrrolidines Related to Nicotine, J. Am. Chem. Soc. **1980**, 102, 7741-7747 [with H. V. Secor, H. Hartung, and R. Galzerano].

25. Processes for Preparing 2-Alkyl Nicotinoids, U.S. Patent 4,220,781, **1980** [with E. B. Sanders and H. V. Secor].

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28. Correlation of Nonadditive Kinetic Effects with MINDO/3 Derived Molecular Geometries, J. Am. Chem. Soc. **1981**, 103, 5982-5984 [with R. Galzerano, K. Curtis, J. C. Schug, and J. W. Viers].

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30. Smoking Compositions, U.S. Patent 4,312,367, **1982**.

31. The tert-Butylation of Nicotine: Novel Reaction Pathways and Racemization Studies, Tetrahedron Lett. **1982**, 2519-2522 [with C. G. Chavdarian].

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36. Organometallic Methylation of Nicotine and Nicotine N-Oxide. Reaction Pathways and Racemization Mechanisms, J. Org. Chem. **1983**, 48, 4899-4904 [with H. V. Secor, C. R. Howe, C. G. Chavdarian, and L. W. Morgan].

37. Correlation of Nonadditive Kinetic Effects with Molecular Geometries. Structure and Reactivity of Alkyl- and Cycloalkenylpyridines, J. Am. Chem. Soc. **1984**, 106, 143-151 [with J. W. Viers, J. C. Schug, and M. D. Stovall].

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39. Rules Governing Asymmetric Synthesis with Organotransition Metal Complexes, Tetrahedron Lett. **1984**, 1845-1848 [with S. G. Davies].

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41. Conformational Analysis of Allylamine. An Ab Initio Molecular Orbital Study, J. Computational Chem. **1984**, 5, 200-206 [with J. Kao].

42. Application of Linear Free Energy Relationships to the Curtin-Hammett Principle: Correlation Between Conformational Equilibrium, Chemical Reactivity, and Product Ratios, J. Org. Chem. **1984**, 49, 2887-2891 [with C. L. Perrin].

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47. On the Conjugative Isomerizations of β,γ-Unsaturated Esters. Stereochemical Generalizations and Predictions for 1,3-Prototropic Shifts under Basic Conditions, J. Org. Chem. **1985**, 50, 3526-3535 [with S. G. Alcock, J. E. Baldwin, R. Bohlmann, and L. M. Harwood].

48. Nicotine Chemistry. The Reaction of Alkyl Radicals with Nicotine: Synthesis of Optically Active 6-Alkylnicotines, Synthesis **1985**, 953-955 [with H. V. Secor and L. Clawson].

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55. The Curtin-Hammett Principle and the Winstein-Holness Equation. New Definition and Recent Extensions to Classical Concepts, J. Chem. Ed. **1986**, 63, 42-48.

56. The Preparation of Hydroxyalkyl-Substituted Nicotinoids, J. Org. Chem. **1986**, 51, 1548-1551 [with C. G. Chavdarian, H. V. Secor, and T. S. Osdene].

57. The Preparation of "Elongated" Nicotine Analogues, Heterocycles **1986**, 24, 1687-1698 [with H. V. Secor].

58. Torsional Motion in Aromatic Molecules. Conformational Analysis of Methyl-, Ethyl-, and n-Propylbenzenes, J. Am. Chem. Soc. **1987**, 109, 3453-3455 [with P. J. Breen, J. A. Warren, and

E. R. Bernstein].

59. Recent Studies on Conformational Analysis and Steric Effects, Pure Appl. Chem. **1987**, 59, 1661-1672.

60. Steric Effects on Pyrolysis Reactions. The Thermal Retro-ene Reaction of Pyrazineethanols, J. Org. Chem. **1987**, 52, 3971-3974 [with Y. Houminer, R. A. Fenner, and H. V. Secor].

61. A Study of Non-Rigid Aromatic Molecules by Supersonic Molecular Jet Spectroscopy. I. Toluene and the Xylenes, J. Chem. Phys. **1987**, 87, 1917-1926 [with P. J. Breen, J. A. Warren, and E. R. Bernstein].

62. A Study of Non-Rigid Aromatic Molecules by Supersonic Molecular Jet Spectroscopy. II. Propyltoluenes, J. Chem. Phys. **1987**, 87, 1927-1935 [with P. J. Breen, J. A. Warren, and E. B. Bernstein].

63. Supersonic Molecular Jet Spectroscopy of Diethylbenzene and Ethyltoluene, J. Chem. Phys. **1987**, 87, 3269-3275 [with P. J. Breen and E. R. Bernstein].

64. Enantiomeric Resolution of Nicotine and Nicotine Analogues by Microcolumn Liquid Chromatography with β-Cyclodextrin Inclusion Complexes, J. Chromat. **1987**, 411, 490-493 [with D. W. Armstrong, L. A. Spino, S. M. Han, and H. V. Secor].

65. Observation and Geometry Assignment of Individual Conformations of Aryl Methyl Ethers in the Gas Phase, J. Chem. Soc., Chem. Commun. **1988**, 393-395 [with H. V. Secor, P. J. Breen, and E. R. Bernstein].

66. Chemical Reactions in Isolated Clusters: Excited State Electron Transfer in 3- and 4-Dimethylaminobenzonitrile, J. Chem. Phys. **1988**, 88, 871-878 [with J. A. Warren and E. R. Bernstein].

67. Enantiomeric Resolution and Chiral Recognition of Racemic Nicotine and Nicotine Analogues by β-Cyclodextrin Complexation. Structure-Enantiomeric Resolution Relationships in Host-Guest Interactions, Anal. Chem. **1988**, 60, 2120-2127 [with H. V. Secor, D. W. Armstrong, K. D. Timmons, and T. J. Ward].

68. Observation and Geometry Assignment of Conformation of Styrenes in the Ground and First Excited Singlet State, J. Am. Chem. Soc. **1988**, 110, 8542-8543 [with V. H. Grassian and E. R. Bernstein].

69. Observation and Geometry Assignemnt of the Minimum Energy Conformations of Methoxy-Substituted Benzenes, J. Am. Chem. Soc. **1989**, 111, 1958-1968 [with P. J. Breen, E. R. Bernstein, and H. V. Secor].

70. A Conformational Study of Jet-Cooled Styrene Derivatives. Demonstration of the Planarity of Sterically Unhindered Styrenes, J. Phys. Chem. **1989**, 93, 3470-3474 [with V. H. Grassian, E. R. Bernstein, and H. V. Secor].

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72. The Perceptual Similarity of Alkyl Substituted Benzenes and Pyridines as a Function of Steric Hindrance, Chem. Senses **1989**, 14, 395-405 [with D. M. Ennis, H. V. Secor, L. Clawson, and J. Palen].

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74. Separation of Homologous and Isomeric Alkaloids Related to Nicotine on a β-Cyclodextrin Bonded Phase, J. Chromatography **1989**, 483, 169-177 [with H. V. Secor, D. W. Armstrong, K. D. Ward, and T. J. Ward].

75. Observation and Geometry Assignment of Conformations of Benzyl Alcohol in the Gas Phase, J. Chem. Soc., Chem. Commun. **1990**, 87-89 [with H. V. Secor, H.-S. Im, and E. R. Bernstein].

76. Extracting the Essence. Adventures of the Editor Who Guided a [Auto]biographical **tour de force**, CHEMTECH **1990**, 20, 86-90. [This article was reprinted in The Stevens Indicator **1990**, No. 3, 14-17.]

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78. Spectroscopy and Structure of Jet-Cooled α-Methylstyrene, J. Phys. Chem. **1990**, 94, 6691-6695 [with V. H. Grassian, E. R. Bernstein, and H. V. Secor].

79. Spectroscopic Observation of Individual sp^3-Nitrogen Stereoisomers. Supersonic Jet Studies of 2-Aminobenzyl Alcohol, J. Am. Chem. Soc. **1990**, 112, 7073-7074 [with H. V. Secor, H.-S. Im and E. R. Bernstein].

80. Capillary Gas Chromatographic Separation of Enantiomers with a Stable Dialkyl α-, β-, and γ-Cyclodextrin Derivatized Stationary Phases, Anal. Chim. Acta **1990**, 234, 365-380 [with D. W. Armstrong, W. Li, A. Stalcup, H. V. Secor, and R. R. Izac].

81. Nicotine Analogs, U.S. Patent 5,015,741, May 14, 1991 [with T. S. Osdene and H. V. Secor].

82. The Ups and Downs of a 22-Volume Series, Publications Quarterly (American Chemical Society, Washington, D.C.) **1991**, 3, 3.

83. Supersonic Jet Studies of Benzyl Alcohols: Minimum Energy Conformations and Torsional Motion, J. Am. Chem. Soc. **1991**, 113, 4422-4431 [with H.-S. Im, E. R. Bernstein, and H. V.

Secor].

84. Supersonic Jet Studies of Ethoxybenzenes: Geometry of their Mininum Energy Conformations, Spectroscopy and Structure of Jet-Cooled Ethoxybenzenes, J. Org. Chem. **1991**, 56, 6059-6063 [with E. R. Bernstein, H.-S. Im, M. Young, R. L. Bassfield and H. V. Secor].

85. Supersonic Jet Studies of Benzylamines: Geometry of their Mininum Energy Conformations, Tetrahedron Lett. **1991**, 3945-3948 [with E. R. Bernstein, H.-S. Im, and H. V. Secor].

86. Smoking Compositions Containing a Heteroaromatic Flavorant-Release Additive, U.S. Patent 5 080 719, January 14, 1992 [with Y. Houminer and H. V. Secor].

87. Supersonic Jet Studies of Alkyl-Substituted Pyrazines and Pyridines. Minimum Energy Conformations and Torsional Motions, J. Am. Chem. Soc. **1992**, 114, 5269-5280 [with J. B. Paine, III, H. V. Secor, H.-S. Im, and E. R. Bernstein].

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89. Letter to the Editor: "Isotopomers, Isotopologs," Chemical & Engineering News, (American Chemical Society, Washington, D. C.) **December 7, 1992**, 2 [with J. B. Paine, III].

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94. Minimum Energy Conformation of Ortho-Xylene in its First and Excited Electronic States, J. Chem. Phys. **1992**, 97, 8130-8136 [with R. Disselkamp, E. R. Bernstein, and H. V. Secor]

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the Presence of TMEDA, Tetrahedron Lett. **1994**, 35(41), 8027-8031 [with L. M. Harwood, Y. Houminer, and A. Manage].

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"In the Pursuit of Discovery," 15-minute, major documentary video interviews.

1. Derek H. R. Barton, 1997.
2. Carl Djerassi, 1997.
3. Koji Nakanishi, 1997.
4. Gilbert Stork, 1997.
5. Marye Anne Fox, 1999.
6. Dudley Herschbach, 1999.

Brief video interviews:

1. Ernest L. Eliel, 1999.
2. William von Eggers Doering, 1999.
3. Frank Westheimer, 1999.
4. Cynthia Friend, 1999.
5. David Evans, 1999.
6. William Lipscomb, 1999.

"Arnold O. Beckman. One Hundred Years of Excellence" for the Chemical Heritage Foundation. (April 2000)

This 14-minute video provides a sensitive overview of the life of Dr. Arnold O. Beckman. Archival film and video interviews Dr. Beckman, conducted from the early 1950's to the early 1990's, are combined with many family and historical photographs to provide insights into the achievements of this famous inventor, businessman and philanthropist. Dr. Beckman talks about his early life, his marriage to Mabel, and his philosophies of inventing, education, and life. His grandson, Arne Beckman, narrates the production. This video is available on CD-ROMs and is included in the biography of Dr. Beckman, "One Hundred Years of Excellence. A Profile of Arnold O. Beckman," written by Drs. Arnold Thackray and Minor Myers, Jr and published by the Chemical Heritage Foundation.

"In the Pursuit of Excellence" for Imperial College of Science, Technology and Medicine (London) (July 2000)

This seven-minute video provides an overview of the educational opportunities and experiences for graduate students and postdoctoral students at the Department of Chemistry, Imperial College of Science, Technology and Medicine. Featured are interviews with faculty and students.

VIDEO PRODUCTIONS

(Continued)

"Excellence, Excitement and Energy. Chemistry at Emory" (August 2001)

This seven-minute video provides an overview of the educational opportunities and experiences for graduate students and postdoctoral students at the Department of Chemistry, Emory University. Featured are interviews with faculty and students.

"Creating a Difference. Inspirations of Cherry Logan Emerson" for Emory University (August 2001)

This eight-minute video celebrates the dedication of Emory University's new chemistry building with a focus on the philanthropist whose generosity made the new building possible.

"The Quest to Cure Malaria" for The Johns Hopkins School of Public Health (January 2002)

A 15-minute video describes the country's World War II urgent need and scientific and technical program to develop a new antimalarial drug. This effort, The Survey of Antimalarial Drugs, was centered at Johns Hopkins University. Chloroquine, the antimalarial drug of choice for many decades, was discovered. Current state-of-the-art malarial research is also discussed by some of the world's leaders in this field.

"From Genes to the Whole Animal. The Excitement of Ideas" for the VCU Medical Center, Virginia Commonwealth University (2005)

This nine-minute video provides an overview of the educational opportunities and experiences for graduate students and postdoctoral students at the Department of Pharmacology and Toxicology, Virginia Commonwealth University. Featured are interviews with faculty and students. The video is on the Department web site.: http://www.vcu.edu/pharmtox/articulate/dept/index.html.

Improving Science Literacy. Self-Discovery and Self-Learning (2008-present)

See: www.archimedesinitiative.org

This series of 17 five-minute videos, funded by the Camille & Henry Dreyfus Foundation, focusing on high school science fairs was produced. The target audience is upper-middle school and high school students. Each theme video centers on a specific aspect of producing a science

fair project, including hypothesis development, experimental design, data collection, data analysis, and conclusions. The videos will encourage youth to consider doing a chemistry science fair project and will provide a framework and a step-by-step process upon which to execute and enjoy doing the project. The students will see and hear other youth who "look just like them" explaining with excitement their chemistry science fair projects. The students will learn substantive chemistry concepts and ideas from the dynamic, world renowned chemist Dudley Herschbach (1986 Nobel Prize in Chemistry) who will narrate the videos. The students will have a visual connection to the "doing" of a science fair project.

Eminent Organic Chemists (2008-present)

A series of video interviews of eminent organic chemists. These chemists talk about their research, their careers, their philosophies and life experiences.

For the Division of Organic Chemistry of the American Chemical Society.

See: http://www.layingthegroundwork.com/chemists/

Women Chemists in the National Inventors Hall of Fame (2010)

A series of video interviews of women chemists in the National Inventors Hall of Fame. These chemists and historians of chemistry talk about their research, their careers, their philosophies and their life experiences.

For the Division of the History of Chemistry of the American Chemical Society.

See: http://www.layingthegroundwork.com/inventors/

Princeton University, Department of Chemistry

Faculty and staff interviews.

See: http://chemistry.princeton.edu/faculty