

CHEMICAL HERITAGE FOUNDATION

DAVID M. HERCULES

Transcript of an Interview
Conducted by

David C. Brock and Arthur Daemmrich

at

Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy
New Orleans, Louisiana

on

20 March 2002

(With Subsequent Corrections and Additions)

CHEMICAL HERITAGE FOUNDATION
Oral History Program
FINAL RELEASE FORM

This document contains my understanding and agreement with Chemical Heritage Foundation with respect to my participation in a tape-recorded interview conducted by David C. Brock and Arthur Daemmrich on 20 March 2002.

I have read the transcript supplied by Chemical Heritage Foundation.

1. The tapes, corrected transcript, photographs, and memorabilia (collectively called the "Work") will be maintained by Chemical Heritage Foundation and made available in accordance with general policies for research and other scholarly purposes.
2. I hereby grant, assign, and transfer to Chemical Heritage Foundation all right, title, and interest in the Work, including the literary rights and the copyright, except that I shall retain the right to copy, use, and publish the Work in part or in full until my death.
3. The manuscript may be read and the tape(s) heard by scholars approved by Chemical Heritage Foundation subject to the restrictions listed below. The scholar pledges not to quote from, cite, or reproduce by any means this material except with the written permission of Chemical Heritage Foundation.
4. I wish to place the conditions that I have checked below upon the use of this interview. I understand that Chemical Heritage Foundation will enforce my wishes until the time of my death, when any restrictions will be removed.

Please check one:

a. _____

No restrictions for access.

NOTE: Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation Oral History Program to obtain permission from Chemical Heritage Foundation, Philadelphia, PA.

b. _____

Semi-restricted access. (May view the Work. My permission required to quote, cite, or reproduce.)

c. _____

Restricted access. (My permission required to view the Work, quote, cite, or reproduce.)

This constitutes my entire and complete understanding.

(Signature) _____



David M. Hercules

(Date) _____

MAY 01 2003

This interview has been designated as **Free Access**.

One may view, quote from, cite, or reproduce the oral history with the permission of CHF.

Please note: Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation Oral History Program to credit CHF using the format below:

David M. Hercules, interview by David C. Brock and Arthur Daemmrich at Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, New Orleans, Louisiana, 20 March 2002 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0241).



Chemical Heritage Foundation
Oral History Program
315 Chestnut Street
Philadelphia, Pennsylvania 19106



DAVID M. HERCULES

1932 Born in Somerset, Pennsylvania, on 10 August

Education

1954 B.S., chemistry, Juniata College
1957 Ph.D., analytical chemistry, Massachusetts Institute of Technology

Professional Experience

Massachusetts Institute of Technology
1954-1957 Assistant, Department of Chemistry
1963-1968 Assistant Professor, Department of Chemistry
1968-1969 Associate Professor, Department of Chemistry

Lehigh University
1957-1960 Assistant Professor, Department of Chemistry

Juniata College
1960-1963 Associate Professor, Department of Chemistry

University of Georgia
1969-1974 Associate Professor, Department of Chemistry
1974-1976 Professor, Department of Chemistry

University of Pittsburgh
1976-1995 Professor, Department of Chemistry
1980-1989 Chairman, Department of Chemistry

Vanderbilt University
1995-present Centennial Professor of Chemistry, Department of Chemistry
1995-present Chairman, Department of Chemistry
1998-1999 Assistant to the Provost

Honors

1974 Fellow, Guggenheim Foundation
1981 Lester W. Strock Medal, Society for Applied Spectroscopy
1983 Alexander von Humboldt-Stiftung Prize

1986 Fisher Award in Analytical Chemistry, American Chemical Society
1987 Benedetti-Pichler Award, American Microchemical Society
1989 Eastern Analytical Symposium Award
1993 Adamson Award in Surface Chemistry, American Chemical Society
1996 Pittsburgh Spectroscopy Award, Pittsburgh Conference on Analytical
Chemistry and Applied Spectroscopy
1997 Award, American Chemical Society, Pittsburgh Section

ABSTRACT

David M. Hercules begins his interview by discussing his childhood and education. He describes his youth in Somerset, Pennsylvania, and his childhood curiosity with science. When he was in high school, he continued to develop an interest in chemistry. Harold B. Brumbaugh and his chemistry teacher, William B. Howe, convinced him to attend Juniata College, a liberal arts school in central Pennsylvania which had a well renowned chemistry department. While at Juniata, he honed his interest in analytical chemistry. He was exposed to a few different types of spectroscopy at Juniata, and was able to attend tours of major academic and industrial labs in Pennsylvania and Delaware. He chose to attend Massachusetts Institute of Technology [MIT] for graduate school, and selected Lockhart B. Rodgers as his graduate advisor. He did his thesis work about the emission spectra of naphthalene compounds. While at MIT, Hercules worked as a teaching assistant for Stephen G. Simpson. After graduation, Hercules decided to pursue an academic career.

Hercules began his professional career at Lehigh University as an assistant professor. He describes how he built a spectrofluorometer at Lehigh and did research on photo-induced luminescence. When he worked at Lehigh, he had summer positions at United States Steel Corporation and Sun Oil Company. After three years at Lehigh, he returned to Juniata and conducted undergraduate research. He became an assistant professor at MIT after three years at Juniata. While at MIT, Hercules used a wide array of instrumentation, including one of the first ESCA [electron spectroscopy for chemical analysis] instruments. He corresponded and collaborated with Kai Siegbahn from Uppsala University in Sweden. Hercules used ESCA and XPS [x-ray photoelectron spectroscopy] to investigate a variety of phenomena, including heterogeneous catalysis. He also consulted for the Central Intelligence Agency, Instrumentation Laboratories, W.S. Merrill and Company, and Exxon Mobil Corporation.

Hercules moved to the University of Georgia after six years at MIT. He then describes the position of analytical chemistry within the chemistry department and the variety of instrumentation that he was able to work with in Georgia. He continued to be interested in catalysis and attended a International Catalysis Society Meeting in Florida. After receiving a Guggenheim Foundation fellowship, he was able to study at Northwestern University with Robert L. Burwell Jr. To continue his work on catalysis, Hercules moved to the University of Pittsburgh [Pitt] after seven years in Georgia. He got to work with an impressive variety of instrumentation at Pitt, and consulted for W.S. Merrill and Exxon. He helped develop and establish the surface science center at Pitt, and helped recruit John T. Yates Jr. to be the head of it. He used many different types of instrumentation, including SIMS [secondary ion mass spectrometry], ion scattering spectroscopy, and Auger electron spectroscopy. At Pitt, he gained interest in mass spectroscopy and began to consult for Leybold-Heraeus. After that, Hercules worked with a LAMMA [laser microprobe mass analyzer] and the MALDI [matrix assisted laser desorption/ionization] process. He served as chair of the chemistry department for nine years and won the Alexander von Humboldt Stiftung Prize. After nineteen years at Pitt, Hercules transitioned to working at Vanderbilt University. He describes the state of the Vanderbilt chemistry department and his place within it.

To conclude, Hercules recounts his role in various conferences, including different Gordon Research Conferences [GRC], as well as the Asilomar Conference on Electron Spectroscopy and the Namur conference. He also recalls the funding of the GRC on electron spectroscopy. He ends the interview by reflecting on his current research on polymers using SIMS and MALDI and on the state of analytical chemistry today.

INTERVIEWERS

David C. Brock is Program Manager for Educational and Historical Services at the Chemical Heritage Foundation in Philadelphia. He is currently a Ph.D. candidate in the History Department, Program in the History of Science at Princeton University. In 1995, Mr. Brock received his M.A. in the History of Science from Princeton University and in 1992, he earned a M.Sc. in the Sociology of Scientific Knowledge from the University of Edinburgh.

Arthur Daemmrich is a policy analyst at the Chemical Heritage Foundation in Philadelphia. He holds a Ph.D. in Science and Technology Studies from Cornell University and has published on biotechnology policy and politics, the sociology of medicine, and pharmaceutical drug regulation. In his research, he brings long-range perspectives to bear on the analysis of globalization, risk, health, and environmental policy. Daemmrich has held fellowships from the Social Science Research Council/Berlin Program for Advanced German and European Studies, and the Kennedy School of Government at Harvard University.

TABLE OF CONTENTS

- 1 Family Background and Youth
Growing up in Somerset, Pennsylvania. Summer jobs delivering furniture. Childhood curiosity with science. Harold B. Brumbaugh and the decision to attend Juniata College.
- 3 Higher Education
Attending Juniata College. Developing an interest in analytical chemistry. Early spectroscopy work. Choosing Massachusetts Institute of Technology [MIT] for graduate school. Selecting an advisor. Thesis work about emission spectra of naphthalene compounds.
- 5 Early Career
Working as a teaching assistant at MIT. Working at Lehigh University. Summer positions at United States Steel Corporation and Sun Oil Company, Inc. Position of analytical chemistry at Lehigh. Building a spectrofluorometer at Lehigh. Interest in photo-induced luminescence. Advising graduate students. Return to Juniata. Receiving funding for and carrying out undergraduate research.
- 11 Professorship at MIT
David N Hume. Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. State of analytical chemistry in MIT. Interest in chemiluminescence. Use of computing resources and image intensifier tubes. Instrumentation including Kai Siegbahn's electron spectrometer. Zeroing out magnetic fields. Consultation for the Central Intelligence Agency, Instrumentation Laboratories, W.S. Merrill and Company, and Exxon Mobil Corporation. First exposure to electron spectrometry for chemical analysis [ESCA]. Contact and collaboration with Siegbahn and Stig Hagstrom. Visit to Uppsala University. Use of ESCA and XPS [x-ray photoelectron spectroscopy]. Work on heterogeneous catalysis. Guggenheim Foundation fellowship to study at Northwestern University with Robert L. Burwell Jr.
- 24 University of Georgia
Decision to move to Georgia. Composition of Georgia chemistry department. Instrumentation at Georgia. Sources of funding for research. Study at Northwestern. Attending the International Catalysis Society Meeting.
- 28 University of Pittsburgh
Catalysis research. Decision to move to Pittsburgh. Instrumentation at Pittsburgh. Consulting with W.S. Merrill and Exxon. Development, funding, and establishment of surface science center at Pittsburgh. John T. Yates Jr. Collaborations with Milton L. Lee at Brigham Young University and Leon Petrakis at Gulf Research Center. Use of ESCA for surface analysis. Use of secondary ion mass spectrometry [SIMS], ion scattering spectroscopy, and Auger electron spectroscopy. Transition to the use

of mass spectroscopy. Consulting for Leybold-Heraeus. Use of laser microprobe mass analyzer [LAMMA] matrix assisted laser desorption/ionization [MALDI]. Winning the Alexander von Humboldt Stiftung Prize.

- 37 Vanderbilt University
Transition to working at Vanderbilt. State of Vanderbilt chemistry department.
- 38 Gordon Research Conferences [GRC]
Initiating the electron spectroscopy GRC. Asilomar Conference on Electron Spectroscopy. David A. Shirley. Namur conference. GRC funding.
- 39 Conclusion
Reflections on current research using SIMS and MALDI. Polymer research.
Reflections on the state of analytical chemistry.
- 42 Notes
- 44 Index

NOTES

1. T. Förster, *Z. Elektrochem* 54 (1950): 42.
A. Weller, *Z. Elektrochem* 56 (1952): 662.
2. Leicester F. Hamilton and Stephen G. Simpson. *Calculations of Analytical Chemistry*. 6th edition. (New York: McGraw-Hill, 1960).
Leicester F. Hamilton and Stephen G. Simpson. *Quantitative Chemical Analysis*. 12th edition. (New York: Macmillian, 1964).
3. Allen J. Bard. "The Fall and Rise of Analytical Chemistry in the 20th Century." (Paper given at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 17 March 2002.)
4. Herbert A. Laitinen and Galen W. Ewing, eds. *The History of Analytical Chemistry*. (Washington: Division of Analytical Chemistry of the American Chemical Society, 1977).
5. Kai Siegbahn, et al. *ESCA-Atomic, Molecular, and Solid State Structure Studied by Means of Electron Spectroscopy*. (Uppsala: Almqvist & Wiksells, 1967)
6. S. Hagstrom, C. Nordling and K. Siegbahn, "Electron Spectroscopy for Chemical Analysis" *Physics Letters* 9 (1964): 235.
7. Kai Siegbahn, et al. *Beta-, and Gamma-ray Spectroscopy*. (New York: Interscience Publishers, 1955).
8. Kai Siegbahn, et al. *ESCA-Atomic, Molecular, and Solid State Structure Studied by Means of Electron Spectroscopy*. (Uppsala: Almqvist & Wiksells, 1967)
Kai Siegbahn, *ESCA Applied to Free Molecules* (Amsterdam: North-Holland Pub. Co., 1969).
9. David M. Hercules. *Anal. Chem.* 42 (1970): 20A.
10. T. A. Patterson, J. C. Carver, D. E. Leyden, D. M. Hercules. *Journal of Physical Chemistry* 80 (1976) 1700. and K. T. Ng, D. M. Hercules, *Journal of Physical Chemistry* 80 (1976): 2094.
11. David M. Hercules. Tape Course for ACS. "ESCA and Auger Spectroscopy," (Washington: American Chemical Society, 1979).

12. Examples include:

D. S. Zingg, L. E. Mavovsky, R. E. Tischer, F. R. Brown, D. M. Hercules. *Journal of Physical Chemistry* 84 (1980): 2898.

B. W. Wright, M. L. Lee, S. W. Graham, L. V. Phillips, D. M. Hercules. *Journal of Chromatography* 199 (1980): 355.

L. Savati, L. E. Makovsky, J. M. Stencel, F. R. Brown, D. M. Hercules. *Journal of Physical Chemistry* 85 (1981): 3700.

13. X. Dong, D. M. Hercules. *Journal of Physical Chemistry* 105 (2001): 3942.

INDEX

3M Corporation, 30

A

Albridge, Royal G., 21, 37

Alcoa Incorporated, 3, 28

Alexander von Humboldt Stiftung Prize, 36

Allinger, Norman Lewis, 26

Altoona, Pennsylvania, 1, 12

American Chemical Society [ACS], 27

American Cyanamid Company, 9

American Electrical Industries [AEI], 26-30

Analytical Chemistry, 22

Anderson, Paul D., 14

Aniline, 9

Anthracene, 15

Anthraquinone, 9, 12

Asilomar Conference on Electron Spectroscopy, 38

Athens, Georgia, 29

Atomic Energy Commission [AEC], 10-11, 15, 20, 25, 27

Automated distillation system, 7

B

Bard, Allen J., 13

Baton Rouge, Louisiana, 33

Beckman Instruments, Inc., 5, 17-18

Benninghoven, Alfred, 36

Biemann, Klaus, 13, 17

Biochemistry, 3

Blackmeer, Dave, 18

Boston, Massachusetts, 17-18, 20, 25

Brigham Young University, 32

British Petroleum Company plc [BP], 28

Brumbaugh, Harold B., 2-3

Brundle, Christopher Richard, 33

Burwell, Robert L., 24

C

Calculations of Analytical Chemistry, 7

California, Berkeley, University of, 14, 20-21, 23

Cambridge, Massachusetts, 26

 Kendall Square subway, 16-17

Carr, Peter W., 26

Carver, Jim, 23

Catalysis, 4, 23-24, 27-29, 32-33, 35-36
heterogenous, 24
Central Intelligence Agency [CIA], 17
Midwest Research Institute, 17
Chemical Abstracts, 19
Chemical and Engineering News [C&E News], 6
Chemiluminescence, 13, 15, 18, 31
Chemistry
analytical, 2-4, 7, 10-11, 13-14, 17-19, 22-24, 26-28, 31, 36, 38, 40-41
classical, 3, 7
electro-analytical, 11, 14
surface, 9, 23, 28, 30-35, 39-40
Cherry, Ronald L., 10
Chevron Corporation, 33
Cobalt molybdenum aluminum, 28
Coetzee, Johann, 28
Cologne, Germany, 35
Complete neglect of differential overlap [CNDO], 23
Cooper, N. John, 36
Cope, Arthur C., 13, 24, 40
Cornell University, 4
Coryell, Charles D., 25

D

Davis, Raymond J., 4
Densitometer, 11
Diisocyanate, 39
Donor acceptor complexes, 9
Dropping mercury electrode polarograph, 3

E

E. I. DuPont de Nemours, and Company, 1, 3, 6
Electrochemistry, 2-3, 14
Electron Spectroscopy for Chemical Analysis [ESCA], 17, 22-23, 27, 29, 32-33, 36-37, 39
Electrospray, 36
Ellis, Betty Ann, 10
Ellis, Calvert, 10
Ellis, David W., 10
Ellis, Elizabeth W., 10
Elving, Philip J., 11
Emmett, Paul M., 4
Ethanol, 5
Ewing, Galen W., 17
Exxon Mobile Corporation, 18, 31, 33

F

Fall and Rise of Analytical Chemistry, The, 13
Findeis, Arthur Frederick, 26
Fish, Velmer, 7, 19
Fisher Scientific International Inc., 17-18
Flash photolysis apparatus, 13-14
Fluorescence, 5-6, 9
Fluorometer, 15
Förster, Theodor, 5-6
Fourier transform infrared instrument, 30
Fragment ions, 39

G

Gardella, Joseph A., 35
Georgia, University of, 13, 19, 24-30
Gordon Research Conferences, 37-39
Gravimetry, 3
Green, Fred D., 15
Grignard reagents, 15
Guggenheim Foundation, 24, 27
Gulf Oil Corporation
 Research Center, 28, 33

H

Hagstrom, Stig B., 15, 20
Hall, W. Keith, 33-34
Hartzler, Eva, 3
Harvard University, 6, 25
Helmholtz coil, 16
Hercules, David M.
 daughter, 29
 father, 1, 19
 high school, 1-2, 10, 32
 sister, 1
 son, 37
 wife [Shirley H. Hercules], 29, 37
Hewlett-Packard Development Company, L.P., 29
High-pressure mercury arc, 6
Hillenkamp, Franz, 36
History of Analytical Chemistry, The, 17
Houston, University of, 28
Howe, William B., 2
Hume, David M., 11, 13, 20, 24
Hydroxylated naphthoic acids, 8

I

Indiana, University of, 4
Instrumentation Laboratories [IL], 12, 17-18, 25
International Business Machines Ltd. [IBM], 14, 33
International Catalysis Society, 28
Iron 3-chelate, 2

J

Jack, John J., 16, 22, 27
Johns Hopkins University, 24
Jolly, William L., 21, 23
Journal of Catalysis, The, 33
Juniata College, 1-3, 6, 10-12, 28, 31, 37

K

Karas, Michael, 36
Kasha, Michael, 5, 8
Keily, Hubert, 31
King, Dick, 8
King, Robert Bruce, 26
Klatt, Leon N., 26
Kokes, Richard J., 24
Kolthoff, Izaak M., 4
Koppers Incorporated, 28
Kratos Analytical, 26

L

Laitinen, Herbert A., 17
Laser microprobe mass analyzer [LAMMA], 35
Lee, Milton L., 32
Leeds and Northrup Company, 17
Lehigh University, 1, 6-9, 11-12
Lester, Joe, 28
Lewistown, Pennsylvania, 1
Lexington, Massachusetts, 25
Leybold-Heraeus [L-H], 35
Leyden, Donald E., 24, 26
Lingane, James J., 6
Lord, Richard C., 4-5, 13, 15, 24, 28
Luminol, 15

M

Maron, Roy, 9
Massachusetts Institute of Technology [MIT], 1-2, 4, 6-20, 24-30
 Laboratory for Nuclear Science, 14

Matrix assisted laser desorption/ionization [MALDI], 36, 39-40
Mellon Institute, 3
Miami Beach, Florida, 28
Michigan, University of, 11
Miller, Foil A., 3, 28
Minnesota, University of, 4, 26
Molybdenum, 24, 28, 32, 34
Monochromator, 5-6, 8, 12
Muenster, Germany, 36

N

Namur conference, 38
Naphthalene, 5-6, 8
Naphthol, 5
Nashville, Tennessee, 37
National Institutes of Health [NIH], 10-11
National Science Foundation [NSF], 8, 10, 26-27, 29, 33, 41
New Hampshire, University of, 26
Nitrobenzene, 9
Nixon, President Richard M., 28
Non-aqueous titrations, 9
Nordling, Carl, 15, 19-20
Northwestern University, 24, 27
Nuclear magnetic resonance [NMR], 19, 22
 carbon-13 NMR, 22

O

Oak Ridge National Laboratory, 21, 26
Organic photochemistry, 13

P

Palm Beach, Florida, 28
Paris, France, 35
Patterson, Tom, 24
Pelletier, S. William, 26
Petrakis, Leon, 28, 33
Philadelphia, Pennsylvania, 3, 7
Philip Morris USA, 26
Photomultipliers, 11
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy [Pittcon], 13, 11, 17
Pittsburgh, Pennsylvania, 1-3, 11-13, 27-30, 32-34, 36-37
Pittsburgh, University of, 28-32, 36-37
 Alumni Hall, 31
Polarography, 3
Polydimethylsiloxane, 40

Polyester, 39-40
Polyurethane, 39-40
Posvar, Wesley W., 32
Potentiometry, 3
Princeton University, 4
Proteomics, 41
Purdue University, 4, 11

Q

Quantometers, 3

R

Rabalais, J. Wayne, 28
Republican National Convention, 28
Research Corporation, 10
Rockefeller University, 26
Roe, David K., 13, 18, 24
Rogers, Lockhart B. [Buck], 1, 4-6, 10-11
Ross, John, 25
Ross, Tom, 12, 18

S

Sanderson, Robert T., 23
Secondary ion mass spectrometry [SIMS], 29-30, 34-36, 39-40
Seitz, W. Rudolph, 26
Serfass, Earl J., 7, 9
Shimadzu Group Company, 26
Shirley, David A., 21, 37-38
Siegbahn, Kai, 15-16, 19, 20-24, 30
Siegbahn, Karl Manne Georg, 19
Simpson, Stephen G., 7
Sodium hydroxide, 5
Somerset, Pennsylvania, 1-2
Spectrofluorometer, 5, 8, 14-15
Spectrometer
 electron, 21
 image intensification, 15
 magnetic, 19-20, 26, 29-30
 quadrupole mass, 30, 35-36
Spectrophotometer
 DU, 5-6
 split coil, 21
 UV-visible, 9, 12
Spectrophotometry, 3, 9
Spectroscopy

Auger electron, 29, 33-34
electron, 17, 22, 27-28, 38-39
ion scattering, 34
mass, 17, 35-36
 unit resolution, 22
photoelectron, 15, 27
x-ray photoelectron [XPS], 23, 28, 30, 32, 36
Sputnik, 10
Standard Oil Company, Ohio [SOHIO], 28
Stannous fluoride, 23
State University of New York at Buffalo, University [SUNY] , 35
Storey, G. Paul, 26
Sun Oil Company, Inc., 1, 7
Surash, John, 9
Swartz, William E., 16-17, 22

T

Texas A&M University, 31-32
Turner Designs Inc., 15

U

U.S. Steel Corporation, 1-3, 7
United States Department of Agriculture, 3
United States Department of Energy, 27-28, 32
 Analytical Chemistry and Fission Elements Program, The, 27
Uppsala University, 20
UV-visible Cary-14, 15

V

Vanderbilt University, 21, 29, 36-37

W

W.S. Merrill and Company, 18, 31
Waraksa, Anthony, 16, 20
Weller, Albert, 5-6
William Penn Hotel, 12
Wilmington, Delaware, 3

X

X-ray photoelectron spectroscopy [XPS], 23, 28, 30, 32, 36

Y

Yates, John T., 31-33