

CHEMICAL HERITAGE FOUNDATION

JAMES F. ROTH

Transcript of an Interview
Conducted by

James J. Bohning

in

Sarasota, Florida

on

23 January 1995

(With Subsequent Corrections and Additions)

ACKNOWLEDGEMENT

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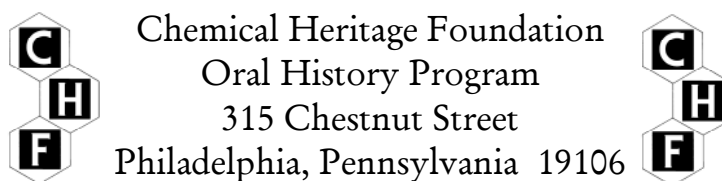
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JAMES F. ROTH

1925 Born in Rahway, New Jersey, on 7 December

Education

1947 A.B., chemistry, University of West Virginia

1951 Ph.D., physical chemistry, University of Maryland

Professional Experience

1951-1954 Senior Research Chemist, Franklin Institute, Philadelphia, PA
1954-1956 Chief Chemist, Lehigh Paint and Chemicals, Inc., Allentown, PA
1956-1959 Research Chemist, General Aniline & Film Corporation, Easton, PA
1959-1960 Manager, Chemistry Laboratory, Franklin Institute, Philadelphia, PA
Monsanto Company
1960-1964 Research Specialist in Heterogeneous Catalysis
1964-1967 Scientist
1967-1973 Manager of Catalysis Research
1973-1977 Director of Catalysis Research
1977-1980 Director, Process Sciences, Corporate Research Laboratory

Honors

1950-1951 National Institutes of Health Fellowship
1986 Chemical Pioneer Award, American Institute of Chemists
1988 Perkin Medal, Society of Chemical Industry (American Section)
1991 Houdry Award, Catalysis Society
1991 ACS Award in Industrial Chemistry

ABSTRACT

James Roth begins this interview by discussing the origins of his interest in research and physical chemistry as well as the impacts of growing up in the Bronx, New York, attending the Bronx High School of Science, and serving in Iwo Jima at the age of nineteen. Next he examines his early intellectual strengths and proclivities and his undergraduate and graduate school work. He describes his early position with the Franklin Institute and his work there on solid propellants and photochemical smog. Then he discusses his move to General Aniline & Film Corporation, where he developed a safe process to produce synthetic rubber. He next discusses his move to Monsanto Company, where he developed heterogeneous catalyst characterization. Roth describes his work under Dr. Leo Spillane and the development of a technology that used noble metal catalysts to produce biodegradable linear olefins from linear paraffins. He also examines his discovery of a low-pressure technology for carbonylating methanol to acetic acid using a rhodium carbonyl iodide catalyst, and his work in homogeneous catalysis. In the process he expounds his views on successfully getting a plant from the pilot stage to full production stage. He touches on the patent competition between Monsanto and other companies, and airs his views on a successful patent process. He then discusses his move to Air Products and Chemicals, Inc., and his creating a world-class laboratory there. Finally, he ends the interview by reflecting on the learning curve for developing technology; the need for empowerment of chemists; and the chemical industry, its future, and the industrial parameters chemists need to achieve their full potential.

INTERVIEWER

James J. Bohning is Professor of Chemistry Emeritus at Wilkes University, where he was a faculty member from 1959 to 1990. He served there as chemistry department chair from 1970 to 1986 and environmental science department chair from 1987 to 1990. He was chair of the American Chemical Society's Division of the History of Chemistry in 1986, received the Division's outstanding paper award in 1989, and presented more than twenty-five papers before the Division at national meetings of the Society. He has been on the advisory committee of the Society's National Historic Chemical Landmarks committee since its inception in 1992. He developed the oral history program of the Chemical Heritage Foundation beginning in 1985, and was the Foundation's Director of Oral History from 1990 to 1995. He currently writes for the American Chemical Society News Service.

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NOTES

1. W.J. Svirbely and James F. Roth, "Carbonyl Reactions I. The Kinetics of Cyanohydrin Formation in Aqueous Solution," *Journal of the American Chemical Society*, 75, (1953): 3106-11.
2. G.P. Wachtell, H. Bickford, L. Conant, and James F. Roth, "Ignition of Solid Propellants by Natural Convection and Radiation," *Bulletin of the First Symposium on Solid Propellant Ignition*, Silver Spring, Maryland (1953).
3. James F. Roth, "Some Adventures and Innovations in Industrial Catalysis," *Catalysis Today*, 13(1) (11 March 1992): 1-12.
4. Vladimir Haensel, interview by James J. Bohning in Amherst, Massachusetts, 2 November 1994 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0115).
5. James F. Roth and Robert C. Doerr, "Air Pollution Studies: Oxidation-Reduction Catalysis," *Industrial Engineering Chemistry*, 53, (April 1961): 293-6.
6. Jim Fair, interview by James J. Bohning in Austin, Texas, 19 February 1992 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0102).
7. A. Wolberg, J.L. Ogilvie, and J.F. Roth, "Copper Oxide Supported on Alumina IV. ESCA Studies," *Journal of Catalysis*, 19(1) (October 1970): 86-9.

A. Wolberg and J.F. Roth, "Copper Oxide Supported on Alumina III. X-Ray K-Absorption Edge Studies on the Cu^{+2} Species," *Journal of Catalysis*, 15(3) (November 1969): 250-5.

Pierre A. Berger and James F. Roth, "Copper Oxide on Alumina II. ESR Studies of Highly Dispersed Phases," *Journal of Physical Chemistry*, 71, (1967): 4307-15.

E. D. Pierron, J. A. Rashkin, and J.F. Roth, "Copper Oxide on Alumina I. XRD Studies of Catalyst Composition During Air Oxidation of Carbon Monoxide," *Journal of Catalysis*, 9(1) (1967): 38-44.
8. Peter R. Rony and James F. Roth, "Supported Metal Complex Catalysts," *Journal of Mol. Catalysis*, 1(1) (September 1975): 13-25.

Arnold Hershman, K. K. Robinson, J. H. Craddock, and J.F. Roth, "Continuous Propylene Hydroformylation in a Gas Sparged Reactor," *Ind. Eng. Chem. Prod. Res. Develop.*, 8(4) (1969): 372-5.

- K.K. Robinson, F.E. Paulik, A. Hershman, and J.F. Roth, "Catalytic Vapor Phase Hydroformylation of Propylene Over Supported Rhodium Complexes," *Journal of Catalysis*, 15(3) (November 1969): 245-9.
- J.H. Craddock, A. Hershman, F.E. Paulik, and J.F. Roth, "Hydroformylation Catalysis by Arylphosphine Complexes of Rhodium," *Industrial Eng. Chem. Prod. Res. Develop.*, 8, (1969): 291-7.
9. James F. Roth, "Perkin Medal Address," *Chemistry and Industry*, October 3, 1988.
 10. James F. Roth, "Evolving Nature of Industrial Catalysis," *Applied Catalysis: A: General* 133, (1994): 131-140. Reprint. Amsterdam, The Netherlands: Elsevier Science Publishers B.V.
 11. James F. Roth, interview by James J. Bohning in Sarasota, Florida. Research file. (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0128).

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