

THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

EARL L. WARRICK

Transcript of an Interview
Conducted by

James J. Bohning

in

Midland, Michigan

on

16 January 1986

(With Subsequent Corrections and Additions)

THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

Oral History Program

RELEASE FORM

This document contains my understanding and agreement with the Beckman Center for the History of Chemistry with respect to my participation in a tape-recorded interview conducted by

James J. Bohning on 16 January 1986.

I have read the transcript supplied by the Beckman Center and returned it with my corrections and emendations.

1. The tapes and corrected transcript (collectively called the "Work") will be maintained by the Beckman Center and made available in accordance with general policies for research and other scholarly purposes.
2. I hereby grant, assign, and transfer to the Beckman Center 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 the Beckman Center 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 the Beckman Center.
4. I wish to place the following conditions that I have checked below upon the use of this interview. I understand that the Beckman Center will enforce my wishes until the time of my death, when any restrictions will be removed.
 - a. No restrictions for access.
 - b. My permission required to quote, cite, or reproduce.
 - c. My permission required for access to the entire document and all tapes.

This constitutes our entire and complete understanding.

(Signature)

Earl L. Warrick

Dr. Earl L. Warrick

(Date)

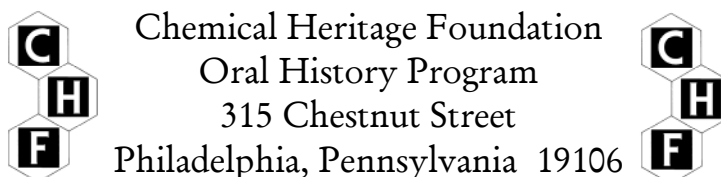
February 11, 1991

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:

Earl L. Warrick, interview by James J. Bohning at Midland, Michigan, 16 January 1986 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0045).



The Chemical Heritage Foundation (CHF) serves the community of the chemical and molecular sciences, and the wider public, by treasuring the past, educating the present, and inspiring the future. CHF maintains a world-class collection of materials that document the history and heritage of the chemical and molecular sciences, technologies, and industries; encourages research in CHF collections; and carries out a program of outreach and interpretation in order to advance an understanding of the role of the chemical and molecular sciences, technologies, and industries in shaping society.

EARL LEATHEN WARRICK

1911 Born in Butler, Pennsylvania on 23 September

Education

Carnegie Institute of Technology
1933 B.S., chemistry
1934 M.S., physical chemistry
1943 Sc.D., physical chemistry

Professional Experience

1933-1934 Teaching Assistant, chemistry, Carnegie Institute
of Technology
1934-1935 Teaching Assistant, chemistry, Brown University
1935-1937 Assistant, Mellon Institute
1937-1946 Fellow, organo-silicon chemistry, Mellon
Institute
1943-1945 Instructor, mathematics, Carnegie Institute of
Technology
1946-1955 Senior Fellow, Mellon Institute
1947-1948 Instructor, chemistry, University of Pittsburgh
1955-1956 Administrative Fellow, Mellon Institute

Dow Corning Corporation

1956-1959 Assistant Director of Research
1959-1962 Manager, Hyper-Pure Silicon Division
1962-1968 General Manager, Electronic Products Division
1968-1972 Manager, New Products Business
1972-1976 Senior Management Consultant

Saginaw Valley State College

1979-1980 Interim Dean, Science, Engineering and Technology
1983-1984 Interim Dean, Science, Engineering and Technology
1984- Special Assistant to the Vice President for
Academic Affairs

Honors

1976 Goodyear Medal, Rubber Division, American Chemical
Society

ABSTRACT

Earl L. Warrick begins the interview with a description of his parents and childhood, which involved frequent moves between cities. He remembers a seventh grade teacher who inspired his interest in chemical engineering by having him build a one-tube radio. He tells of his undergraduate years at the Carnegie Institute of Technology, where the chemical engineering department was a bit disappointing. This led him to switch to physical chemistry, in which he received a master's degree. After recounting his year at Brown, Warrick describes his experiences at the Mellon Institute, where he developed a glass coating. He received his Sc.D. for a kinetic study carried out almost exclusively on nights and weekends while he continued work at Mellon. Warrick summarizes his career at Dow Corning, including the development of the "200 fluid," extensive rubber, polymer, and silicone research, his invention of "Silly Putty," and his work with silicon. He mentions the influence of several colleagues, especially McGregor, Collings, Hyde, Bass, and Speier. Warrick concludes by commenting on his position at Saginaw Valley State College, his current writing, and the changes that have occurred in chemistry throughout his career.

INTERVIEWER

James J. Bohning, Assistant Director for Oral History at the Beckman Center, holds the B.S., M.S., and Ph.D. degrees in chemistry. He was a member of the chemistry faculty at Wilkes University from 1959 until 1990, where he served as chair of the Chemistry Department for sixteen years, and chair of the Earth and Environmental Sciences Department for three years. He was Chair of the Division of the History of Chemistry of the American Chemical Society in 1987, and has been associated with the development and management of the Center's oral history program since 1985.

TABLE OF CONTENTS

- 1 Family and Childhood
Description of parents. Moves frequently from city to city. Strongly influenced toward chemical engineering by seventh grade teacher. Builds one-tube radio.
- 3 Carnegie Institute of Technology
Attends due to location and economic circumstances. Finds that chemical engineering department is not very strong. Warner advises to pursue master's in physical chemistry. Chemical engineering facilities quite poor. Monitors freshman chemistry labs and recitations as graduate student.
- 5 Brown University
Convinced by Warner to get Ph.D. Works with Kraus in impressive lab. Comparison of graduate students' situation under Kraus and Noyes. Dielectric constant measurements. Starts work on precision condenser but leaves after a year to get a job.
- 7 Mellon Institute
Corning sponsors fellowship. Develops glass coating. Experiments with etherless Grignard reagents. Combines efforts with Hyde at Corning. Dow Corning is formed. Collings is very effective leader.
- 14 Graduate Education
Takes courses at University of Pittsburgh while working. Accepted as part-time Sc.D. student at Carnegie Tech while still at Mellon. Kinetic study under Fugassi, primarily on nights and weekends. Marriage in the fall of 1940. Develops formula for calculation of equilibria.
- 16 Dow Corning
Interacts frequently with Hyde and others from Corning. McGregor comes to Midland. Bass (who eventually becomes president) is director of research and head of development. Work in radiation chemistry. Develops "200 fluid" which prevents foaming in the oil in aircraft. Work on laminating resins. Develops silicon caulking for own aluminum windows. Begins work with rubbers by gelling "200 fluid." Investigates silicas which lead to high-strength rubber. Experiments using boric oxide dehydration lead to invention of Silly Putty. Begins use of acid polymerization techniques. Intense study of fundamentals of rubber. Works closely with McGregor, whom he describes as an "ideal boss." Work with silicones. Moves into silicon in 1959. Learns about growing them from Knapic in San Francisco. Goes to

Germany to get Siemens license. Begins to make single crystals by zone refining. Lowery convinces to concentrate on polycrystals. Becomes manager of New Products Business to push ahead projects that had not been fully developed. Group develops foam-filled tire and anti-microbial material. Semi-retires in 1972 as per company policy, but continues to consult.

- 33 Saginaw Valley State College
Travels. Visits daughter in Zaire. Yien contacts to fill interim position as dean of the newly formed School of Science and Engineering. Permanent replacement finally found, but continues on part-time basis. Works to secure agreement from other schools to put Saginaw's engineering degree program in place.
- 35 Mineralogy
Interest in jade begins on trip to Hearst Castle. Enjoys working with it as a hobby; makes jewelry for wife. Gives talks on it, travels to museums to see collections.
- 36 Changes in Chemistry Throughout Career
Terrific development in technology. Skepticism about consequences of tendency to work with only very small quantities of chemicals. Believes there is a great deal more to be done with silicon chemistry—the possibilities are endless.
- 40 Notes
- 41 Index

NOTES

1. Rob Roy McGregor and Earl L. Warrick, "Composition for Use in Mortar Bonding Glass and the Like Articles," U.S. Patent 2,299,552, issued 20 October 1942 (application filed 18 April 1939).
2. K. A. Andrianov and O. Gribanova, "Alkyl- and Aryl-substituted Orthoesters of Silicic Acid. I. Preparation of Organomagnesium Compounds Without Ether in the Presence of Tetraethoxysilicane," Journal of General Chemistry (U.S.S.R.), 8 (1938): 552-556; Andrianov and Gribanova, "II. Synthesis of Alkyl-substituted Orthoesters of Silicic Acid," Ibid., 8 (1938): 558-562.
3. Dorothy L. Yates, William R. Collings: Dow Corning's Pioneers Leader (Midland, Michigan: McKay Press, 1985).
4. Paul Fugassi and Earl Warrick, "The Empirical Correlation of the Activation Energies of Gaseous Unimolecular Reactions with Vibrational Frequencies," Journal of Physical Chemistry, 46 (1942): 630-639.
5. E. L. Warrick, "Silicone Rubber--A Perspective," Rubber Chemistry and Technology, 49 (1976): 909-936.
6. Paul J. Flory, "Molecular Size Distribution in Three-Dimensional Polymers. I. Gelation," Journal of the American Chemical Society, 63 (1941): 3083-3090.
7. B. S. Biggs and C. S. Fuller, "Paracon--A New Polyester Rubber," Chemical & Engineering News, 21 (1943): 962-963.
8. Rob Roy McGregor and Earl L. Warrick, "Treating Dimethyl Silicone Polymer with Boric Oxide," U.S. Patent 2,431,878, issued 2 December 1947 (application filed 30 March 1943).
9. S. M. Ohlberg, L. E. Alexander and E. L. Warrick, "Crystallinity and Orientation in Silicone Rubber. I. X-ray Studies," Journal of Polymer Science, 27 (1958): 1-18; E. L. Warrick, "Crystallinity and Orientation in Silicone Rubber. II. Physical Measurements," Journal of Polymer Science, 27 (1958): 19-38.
10. J. J. Schedel, The Splendor of Jade: Four Thousand Years of the Art of Chinese Jade Carving (New York: Dutton, 1974).
11. Earl L. Warrick, Forty Years of Firsts (New York: McGraw-Hill, Inc., 1990).

INDEX

A

Adhesion, 7
Africa, 33, 34
Aircraft, 19
Albion College, 33
Alexander, L. E., 25
Ammonia, 10
Ammonium chloride, 10
Andrianov, K. A., 8
Arizona, 34
Atlantic Richfield, 6
Australia, 32

B

Barium hydroxide, 26
Barry, Arthur J., 17, 18
Bass, Dolph, 28
Bass, Harlan, 28
Bass, Shailer, 17, 24, 27-29
Bay City, Michigan, 33
Bell Telephone Company, 1
Bell Telephone Laboratories, 21, 29
Benzoyl peroxide, 21
Berlin, Germany, 29
Biggs, B. S., 21
Bioguard socks, 32
Boeschenstein, Harold, 11
Boric oxide, 22
Boston, Massachusetts, 18
Braley, Silas, 22
Britton, Edgar C., 10, 12, 17
Brown University, 5, 6
Butler, Pennsylvania, 1

C

California, 35
Carbon, 17
Carbon-13, 37
Carbon dioxide, 26
Carnegie Institute of Technology, 3-5, 14
Carothers, Wallace, 22
Carrollton, Texas, 38
Caulking compounds, 20
Center for the Aid to Medical Research, 27
Chicago, Illinois, 2, 35
Chlorine, 20
Collings, William R., 12, 13, 17, 29
Copper phthalocyanine, 22
Corning Glass Works, 7-11, 13, 16, 26, 28
Crepe hardening, 22
Crystal growth, 29, 30
Crystallinity, 25
Cyclotron, 18

D

Daubert, Bernard F., 15
Daudt, William, 16
DC-4 compound, 19, 21
Defoaming products, 24, 26
Detroit Institute of Art, 36
Detroit, Michigan, 11, 14, 32
Dielectric constants, 6
Diamine, 20
Direct process, 24
Dow Chemical Corporation, 10-12, 18, 32, 33
Dow Corning Corporation, 11-13, 16, 18-20, 24, 27, 28, 30, 36, 38
 New Products Business, 30-32
Dow, Willard, 12
du Pont, de Nemours and Company, E. I., Inc., 24

E

Electric motor insulation, 11
Electron beams, 18
Eli Lilly and Company, 38
Elmer, Perkin, 29
England, 8, 17, 19, 36
Ester changes, 22
Ether, 8
Etherless Grignard, 10, 12
Ethyl cellulose, 12, 13
Ethyl silicate, 7-9
Europe, 17

F

Fairchild Semiconductor, 29
Falcon Missile, 28
Fleming, Robert, 16
Flint Institute of Art, 36
Flint, Michigan, 33
Florida, 34
Flory, Paul, 19
Fort Bragg, North Carolina, 37
France, 33
Fugassi, James Paul, 14, 15
Fuller, C. S., 21

G

General Electric, 11, 23, 24, 33
General Electric Company [British], 17
Germany, 29-31
G factors, 18, 19
Gibson Island [Maryland] High Polymer Conference, 24
Glassco heaters, 16
Goodwin, John, 12, 13, 28
Goodyear Tire and Rubber Company, 25, 32
Grant, George, 20
Great Depression, 3, 7

Grebe, John, 18
Gribanova, O., 8
Grignard reagents, 8-10, 17
Gulf Oil Chemicals Company, 9, 19, 21, 26

H

Hammer, W. A., 6
Harrisburg, Pennsylvania, 1, 2
Hearst Castle, 35
Hemlock, Michigan, 29, 31
Hemoglobin, 22
Holter, John, 27
Holter valve, 27
Hughes Aircraft Company, 28, 29
Hunter, Melvin J., 17, 18, 33
Hyde, J. Franklin, 7, 9-11, 13, 16, 20, 23, 24
Hyde resin, 12
Hydrocephalus valve, 27
Hydrogen, 31, 37
Hydrogen chloride, 10

I

Infrared spectroscopy, 15, 16
Instron, 25
Interwoven, 32
Ionia, Michigan, 30

J

Japan, 31, 32
Johannson, O. Kenneth, 16, 21
Journal of Polymer Science, 25

K

Kabi, A. B., 38
Kauppi, Toivo Andrew, 17, 21
K-gels, 21
Kipping, Frederick Stanley, 8, 17
Knapic, Dean, 29
Kraus, Charles, 5, 6

L

Lauterbur, Paul, 37
Lazadra Museum [Chicago], 36
Lindy-A silica, 22
Los Angeles, California, 35
Lowery, William E., 30
Lurgi cell, 31
Lyon, France, 33

M

MacBeth-Evans Glass Company, 7, 9
MacBeth, George, 9
Magnesium, 11
McGregor, Rob Roy, 7-9, 13, 16, 23, 26, 27

Mease, Ed, 10
Mellon Institute, 6, 8-10, 13-22, 25-28, 38
Methocel, 12
Methyl bromide, 9, 12, 13
Methyl chloride, 9, 12, 24
Midland, Michigan, 11, 13, 14, 16, 18, 20, 22, 26, 27, 29
Mine Safety Appliance, 26
Morrow, Les, 10, 11
Mustang [automobile], 30

N

New York City, New York, 7
Nitrogen, 22
North Africa, 19
North Carolina, 32
Noyes, W. Albert Jr., 5
Nuclear magnetic resonance [NMR], 16, 37
Nuremberg, Germany, 29

O

Ohlberg, S. M., 25
Opals, 7, 35
Optical activity, 17
Optics, 28, 29
Owens-Corning Fiberglas, 10, 11
Oxygen, 22, 26, 31
Oxygen compressor, 26, 27

P

PA fluid, 22
Palo Alto, California, 29
Paracon rubber, 21
Pennsylvania State University, 2, 28
Perry High School, 2
Phenol Grignard, 10
Phenyl ethyl, 10
Philadelphia, Pennsylvania, 6
Pittsburgh, University of, 14-16, 18, 28
Pittsburgh, Pennsylvania, 1, 2, 6, 14, 20, 26, 37
Polmanteer, Keith, 22
Polymerization, 15, 16, 21, 22, 24, 25, 27
Pretzfeld, Germany, 29
Purcell, Mary, 16

Q

Quartz, 28

R

Radiation chemistry, 18, 19, 27, 28, 37, 38
RCA Building [New York City], 7
Resins, 10-12, 19, 20, 28
Rheopexy, 23
Rickover, Hyman G., 11
Rochow, Eugene, 11, 24

Rubber, 21-23, 25, 26, 33
Rubber Reserve Company, 10

S

Saginaw Valley State College, 33-35
San Francisco, California, 29, 35
Schedel, J. J., 36
Schenectady, New York, 2
Seltz, Harry, 5
Shockley, William, 29
Siemens-Westinghouse license, 29
Silicas, 22, 24
Silicon, 10, 20, 28-31, 38
Silicon-29, 37
Silicon rubber, 38
Silicone, 17, 19, 22, 24, 26-28, 32
Silicone chloride, 24
Silicone rubber, 25, 27
Silly Putty, 22, 23
Sommer, Leo, 28
Speier, John, 9, 15, 16, 26, 37, 38
Sperry Gyroscope, 23
Stark, Forrest, 28
State University of New York [SUNY, Stony Brook], 37
Stearic acid, 37
Stockholm, Sweden, 38
Sulfur, 6
Sulfuric acid polymerization, 24
Sullivan, Eugene C., 13
Sussex, 17

T

Tertiary-butyl propionate decomposition, 14
Toepler pump, 14
Toledo, Ohio, 36
Torch Club, 34
Transistors, 29
"200 fluid", 19, 21, 24, 26, 38

U

Union Carbide, 7
United States Army, 37
United States Navy, 10-12

V

Variac, 16
Vinyl acetate, 7, 8
Vinyl chloride, 7
Vulcanization, 18, 20, 21, 25

W

Warner, John C. [Jake], 4, 5, 14

Warrick, Earl Leathen

- aluminum windows, creates caulking compound for, 20
- anti-microbial material, develops for paper and cloth, 32
- application work on viscosity of "200 fluid," 21
- attends Corning-Mellon research conferences, 13, 14
- chemistry set, 2
- early entrepreneurial idea, 4
- equilibria, article on calculation of, 15
- family, 1-3, 6, 15, 16, 26, 33-35
- foam-filled tire, development of, 31, 32
- Forty Years of Firsts, work on, 36
- gamma ray work, 18
- glass coating development, 7, 8
- Goodyear Medal address, 15
- graduate education, 4-6, 14, 15
- high school, 2, 3
- interest in jade, 35, 36
- kinetic study thesis, 14
- marriage, 15
- patent suit on treating fillers, involvement in, 33
- "tombstones," development of, 32
- undergraduate education, 4, 5

Warrick, Jean [wife], 15, 16, 26

Warrick, Samuel Edward [father], 1-3, 6

West Berlin, Germany, 29

Westinghouse Corporation, 20, 26, 29

Williamsport, Pennsylvania, 2

World War II, 11, 12, 23

X

X-rays, 25

Xylene, 10

Y

Yates, Dorothy, 13

Yien, Robert, 34, 35

Z

Zaire, 34