CHEMICAL HERITAGE FOUNDATION

ELSA REICHMANIS

Transcript of an Interview Conducted by

David C. Brock

at

Murray Hill, New Jersey

on

1 August 2001

(With Subsequent Corrections and Additions)

CHEMICAL HERITAGE FOUNDATION Oral History Program FINAL RELEASE FORM

with r	This document contains my understanding and a th respect to my participation in a tape-recorded interval David C. Brock on 1	view conducted by	
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:		
		terview for purposes of publication are obliged under the age Foundation Oral History Program to obtain permission	
		Semi-restricted access. (May view the Work. My permission required to quote, cite, or reproduce.)	
	c Restricted access. (M cite, or reproduce.)	y permission required to view the Work, quote,	
	This constitutes my entire and complete understanding.		
	(Signature	Elsa Reichmanis	
	(Date)	9/18/02	

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:

Elsa Reichmanis, interview by David C. Brock at Murray Hill, New Jersey, 1 August 2001 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0222).



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



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.

ELSA REICHMANIS

1953	Born in Melbourne, Australia on 9 December
	Education
1072	D.C. ahamistay Cymaeyga Haiyyarsity
1972 1975	B.S., chemistry, Syracuse University Ph.D., organic chemistry, Syracuse University
1773	Th.D., organic elicinistry, Syracuse Chiversity
	Professional Experience
	Syracuse University
1972	Organic Chemistry Teaching Assistant
1973-1975	Research Fellow
1975-1976	Postdoctoral Intern
1976-1978	Dr. Chaim Weizmann Fellow
	AT&T Bell Laboratories
1978-1984	Technical Staff, Organic Chemistry Research and Development
	Department
1984-1994	Supervisor, Radiation Sensitive and Applications Group
1994-1995	Head, Polymer and Organic Materials Research Department
	Bell Laboratories, Lucent Technologies
1996-present	Director, Polymer and Organic Materials Research Department
	11
	<u>Honors</u>
1972	Phi Beta Kappa
1992	R&D 100 Award, Research and Development Magazine
1993	Society of Women Engineers Achievement Award
1995	Elected to the national Academy of Engineering
1995	AT&T Bell Laboratories Fellow
1996	ASM International Engineering Materials Achievement Award
1997	Elected Fellow of the American Association for the Advancement of Science
1998	Photopolymer Science and Technology Award
1999	ACS Award in Applied Polymer Science
2001	Perkin Medal, Society of Chemical Industry
2001	George Arents Pioneer Medal, Syracuse University

ABSTRACT

Elsa Reichmanis begins the interview with a description of her family's immigration to the United States and her childhood years in Syracuse, New York. Reichmanis developed an interest in chemistry after taking a high school chemistry course. After graduating a year early from high school, Reichmanis enrolled at Syracuse University. While obtaining her B.S. in chemistry, Reichmanis performed heteroaromatic chemistry research in Apostolos G. Anastassiou's laboratory. Completing her degree in three years, Reichmanis decided to remain at Syracuse University for her Ph.D. Upon matriculation, Reichmanis took a technical staff position at AT&T Bell Laboratories, which is currently known as Bell Labs, Lucent Technologies, where she still remains. Reichmanis' work has focused on deep-UV lithography, such as the creation of 248 nm and 193 nm resist technologies. Currently, Reichmanis is performing photonic research. While at Bell Labs, Reichmanis has held numerous positions ranging from technical staff to supervisor to director. Reichmanis concludes the interview with a discussion of Valerie J. Kuck's research on women in chemistry, the definition of innovation, and the future of chemistry.

INTERVIEWER

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.

TABLE OF CONTENTS

1 Childhood and Early Education

Parents. Family. Emigration from Australia to the United States. Growing up in Syracuse, New York. Importance of education. Beulah P. Durr. Budding interest in chemistry. Assessment of current science and mathematics education in public schools. Hobbies

8 College Education

Graduating early from high school. Applying to Syracuse University. Undergraduate research. Apostolos G. Anastassiou. Heteroaromatic chemistry. Finishing college in three years. Decision to stay at Syracuse University for graduate school. Ph.D. dissertation. Weizmann Fellowship.

18 Career at Bell Laboratories

The Bell Labs reputation. Reflections on meeting and marrying Francis J. Purcell. Interest in deep-UV lithography. Larry F. Thompson and Murrae J. Bowden. The importance of knowing one's limitations. Laboratory budgets. Technology-licensing program. Research into deep-UV resists. Edwin A. Chandross and Cletus W. Wilkins, Jr. 248 nm resists. Francis M. Houlihan and Thomas X. Neenan. SEMATECH and Olin Ciba-Geigy Microelectronic Materials, Inc. [now Arch Chemicals, Inc.] contract for the commercialization of 248 nm technologies. Promotion to supervisor, radiation sensitive materials and applications group. Birth of children. 193 nm technology. Promotion to director of polymer and organic chemistry research. Agree Systems, Inc. Photonics.

43 Conclusion

Thoughts on mentoring young scientists. Valerie J. Kuck's research. Women in chemistry. Definition of innovation. Serendipity and research. The future of chemistry.

- 49 Notes
- 51 Index

NOTES

- 1. Mairin B. Brennan, "Elsa Reichmanis Wins Perkin Medal: Bell Labs Chemist Honored for Pioneering Work on the Design of Photoresists," *Chemical and Engineering News* (12 March 2001): 64-67
- 2. Apostolos G. Anastassiou, Elsa Reichmanis, and Ronald C. Griffith, "(7-Cycloheptatrienyl)-cis⁴-1,3,5,7,-cyclononatetraene)," *J. C. S. Chem. Commun.* (1972): 913.
- 3. See Note 2.
- 4. Elsa Reichmanis. "Pericyclic Synthesis and Study of Select π -Excessive Frames," Ph.D. diss., Syracuse University, 1975
- 5. A. G. Anastassiou and E. Reichmanis, "Dioxa and Trioxa Derivatives of C₈H₈," *J. Organic Chem.* 38 (1973): 2421.
 - A. G. Anastassiou, E. Reichmanis, and R. L. Elliott, "The 4,5-Benzazonine System," *Tetrahedron Letters* 3805 (1973).
 - A. G. Anastassiou, A. E. Winston, and E. Reichmanis, "The 9-Azabarbaralane(9-Azatricyclo[3.3.1.0^{2,8}] nona-3,6-diene) Systems," *J. C. S. Chem. Commun.* 779 (1973).
 - A. G. Anastassiou and E. Reichmanis, "3H-3-Benzazonine and the 3-Benzazoninyl Anion," *Angew. Chem.* (1974): 86, 410 and *Angew. Chem. Internat. Edit.* 13 (1974): 404.
 - ———, "trans-Benzocyclononatetraenyl Anion," *Angew. Chem.* 86 (1974) and *Angew. Chem. Internat. Edit.* 13 (1974): 728.
 - A. G. Anastassiou, R. L. Elliott, and E. Reichmanis, "Effect of Heteratom Electronegativity on the Development of Diatropic Character in cis,trans,cis,trans-Aza[13] annulene," *J. Am. Chem. Soc.* 96 (1974): 7823.
 - A. G. Anastassiou and E. Reichmanis, "A Stable trans-Benzazoninyl Anion," *J. C. S. Chem. Commun.* 149 (1975).
 - A. G. Anastassiou, E. Reichmanis, and J. C. Wetzel, "The Functional Behavior of 9-Heterbarbaralanes," *Tetrahedron Letters* 1651 (1975).
- 6. United States v. Western Electric Co., 1956 Trade Cas. (CCH) 68,246 (D.N.J. 1956).

- 7. Larry F. Thompson, C. Grant Willson, and Murrae J. Bowden, eds., *Introduction to Microlithography: Theory, Materials, and Processing*, (Washington, D.C.: The Society, 1983).
- 8. C. Grant Willson, Hiroshi Ito, Jean M. J. Frechet, and Frank Houlihan, "Chemical Amplification in the Design of Polymers for Resist Applications," *International Union of Pure and Applied Chemistry*, 28 (1982): 448.
 - J. M. J. Frechet, H. Ito, and C. Grant Willson, "Résines pour UV lointain mettant an oeuvre un mécanisme d'amplification chimique," *Colloque Internationale sur la Microlithographie: Microcircuit Engineering* 82 (1982): 260.
 - C. Grant Willson, Hiroshi Ito, and Jean M. J. Frechet, "L'amplification chimique appliquée au développement de polymères utilisables comme résines de lithographie," *Colloque Internationale sur la Microlithographie: Microcircuit Engineering* 82 (1982): 261.
- 9. United States v. American Telephone & Telegraph Company, 552 F. Supp. 131 (D.D.C. 1982), aff'd, 460 U.S. 1001 (1983).
- 10. Gordon E. Moore, interview by Arnold Thackray and David Brock at Santa Clara, California, 8 August 2001 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0223).
- 11. See Note 9.

INDEX

```
193 nm resist, 27-28, 34, 38-41
248 nm resist, 30-31, 33-36, 38, 40-41
Agere Systems, Inc., 40-42
Allied Chemical, 20
Aluminum, 46
American Association for the Advancement of Science [AAAS], 42
American Chemical Society [ACS], 43-44
American Telephone and Telegraph Company [AT&T], 22, 25-26, 41
   1984 Justice Department decree, 36
   Bell Telephone Laboratories, Inc., 22
Anastassiou, Apostolos G., 10-14, 17
Applied Materials, Inc., 26
Arch Chemicals Inc., 33, 35-36, 38-39, 41
Aromatic chemistry, 30
В
Bao, Zhenan, 39
Bardeen, John, 25, 46
Basel, Switzerland, 33-34
Bell Communications Research, Inc. [Bellcore]. See Telcordia Technologies Inc.
Bell Laboratories, 18-20, 22-26, 32, 35-36, 43, 46-47
   consent decree, 25
   materials chemistry research department, 39
   organic chemistry research department, 21
   radiation sensitive materials and applications group, 35
   semiconductor device, 25
   technology-licensing program, 25
Benzazonine system, 15
Bowden, Murrae J., 23, 25, 29, 36
Brattain, Walter H., 25, 46
C
Carboxylic acid, 30
Carrier Corporation, 4
Chain cleavage, 28, 30, 39
Chain scission, 28
Chandross, Edwin A., 27-28, 31
Chemical and Engineering News [C&E News], 4, 44
Chiba Conference of Photopolymer Science, 32
Chicago, Illinois, 44
Cholate ester, 27, 38
```

Cholic acid, 30

Deep-UV lithography, 22-23 Deep-UV resist, 25-27, 36 Defense Advanced Research Projects Agency [DARPA], 35 Department of Defense [DOD], 35 Diazonaphthoquinone, 29 Dissolution inhibitor, 28, 38 Dow Chemical Company, 32 DuPont, E. I. de Nemours and Company Experimental Station, 14 Durr, Beulah P., 5

\mathbf{E}

Eastman Kodak Company, 32 E-Ink Corporation, 39 Electron beam lithography, 23, 25, 29, 38 Electron beam resists, 23 Etching resistance, 30, 39 Excimer laser, 41

F

Frechet, Jean M. J., 30

G

General Electric Company [GE], 4, 32 Griffith, Ronald C., 10

H

Heteroaromatic chemistry, 10, 18 Hewlett-Packard Company [HP], 32 Houlihan, Francis M., 31, 34, 39

Ι

IBM Corporation, 25, 32, 34, 39 Apex, 34 Indene carboxylic acid, 29 Intel Corporation, 45 Intellectual property [IP], 47 Introduction to Microlithography, 29 Ito, Hiroshi, 30

K

Kalle GmbH and Company, KG, 29 Katz, Howard E., 39 Kuck, Valerie J., 43

L

Lucent Technologies, 25-26, 40-42, 47

\mathbf{M}

Methacrylate, 28-29, 38
Methacrylate methacrylic acid, 29
Methacrylic acid, 30-31
Methyl methacrylate, 28
Methyl methacrylate-methacrylic acid, 27
Moore, Gordon E., 45-46
Motorola Inc.
Laboratories, 32

N

Nalamasu, Omkaram, 39
Naphthoquinone, 29
Neenan, Thomas X., 31, 34
Nitrobenzyl ester, 30-31
Norbornene-maleic anhydride, 39
Notre Dame, University of, 20
Novolac, 29
Nuclear magnetic resonance [NMR], 11, 16

O

Olin Ciba-Geigy Microelectronic Materials, Inc. [OCG], 33 248 nm resist, 33 Olin Hunt Specialty Products, Inc., 33 Oxime ester, 28

P

Perkin Medal, 44 Photochemistry, 28 Photolithography, 22, 38 Photonics, 39, 42-43, 47 Photoresist, 23, 29-30 Polymer chemistry, 23, 27 Providence, Rhode Island, 33

```
R
Radio Corporation of America [RCA], 32
   Laboratories, 25
Raman fluorometer, 21
Raman spectrophotometer, 21
Reichmanis, Elsa
   aunt [Anna Kruka], 3
   children, 3, 36-37
   father [Peteris Reichmanis], 1-3, 17
   husband [Francis J. Purcell], 20-21
   mother [Nina Reichmanis], 1-4, 17, 37
   Perkin Medal, 44
   Ph.D. dissertation, 15-16
   sister [Maria Reichmanis], 2-4
   Weizmann Fellowship, 17-18
S
Semiconductor device, 22-23, 26, 31, 35, 39-40, 42, 45
Semiconductor Manufacturing Technology, Inc. [SEMATECH], 33, 35
Shipley Company Inc., 34
Shockley, William B., 25, 46
Society of Photo-Optical Instrumentation Engineers [SPIE], 32
Somerset, New Jersey, 25
Spex Industries, Inc., 21
State University of New York [SUNY]
   College of Environmental Science and Forestry, 16
Sulfonic acid, 30
Summit, New Jersey, 21
Syracuse University, 8-10, 13-14, 16-17, 20
   Press. 4
Syracuse, New York, 3-5, 17
Telcordia Technologies Inc., 36
Tert-butoxycarbonyloxystyrene [tBOC], 30
Thompson, Larry F., 23, 25, 29
Tolkien, John R. R., 7
Tosylate ester, 30
Trozzolo, Anthony M., 20
U
Union Carbide Corporation. See Dow Chemical Company
Vincow, Gershon, 16-18
```

\mathbf{W}

Wallow, Thomas I., 39 Wasserman, Edel, 20 Wilkins, Jr., Cletus W., 27-28, 31 Willson, C. Grant, 29-30 Wolff-Kishner rearrangement, 29 World War II [WWII], 1

\mathbf{X}

X-ray lithography, 36, 38

Y

Yakali, Emel, 17