

CHEMICAL HERITAGE FOUNDATION

STEPHANIE L. KWOLEK

Transcript of an Interview
Conducted by

Bernadette Bensaude-Vincent

at

Wilmington, Delaware

on

21 March 1998

(With Subsequent Corrections and Additions)

ACKNOWLEDGMENT

This oral history is one in a series initiated by the Chemical Heritage Foundation on behalf of the Society of Chemical Industry (American Section). The series documents the personal perspectives of the Perkin and the Chemical Industry Award recipients and records the human dimensions of the growth of the chemical sciences and chemical process industries during the twentieth century.

This project is made possible through the generosity of the Society of Chemical Industry (American Section) member companies.

THE CHEMICAL HERITAGE FOUNDATION

Oral History Program

RELEASE FORM

I hereby certify that I have been interviewed on tape on

21 March 1998 by Dr. Bernadette Bensaude-Vincent,

representing the Chemical Heritage Foundation. It is my understanding that this tape recording will be transcribed, and that I will have the opportunity to review and correct the resulting transcript before it is made available for scholarly work by the Chemical Heritage Foundation.

At that time I will also have the opportunity to request restrictions on access and reproduction of the interview, if I so desire.

If I should die or become incapacitated before I have reviewed and returned the transcript, I agree that all right, title, and interest in the tapes, transcript, photographs, and memorabilia, including the literary rights and copyright, shall be transferred to the Chemical Heritage Foundation, which pledges to maintain the tapes and transcript and make them available in accordance with general policies for research and other scholarly purposes.

I am also donating one-half yard of Kevlar fabric to CHF.

(Signature) Stephanie L. Kwolek
Dr. Stephanie L. Kwolek

(Date) 3/21/98

(Revised 25 March 1997)

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:

Stephanie L. Kwolek, interview by Bernadette Bensaude-Vincent at Wilmington, Delaware, 21 March 1998 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0168).



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.

STEPHANIE L. KWOLEK

1923 Born in New Kensington, Pennsylvania on 31 November

Education

1946 B.S., chemistry, Carnegie-Mellon University

Professional Experience

E. I. du Pont de Nemours & Co., Inc.
1946-1959 Chemist
1959-1967 Research Chemist
1967-1974 Senior Research Chemist
1974-1986 Research Associate
1986- Consultant

National Academy of Sciences, Research Council
1986- Consultant

Honors

1959 Publication Award, Delaware Section, American Chemical Society
1976 Howard N. Potts Medal, Franklin Institute of Philadelphia
1978 Award for Contributions to "Kevlar" (du Pont trademark for aramid fiber),
American Society for Metals
1980 Chemical Pioneer Award, American Institute of Chemists
1980 Award for Creative Invention, American Chemical Society
1981 Honorary Doctor of Science degree, Worcester Polytechnic Institute
1983 Alumni Association Merit Award, Carnegie-Mellon University
1985 Engineering/Technology Award, Society of Plastics Engineers
1985 Polymer Processing Hall of Fame, University of Akron
1988 Harold DeWitt Smith Memorial Award, American Society of Testing
Materials
1990 du Pont Honoree at the Bicentennial Celebration of the United States Patent
and Copyright Laws
1995 Inducted member of the Inventor's Hall of Fame
1997 Perkin Medal, Society of Chemical Industry (American Section)

ABSTRACT

Stephanie Kwolek begins the interview with a discussion of her early career at DuPont. She joined DuPont in 1946, the same year she earned her B.S. in chemistry at Carnegie-Mellon University. Kwolek spent much of her time working on polymers, including aliphatic and aromatic polyamides. She discusses her level of independence in the laboratory, as well as her relationship with her supervisors. Kwolek began work with 1,4-B, and was able to get a high molecular weight polymer. It was eventually discovered that the polymer spun beautifully, and was quite strong. This polymer became Kevlar. Kwolek discusses industry competition, the testing and scale-up of Kevlar, and the problems of confidentiality. She further discusses the relationship between Kevlar and Paul Flory's theory of liquid polymer crystals. Kwolek concludes the interview with comments on her love of writing, her decision to leave DuPont, and the future of polymer research.

INTERVIEWER

Bernadette Bensaude-Vincent is a professor in the Department of Philosophy at Université Paris X. She holds a doctorate in philosophy from the Sorbonne, and is currently a fellow at the Dibner Institute of the Massachusetts Institute of Technology. Bensaude-Vincent is the author of numerous articles and books on the history of chemistry and physics, including *Eloge du mixte: matériaux nouveaux et philosophie ancienne*. In 1997, she received the Dexter Award for outstanding achievement in the history of chemistry.

TABLE OF CONTENTS

1	Early Career at DuPont Entering industry with a B.S. degree. Methods of polymerization. Aliphatic polyamides. Aromatic polyamides. Emphasis on long-term research. Hale Charch. Paul Morgan. Independence in laboratory.
4	Kevlar Finding a solvent for 1,4-B. Spinning the polymer. Commercial opportunity in radial tires. Discovery of bullet-resistance. PVDT. Competition. Scaling up Kevlar. Secrecy.
14	Liquid Crystals Paul Flory. Kevlar as theoretical discovery. Publishing results.
17	Scientific Process Importance of clarity in writing. Necessity of honesty. Knowing when to abandon a line of research.
20	Conclusion Decision to leave DuPont. Trend towards improving old products. Necessity of basic research. Future of innovation. Laboratory atmosphere. Colleagues. Choosing research projects. Current activities. Consulting.
35	Notes
36	Index

NOTES

1. Paul W. Morgan, *Condensation Polymers: By Interfacial and Solution Methods* (New York: Interscience Publishers, 1965).
2. Paul J. Flory, *Principles of Polymer Chemistry* (Ithaca: Cornell University Press, 1953).

INDEX

A

Acrylics, 3
Akron, Ohio, 9
Antal, Paul, 15

B

Bair, Thomas I., 8
Bellows, Saul, 32
Beste, Lawrence Forwood, 5
Blades, Herbert, 9
Buffalo, New York, 25

C

Calcium chloride, 5
Cambridge University, 32
Carothers, Wallace H., 1
Cellophane, 3, 25
Charch, William Hale, 3, 25
Clinton, President William Jefferson, 32
Condensation, 1-2
Cyanochloride, 5

D

Dacron, 8
du Pont de Nemours & Company, E. I., 8, 13, 17, 20, 33-34
 Experimental Station, 7, 13

E

Esso, 19

F

Flory, Paul J., 14-16

G

Goodyear Tire and Rubber Company, 15

H

Heterocyclics, 17
Hexamethyl diamine, 2
Hexamethylenediamine, 2
Hill, Wayne X., 22
Hydrogen chloride, 2, 5

I

Isothalic acid, 2-3

J

Journal of Polymer Science, 17

K

Kevlar, 3-4, 20, 34

Kwilek, Stephanie

brother, 18, 31

father, 18-19

L

Liquid crystals, 9-10, 14-15

Lithium chloride, 5

Lycra, 3

M

Macromolecules, 17

Marvel, Carl S., 17

Metaphenylene diamine [MPD], 3

Modulus, 4, 7, 9-10, 15-16

Monsanto Company, 8-9

Morgan, Paul W., 2-3, 5, 8, 17, 22

N

Nobel Prize, 14

Nomex, 3, 15

Nylon, 1, 9, 13

O

Orlon, 3

Oxford University, 32

P

Par-aminobenzochloride hydrochloride, 5

PBDT, 5

Phillips Petroleum Company, 22

Poly-1,4-benzamide, 4-5, 7-9, 11, 13

Polyamides, 2-3, 5, 8

Polyesters, 2, 8

Polymers, 1-6, 8-17, 23-25, 29

Poly-paraphenylene terephthalamide, 4

Polyurethane, 2-3

PVDT, 8-9

R

Rivers, Joseph T., 7

S

Sebacic acid, 2

Sebacyl chloride, 2

Shaefgen, John R., 15

Spinning fibers, 1, 6, 8-10, 16

Sulfuric acid, 4, 6, 8-9

T

Tenacity, 9-10, 12

Terephthalic acid, 2, 8

Tetramethylurea, 5-6

U

United States Congress, 32

United States Patent Office, 32

W

Washington, D.C., 32

Weizmann Institute, 33

Wilmington, Delaware, 1, 27

Wittbecker, Emerson L., 2

World War II, 2