

THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

ELIZABETH DYER

Transcript of an Interview  
Conducted by

Herman Skolnik

in

Hockessin, Delaware

on

13 October 1986

THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

Oral History Program

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*Elizabeth Dyer*  
Elizabeth Dyer

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ELIZABETH DYER

1906 Born in Haverill, Massachusetts on 10 May

Education

1927 B.A., chemistry, Mount Holyoke College  
1929 M.A., chemistry, Mount Holyoke College  
1931 Ph.D., chemistry, Yale University  
1931-1933 Postdoctoral Fellow, Yale University

Professional Experience

University of Delaware, Department of Chemistry  
1933-1940 Instructor  
1940-1947 Assistant Professor  
1947-1951 Associate Professor  
1951-1971 Professor  
1971- Professor Emeritus

Honors

1958 Excellence in Teaching Award, Manufacturing  
Chemist's Association  
1969 Excellence in Teaching Award, University of  
Delaware  
1971 Elizabeth Dyer Teaching Award established for  
graduate assistants in chemistry, University  
of Delaware

## ABSTRACT

Elizabeth Dyer recounts her childhood in Haverhill, Massachusetts and entering Mount Holyoke College at the age of seventeen. There she was influenced by two outstanding teachers, Louisa Stevenson and Dorothy Hahn, which led, first to a major in chemistry, and then to the M.A. degree. It was at Mount Holyoke that Dyer had her first experience of teaching chemistry before she moved to Yale for Ph.D. studies, and later post-doctoral work, researching heterocyclic chemistry under the guidance of Treat B. Johnson. In 1933 Elizabeth Dyer accepted an instructorship at the Women's College, University of Delaware, where she was to remain for the rest of her career. She discusses her early years there before the merger of the Women's and Men's Colleges and recounts her sabbatical year working with George Barger at the University of Edinburgh. In 1943 she commenced her research studies in polymer chemistry, largely at the suggestion of the Armstrong Cork Company. She describes her linoleate copolymerization work and her later polyurethane studies. As a consequence of the new research initiative, Dyer set up courses in polymer chemistry, some of the earliest after the polymer program at Brooklyn Polytechnic Institute. In the final section of the interview Elizabeth Dyer reflects on her priorities as an academic and briefly discusses her retirement hobbies.

## INTERVIEWER

Herman Skolnik received the B. S. degree in chemical engineering from The Pennsylvania State University, and the Ph.D. degree in organic chemistry from the University of Pennsylvania. He joined Hercules, Inc. as a research chemist in 1942, and served as a divisional research manager from 1952 until his retirement in 1979. He was the founding editor of The Journal of Chemical Documentation, and has published over 200 papers and four books, including A Century of Chemistry, the centennial history of the American Chemical Society.

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INTERVIEWER: Herman Skolnik  
LOCATION: Hockessin, Delaware  
DATE: 13 October 1986

SKOLNIK: Do you have a middle initial or a middle name?

DYER: No.

SKOLNIK: I didn't think so. I know that you were born on May 10, 1906 in Haverhill, Massachusetts. Can you tell me something about your parents?

DYER: My father was Charles Newton Dyer and my mother Emma Wilson Emerson Dyer.

SKOLNIK: Was she related to the Emerson?

DYER: No, unfortunately, we are not related to Ralph Waldo.  
[laughter]

SKOLNIK: And do you have brothers or sisters?

DYER: Yes. There were two of us. My brother is four years younger. He is a graduate of MIT and I probably should tell you his claim to fame. In 1933, he was the radio engineer for the Byrd Expedition in the Antarctic.

SKOLNIK: What was your father's occupation?

DYER: He sold what were called narrow fabrics for shoes. That means tapes for shoes. He had a small factory with somebody else in Lowell, for the manufacture of these goods.

SKOLNIK: Back then that was the shoe and textile center of the United States.

DYER: It was the shoe center, but textiles were centered more in

Lawrence.

SKOLNIK: Since you were older than your brother, you were the king of the roost for a good number of years. [laughter] That must have been happy both physically and intellectually. Were you very physical as a child? Were you into sports when you were six, seven, or eight years old?

DYER: No. I didn't particularly do sports. I was never very good at sports. Being so tall, I always had to be first in gym, which was a painful business because I was poor in apparatus work. But there isn't much to say about that. I could tell you some more about my brother. He became the director of the American British Laboratory in England during the war. They were involved in countermeasures beginning in 1940.

SKOLNIK: I'm more interested in your interactions with him than I am with what he accomplished. There was certainly no rivalry there since you were the older. What was it like when you were both young?

DYER: Well, he was four years younger.

SKOLNIK: So you were his teacher for many things.

DYER: Well, not exactly. I think my father helped him more with the chemistry set that he had in the basement.

SKOLNIK: And that's before you had a chemistry set?

DYER: Yes, that's before I got interested in it at all. He was interested in science. Maybe it's of modest interest that my father, when he graduated from high school in South Weymouth, Massachusetts, did an entertaining speech on the progress of chemistry! [laughter]

SKOLNIK: That would be in the nineteenth century, of course.

DYER: Yes, of course it was!

SKOLNIK: What was your elementary education like?

DYER: Well, I went to a good public school. The principal



remarked that she had taught my mother who was an excellent student.

SKOLNIK: So you were in competition with your mother for your teacher!

DYER: Yes. My mother was one of ten children, and she grew up in a family where she was the only girl who was sent to college. She was sent to Wellesley for two years.

SKOLNIK: That was very unusual for that period of time.

DYER: Well, her father said that two years was enough for any woman. But he sent her brothers to Harvard for a full course of study. My mother taught before she was married.

SKOLNIK: Did you father go to college?

DYER: No. He didn't go to college at all.

SKOLNIK: Did you have any particular interests in elementary school?

DYER: I don't remember anything other than generally playing with the neighborhood children. In those days, of course, we walked home from the public school. We stopped at each of the families of my friends for food on the way to my house, where my parents had arranged to have as many interesting things as possible so that the children would gather there. That is, we had a tent, swings, and things of that sort.

SKOLNIK: Were there many books in your house, and did your parents encourage you to read?

DYER: Oh, yes. We had a library of books, and I'm sure that both of us read at a young age. In fact, my mother taught me to read so that I went into the second grade when I started school.

SKOLNIK: You skipped first grade?

DYER: Yes. The environment was very good for education. And of course we were also very happy as a family. My father took us for walks in the woods on Sunday afternoons. We were all

admirers of outdoor things.

SKOLNIK: When did you have your first ride in an automobile?

DYER: Well, my father had an automobile. I can't tell you when. I'd have to look that up.

SKOLNIK: You probably were still in grammar school.

DYER: Yes. It was when I was still in grammar school. I know that. We had hens, if that interests you. The children took some care of the poultry. During World War I, my father had three lots to begin with, and he plowed up one whole lot to grow food. We all heard about the starving Armenians [laughter] and how we had to grow our own potatoes and as many things as we could. My mother canned and dried.

SKOLNIK: So you learned farming while you were still in junior high school and high school.

DYER: Yes. And we all had chores around the place. I remember picking pears and apples and going out to the trellis and picking the grapes.

SKOLNIK: Do you think farming encourages people to go into science? Did it affect you in any way?

DYER: Oh, I don't think you could make any such conclusion as that.

SKOLNIK: That's one of the things I keep telling the teachers. They like to plant seeds for the kids in third or fourth grade and watch them sprout and grow.

DYER: Yes, well that's fine.

SKOLNIK: That's fine, but it doesn't teach them science.

DYER: No, I don't think so.

SKOLNIK: Not many farmers have made their mark in chemistry.

DYER: True.

SKOLNIK: The one who did was a monk and not a farmer.

DYER: Who's that?

SKOLNIK: Linnaeus, the botanist.

DYER: Oh, yes.

SKOLNIK: Then you still had no interest in science by the time you went through the first six grades of school.

DYER: No, I didn't. I think my first real interest in science came in college.

SKOLNIK: Not even in high school?

DYER: Well, I had chemistry in high school.

SKOLNIK: You had physics?

DYER: I didn't have physics. The chemistry teacher was so much poorer than the other teachers I had. He didn't capture my interest. In fact, I might have been interested, but he thought that girls weren't worth working with. At least, I felt no sense of rapport with my high school chemistry teacher.

SKOLNIK: How about your biology teacher?

DYER: I didn't have biology in high school. What I had in high school was four years of Latin, four years of English, and three years of French.

SKOLNIK: What about history?

DYER: Not every year. I had ancient history as a freshman and American history as a senior. I can't remember what else we had. But we didn't have as much science as people do now. That's certainly true.

SKOLNIK: What were you reading when you were in high school?

DYER: Well, it's hard to remember. I studied hard in high school as I was determined to go to college.

SKOLNIK: Did you make this decision yourself or is this something that your parents more or less expected of you?

DYER: Oh, I'm sure they expected it, but also I wanted to get into the college of my choice, so I did my lessons and did all the reading.

SKOLNIK: So you were a conscientious student in high school.

DYER: Yes.

SKOLNIK: Were you valedictorian when you graduated?

DYER: I didn't have to make any speeches.

SKOLNIK: You were number one though?

DYER: I did win some prizes. I guess the thing I should tell you is that because of all that studying, I did very well on the entrance exams at Mount Holyoke.

SKOLNIK: They were college boards then, right?

DYER: College boards. I think I was number one and got a four hundred dollar scholarship for leading the class in entrance exams.

SKOLNIK: You didn't have to take a college board exam in science then did you? There's one in chemistry, one in physics, and one in biology. But you didn't have to do those three then.

DYER: I don't think I did. If I took any, it would have been in chemistry, but I cannot remember which exams I took. I'm sure I took math and English.

SKOLNIK: I'm sure you took Latin.

DYER: Yes. There is another thing I forgot to tell you about my family. I just thought of it in connection with the entrance exams. I remember writing a paper on the English exam on the subject of music in the family. Both my mother and father were quite musical. My father played the clarinet and I started the piano early.

SKOLNIK: When you were five or six or seven?

DYER: Yes. I did learn that you could play scales and read and people in the kitchen wouldn't know the difference. [laughter] I loved to read. I just can't tell you everything I read, but we had a huge library.

SKOLNIK: I thought you might have one or two favorites from that period.

DYER: The Alcott books were favorites of mine. We had a good public library in Haverhill too.

SKOLNIK: Did you ever read any of the philosophers by the time you were in high school?

DYER: No.

SKOLNIK: You never went that far.

DYER: I didn't go that far, but I'm trying to remember. We had a set of books, fifteen or more. One was on travel, one was on exploration, one was on fantasy. I think I read almost all of that.

SKOLNIK: Was it the Elliott series?

DYER: No. It was another series. It looked like volumes of an encyclopedia, but it was much more interesting. They were very interesting to a child.

SKOLNIK: The Book of Knowledge had books like that.

DYER: I don't think it was the Book of Knowledge. I don't remember who published it. But anyway, I read. There's no question about that.

SKOLNIK: Your favorite subject in high school was Latin.

DYER: Yes.

SKOLNIK: Your next favorite subject was probably English or history.

DYER: Definitely not history. I enjoyed the French and I also enjoyed the English. I had excellent teachers in English. It really appealed to my imagination.

SKOLNIK: Particularly the literature part.

DYER: Yes. That's it, the literature part.

SKOLNIK: There's nothing like English literature. I think it's the best in the world. Maybe the French is second and the German third.

DYER: Yes. Oh, we read Shakespeare's plays. I think we read some English novels, but I can't tell you exactly. I know it appealed to me anyway.

SKOLNIK: But it had no impact on your career as a scientist.

DYER: No.

SKOLNIK: High school didn't either.

DYER: I got a good general education, but it was not heavy on science.

SKOLNIK: What about mathematics?

DYER: I did well in mathematics and I enjoyed it.

SKOLNIK: Did you work with your hands a lot, whether it was sewing or carpentry?

DYER: Not really. Definitely not sewing! I had to stay after school in sewing. My brother did more things with carpentry. Of course, I helped with the chores around the place. I don't think I did manual things particularly. I liked cooking, but I just did the usual chores.

SKOLNIK: Well, cooking is chemistry, so you did have an early interest in chemistry, then! [laughter] How did you choose college?

DYER: Well, my mother had wanted me to go to Wellesley because she went there. I wanted to get away from home. That's the first thing, like many adolescents, and I think it's wise. I had a cousin who had gone to Mount Holyoke and who liked it very much. She studied astronomy there. My favorite math teacher in high school was a Mount Holyoke graduate. Most important of all, a girl on my street, three years older than I and whom I admired, went to Mount Holyoke and studied chemistry. She used to tell me wonderful tales about how exciting it was at Mount Holyoke. So my family wisely let me go where I wanted to, which I think was very good.

SKOLNIK: You graduated from high school in 1923 when you were seventeen. Did you enter Mount Holyoke in 1923?

DYER: Yes.

SKOLNIK: But you did not major in chemistry when you entered Mount Holyoke. I assume it was just a liberal arts course.

DYER: No, but I started it as a freshman. I took general chemistry with Louisa Stone Stevenson, whom you have never heard of. She was a marvelous teacher. She was outstanding as a teacher rather than as a researcher. She was just excellent. Well, I decided I was going to take more of that. It was very interesting to me. That's when I really got interested in chemistry. Then as I went through college, I came into contact with people who were not only excellent teachers, but were doing research. Mount Holyoke women did research early in the game.

SKOLNIK: You're talking about what the professors did.

DYER: Yes, and the students.

SKOLNIK: Of course, you probably did [research] as a senior too.

DYER: Oh, yes. I mentioned Miss Stevenson. There was also Miss [Mary L.] Sherrill who did research.

SKOLNIK: Was she related to Miles S. Sherrill at MIT?

DYER: Well, she's dead now, but she was related to the MIT Sherrill.

SKOLNIK: Was she a physical chemist?

DYER: Yes, she was a physical organic chemist.

SKOLNIK: That follows.

DYER: And then there was Miss [Emma P.] Carr, who was famous for her early work on spectroscopy, but a bit distant as a person. The individual on the faculty who did the most for me was Miss Dorothy Hahn, who had a way of picking out people that she wanted to have as graduate students while they were still undergraduates, and persuade them to do a Master's at Mount Holyoke. That's exactly what I did.

SKOLNIK: Did they give you a scholarship or a fellowship to get your Master's degree?

DYER: I had a teaching assistantship. Both of those degrees at Mount Holyoke are B.A. and M.A. There are no B.S. or M.S. degrees at Mount Holyoke. They're all arts degrees.

SKOLNIK: Did you have physical chemistry as an undergraduate?

DYER: Yes, we had a full year of physical chemistry.

SKOLNIK: Do you remember what book you used?

DYER: Oh goodness. I can't tell you that now. But I know it



was a good course. We had the usual analytical chemistry, both qualitative and quantitative analysis. When I was a senior I started doing research with Miss Hahn. She worked on hydantoins. I used to go in on Saturday to work with her.

SKOLNIK: So you were a heterocyclic chemist by the time you got your B.A. degree.

DYER: That's true. I want to tell you some special things about the support I received from Miss Hahn. She had appendicitis during the year that I was a senior student. She said to the faculty, "Now, I don't want any of you old folks taking my classes. Miss Dyer is thinking of going into teaching. Let her handle my classes. She'll find out if she can do it, and I don't think the students will suffer, because I'll give her the outline she should cover." Well, I liked it very much. So of course she said, "There's no doubt about the fact that you must do graduate work."

SKOLNIK: Was this the organic class?

DYER: Yes. I took care of the undergraduate organic classes.

SKOLNIK: What about the laboratory?

DYER: Well, she had a graduate assistant to help with the laboratory. She also had also a course in organic theory, but I don't think I took that.

SKOLNIK: There wasn't too much theory back then, was there?

DYER: I think we used a book by Hendrich (1).

SKOLNIK: Yes, I know the name.

DYER: A graduate assistant at Mount Holyoke usually took two years to finish because it was part time teaching and part time research. In my second year, when I should have been writing a thesis, Miss Hahn said, "I am going on a leave of absence and you will have to finish your research and write your thesis without much help from me." Well, I was a bit stunned, but it was ideal training for the graduate work at Yale which came later because there I had to do a great deal on my own.

Even though she went to Egypt, she would receive mail. After the Mount Holyoke experience, we published two papers (2).

Miss Hahn helped me a great deal in writing the papers. She was a severe taskmaster, but very useful in showing how to present scientific material.

At Yale I worked with Treat B. Johnson, who was a great man.

SKOLNIK: Did you stay with heterocyclic chemistry at Yale?

DYER: Well, not entirely. I worked on nitro and amino triphenylguanidines with him. Johnson realized that no woman could be a teaching assistant at Yale. We had no means of earning money. So he reserved a certain number of research assistantships, as they were called, for a series of women that Miss Hahn sent to him. He knew if they came from Miss Hahn that they were properly trained. There was a whole series of Mount Holyoke women who were helped in that way at Yale by Treat B. Johnson.

SKOLNIK: In other words, as soon as you entered Yale, you chose to work with Johnson. Did you have to take courses first?

DYER: You see, I had a Master's degree. We could start the thesis work at once. Of course, I had to pass the usual comprehensive examinations.

SKOLNIK: But that was before or after you were in Yale?

DYER: That was after I arrived at Yale. I didn't have to take any entrance exams. I know that we had [Arthur J.] Hill in advanced organic and we were told before we took the comprehensive examinations in organic chemistry that should read the three volumes of Cohen (3). In physical chemistry, I don't seem to remember what we studied. I know I worked hard to pass the course. We had our thermodynamics with the under-graduates at Yale.

SKOLNIK: Did you use Getman and Daniels for physical chemistry (4)?

DYER: I don't remember. We had thermodynamics and the phase rule in separate courses.

There were a great many postdocs at Yale who were very helpful to me. I had learned from Miss Hahn's absence that you had to go around and find out about details. I'd also learned, from what she told me of T. B. Johnson, that I would never get detailed experimental help from him. I used to go to Karl Folkers, or to R. D. Coghill, postdocs with T. B. Johnson, when I was there, or other people of that ability to find out how

actually to do a hydrogenation or something of that sort. [John J.] Donleavy was another source of help. He was not a particular good researcher, but an excellent teacher and technician.

SKOLNIK: Who was [Oskar] Baudisch? Was he a biochemist?

DYER: Excuse me for laughing. He was a character. I was a postdoc at Yale for two years. I got my Ph.D. in 1931 and then was a Chemical Foundation postdoc for two years with Dr. Johnson. It was Johnson who said to me, "Miss Dyer, do you think you could bring Baudisch down to earth?" [laughter]

SKOLNIK: Was he a professor?

DYER: He was a research associate. He had an orthoquinone test for cysteine. It was one of the things that Dr. Johnson wanted me to do to bring him to earth. I did some routine work to show the details needed for the test, but I never did get into the theory of it. I couldn't tell you the source of the pink color. So although I worked with Dr. Baudisch, it was not outstanding.

SKOLNIK: You mean it went from colorless to pink.

DYER: That's it. It went to pink if you had a cysteine amino acid.

SKOLNIK: Well, I think any reducing environment would have caused it.

DYER: Yes. I don't remember about that. Let's see. What else did I publish when I was there? My doctoral thesis was on nitro and amino triphenylguanidines (5). It has since been corrected. We made a wrong assignment of an isomer. The present day NMR and mass spec and so on got it corrected. At least I was glad somebody else worked on it.

I had two other papers with Johnson when I was a postdoc (6). And then in 1933 I was very lucky to get a job at the Women's College of the University of Delaware. You may remember that there was a Depression in 1933.

SKOLNIK: I remember well!

DYER: I had written at least sixty letters and had heard of only two places where a woman would be acceptable. One was at the Women's College and the other was in Washington.

SKOLNIK: Were all of your letters written to universities for teaching, or did you write to industries as well?

DYER: I only wrote to universities. At that time I didn't think there was a chance in industry. Later on, I did have an interview at the Sun Oil Company, but decided it was not for me in spite of the attraction of the salary.

SKOLNIK: Was that in Philadelphia or Marcus Hook?

DYER: Marcus Hook. In spite of the attraction of the salary, I decided I was better off with teaching.

SKOLNIK: Was the salary for teaching equal to the one in industry?

DYER: Oh, the salaries in teaching were very low in those days.

SKOLNIK: Well, they were in industry too. A Ph.D. in industry might get a couple hundred dollars a month.

DYER: Well, my salary when I started teaching as an instructor at the University of Delaware (it was the Women's College), after the Ph.D. and the postdoc, was sixteen hundred and twenty dollars a year. But all the faculty were taking cuts. So that's not anything remarkable.

SKOLNIK: Was that less than what they were giving the men in the Men's College?

DYER: I don't think so. I think everybody was taking cuts because of the Depression. We had some good students in the Women's College. There were excellent students and morale was good. Students did honors work with me at the Women's College, even though at that time they couldn't get a Master's Degree from our work.

SKOLNIK: Could they major in chemistry at the Women's College?

DYER: Oh, yes. It was exactly the same course as the men were taking. I remember we had excellent instruction. Miss [Quaesita C.] Drake was nothing if not a person of high standards. The

department at the Women's College consisted of Miss Drake, myself, and a half-time graduate assistant. I shouldn't say graduate assistant, but just a half-time assistant, because she couldn't get a graduate degree at that time. Miss Drake said to me the very first year that I was there, "Betty, I want to teach all the freshman courses and all the seniors. And you should teach what is in between, qualitative and quantitative analysis, and organic chemistry. We will alternate in different years. And I hope you'll have time to start research, because if you don't, you won't amount to peanuts." [laughter] And this was from Miss Drake the first year I was there. She was a very generous and forward-looking person. Well, the work on beta-amino acids was done, and there's a paper with [Elizabeth] Ballard (7). She was one of our assistants who did the work for me, and we were able to publish it. Later she went on for a Ph.D. somewhere else.

SKOLNIK: Was there anyone else besides Johnson at Yale that influenced you in your career?

DYER: Well, there was the organic man, Dr. A. J. Hill, who did the advanced organic survey. He was an excellent teacher, although he didn't have the imagination of T. B. Johnson for research. He was a superior teacher. Aside from the fact that, with his New England background, he used to put an R on places where it didn't belong, everything was presented with great clarity. We were encouraged to read. He was an excellent help. In my class was a man named Julian Sturtevant, whom you may or may not have heard of. He was the top student in my class at Yale. He taught at Yale after he got his Ph.D. He was very helpful and very nice to all of us.

SKOLNIK: What journals were you reading in graduate school?

DYER: I can't really tell you what I was reading then. I'm sure we read the Journal of American Chemical Society and we were encouraged to go to local section meetings in New Haven. I should have told you something else. Do you mind if I jump around, because this is part of my education?

SKOLNIK: No, of course not.

DYER: Sometime in my connection with Miss Hahn she ordered me to make a presentation of our work at a section meeting. It was probably the Connecticut Valley American Chemical Society section, because I remember it was in Middletown. I had to give a paper on my own, and she made me do it instead of her doing it. You see the emphasis was to help people to develop which I think is remarkable.

We could probably jump to the time of the merger of the Women's College and Delaware College for Men if you want to.

SKOLNIK: Well, until then, were you conscious of the fact that being a female you had problems in science?

DYER: I wouldn't say so.

SKOLNIK: Because you were never unemployed, ever since you left high school.

DYER: No.

SKOLNIK: Except that you did write a lot of letters!

DYER: Yes. I felt that I was lucky. As I told you, I did interview at Sun but decided against it.

SKOLNIK: In other words, they offered you a job at Sun.

DYER: They offered me a job.

SKOLNIK: That would not be as an organic chemist though, was it?

DYER: It would have been, I think, as a synthetic chemist. What else is there at Marcus Hook?

SKOLNIK: Sharpe and Dohme also was in that area at that time.

DYER: No, it was Sun. I'm sure it was Sun. Well, anyway, the faculty at Yale were very cordial to us. I think that the women at Yale were not discriminated against, except in this business of not being able to have teaching assistantships in those days. We went to Section meetings at Yale and I got pretty well acquainted with the people in chemical engineering as well as in chemistry because we met them at the Section meetings. They were nice to us.

SKOLNIK: You never had an interest in the engineering part of chemistry, did you?

DYER: No, not really. I never did.

SKOLNIK: Did you ever meet Dorothy Quiggle from Penn State?

DYER: No I didn't.

SKOLNIK: She was married to Merrell Fenske at Penn State. During the Depression they didn't allow married couples both to be employed, so she used her maiden name.

DYER: That same kind of discrimination occurred at Delaware for many years. Husbands and wives weren't allowed to work on the staff. But not being a wife, I didn't have to worry about that.

SKOLNIK: Well, how about other women chemists in other universities? Were you close to them?

DYER: I was on the national Women Chemists Committee.

SKOLNIK: Was that in the 1930s?

DYER: No, I was on that Committee from 1968 to 1970 and 1971 to 1973. Well, I went to Section meetings in Delaware then, and I was secretary one year. Miss Drake knew the people in the Delaware section very well.

SKOLNIK: I believe she was a counselor back in the 1930s.

DYER: Yes. She knew a lot of the men in the section too. You asked me if I felt discriminated against. I certainly didn't.

The men in the combined department were very helpful and very cordial. There wasn't any trouble. In fact, way back at the Women's College, when we had honors students who had to take oral exams, as well as write a thesis, Dr. [Glenn S.] Skinner used to come down and hear their exams. He was helpful, gave good suggestions, and was not at all hard on us. I think he respected our work.

Is there anything more you want to know about the early period?

SKOLNIK: Well, when did you discover polymer chemistry?

DYER: Okay. I'll get to that! In about 1943, during the war,

the Armstrong Cork Company approached Dr. [Allan P.] Colburn, who was provost at Delaware, and said that the chemistry faculty members were probably not very busy because of all the men that were in the war. They asked if he knew anybody who would like to go out to Lancaster and work on polymers. Well, Colburn said he didn't know, but he would ask the people in the chemistry department what they thought about it. He said that it was very unlikely that any of us would go to Lancaster because we had the Navy on campus, and we had to teach them everything they were supposed to know about chemistry, physics, and math. (We didn't teach the physics and math.) In a very few months, Bill Mosher put Quaesita onto the organization of that, because she was excellent at organizing difficult things.

SKOLNIK: Bill didn't come to the University of Delaware until 1945.

DYER: Right. But anyway, Armstrong's approach to us must have been about 1943. Well, the Provost told Armstrong that while we probably could not go, we would like to strengthen graduate work. Could they see their way to a fellowship for us? They said they would give us a fellowship if we would work on polymers on some subject that was of interest to them. So Dr. Colburn asked the people of the chemistry department if anyone would be willing to work on polymers. I was the low man on the totem pole, absolutely the junior member. They all turned it down and it got to me. And I said, "Well, I have no previous experience in polymers, but I'd like to do it if you'll give me a chance."

[END OF TAPE, SIDE 1]

DYER: Then we searched for a candidate for the Armstrong fellowship.

SKOLNIK: What area of polymer chemistry were they interested in?

DYER: Their suggestion was that we should do some work on isoprene and styrene copolymers. Butadiene and styrene were well known, and they wanted to know what the isoprene polymers would be like. I must tell you about personnel. Our best candidates for the fellowship were twins that did not want to separate.

SKOLNIK: Were these two fellows or two girls?

DYER: They were two women from Greensboro College in North Carolina, Dorothy and Katheryne Levis. They were excellent people. Since they wouldn't separate and since they were so



good, Colburn dug out another fellowship. I think he got it from Continental Diamond Fiber Company. So we had two women and two fellowships to start work. One of the girls worked on the isoprene-styrene work. And I was trying to direct research in a field that I didn't know anything about.

SKOLNIK: Did you get your isoprene from Hercules?

DYER: I don't remember. I should have, should I?

SKOLNIK: You should have, because that was my project at Hercules, getting the isoprenes from terpenes.

DYER: Really? I should have talked to you in those days. We did talk to Harold Spurlin. We didn't have enough money from Armstrong to put both of the graduate students on the Armstrong work. We wanted to get another project started. I remember talking to Harold Spurlin, and he said, "I'm sure that polyurethanes will be important some day. Why don't you start some basic work on rate of reactions of various hydroxy compounds with isocyanates."

SKOLNIK: These would be bifunctional chemicals.

DYER: Well, we started with monofunctional things. Of course, there was not much known at that time. Maybe Hercules knew it and had it filed, but we started with the rates of reaction of primary and secondary alcohols with phenyl isocyanate. Harold suggested we could do it by a dilatometric expansion method. Later on, improvements were made. So I had a lot of help from various people.

I guess I jumped ahead a little bit there because I see that before we talked to Spurlin one twin sister worked on the reactions of cellulose derivatives with isocyanate. I may have gotten that idea from Du Pont. I did have a conference with Maurice Ernsberger in Du Pont. It was in the late 1940s that Harold Spurlin suggested to us the reactions of isocyanates with alcohols.

Now in the meantime, I was given a chance to work in the chemical engineering part of the Brown lab, because there weren't facilities for me in the very beginning in the chemistry area.

SKOLNIK: Because Colburn was also in charge of the chemical engineering?

DYER: Yes, and he helped me very much. There were others who helped in getting supplies and trying to get a laboratory staff.

I was kind of a roommate of their first Ph.D. in chemical engineering, James Westwater.

SKOLNIK: Actually, up to 1950, you really had hardly done any polymerization. It was all with monofunctional groups.

DYER: Yes. That's true.

SKOLNIK: And then in the 1950s you started on copolymerization when you worked with J. L. Maxwell on the polymerization of styrene with ethyl linoleate (8).

DYER: Yes, she was an Armstrong fellow.

SKOLNIK: The only thing that would polymerize there would be the styrene, or else you styrenated the ethyl linoleate.

DYER: Well, you can styrenate ethyl linoleate.

SKOLNIK: But that's not copolymerization. That's styrenation. Was there any peroxide present? This was definitely a metathetical reaction.

DYER: I think we had some peroxide there.

SKOLNIK: Then you polymerized the styrene.

DYER: Well, certainly the linoleate got into it somehow. I did want to tell you that I also had some help from a referee in the American Chemical Society. It was a very important piece of help. When I first turned in a paper on the styrene-isoprene work, it was really pretty poor. The referee said it was apparent that we had not had access to the government work on polymerization, and he would see that we got copies of what we should have.

SKOLNIK: Did you use a peroxide catalyst, such as benzoyl peroxide?

DYER: We might have used benzoyl peroxide in the early days. I'm not sure. Anyway, the important point was that we got the reports we needed to read on the federal work on polymerization. Now we had gotten some help on that from Armstrong, but I think

not as much as we should have had.

SKOLNIK: This was in the 1950s, and you did not have access to the postwar reports from Germany?

DYER: No, we didn't at that time.

SKOLNIK: That's a shame. We had so many on polymerization at Hercules, that we could have loaned them to you.

DYER: Yes, we should have had that of course, because I think some of our early work was not too great. I really think that some of the better work was the monofunctional isocyanate rates which were very helpful to people.

SKOLNIK: Aren't they applicable to the condensation polymerization of isocyanate with the bifunctional alcohols, or phenols?

DYER: Well, we did some of those later.

I forgot to tell you about a leave of absence in Scotland in the late 1930s, working under Professor George Barger. I worked on polycyclic nitrogen chemistry in a very interesting international laboratory. Professor Barger was at the University of Edinburgh, and I worked with him and with people from all over Europe in the department of medicinal chemistry. He could speak seven languages. It was a very stimulating laboratory to be in. Incidentally, one of his famous contributions was the development of the synthesis of thyroxin, but he later did a lot of alkaloid work. Two papers resulted from my year in Scotland (9). I would say it was an outstanding year.

Lewis J. Sargent later worked at one of the federal laboratories. He and I were the only Americans in the laboratory. I was supported by a fellowship from the American Association of University Women (AAUW). It was based on the fact that I needed broadening because of my limited experience in research prior to that time, at least at the Women's College. Now I had done some research with students, but still, I considered that an important experience.

SKOLNIK: In other words, he was an important influence in your life.

DYER: Yes. He's not living now, but I should say, one of the things that I learned from him was the importance of working with little bits. As you may know, alkaloids, at least in those days, resulted in tiny amounts of products.

SKOLNIK: Yes.

DYER: The first job I had to do was to make a substance he thought was a breakdown product of the Mitragyna rotundifolia alkaloid. I synthesized a tricyclic indole, but it wasn't the substance that he got out. After that job, I did some work with Sargent on the isolation procedures. It was tedious work, by present day standards where so much is done in spectroscopy, but I consider it very valuable to me.

SKOLNIK: When did you decided to teach a polymer course?

DYER: It was after this approach from Armstrong. I had some notes indicating that I taught a polymer course at least by 1945. It was given for a few people consisting of the twins and some students from chemical engineering. This was not offered at that time outside the university. I think it was just an in-house thing where I worked very hard trying to get some background.

SKOLNIK: Was it a one credit course that first year?

DYER: Oh, no. It was a two credit course, and I think it was always a graduate course. But it was not offered to the general public then. It was probably just as well, because I had to do an enormous amount of studying to get together materials.

SKOLNIK: Actually, there weren't too many books around on polymer chemistry yet.

DYER: No.

SKOLNIK: So you had to depend on the general periodical literature to design your curriculum.

DYER: Yes, although I had help from a man I met at a Gordon Conference. He was from Michigan State College, and he gave me an outline of a course he was developing at the same time that I was trying to work mine out. I should remember his name, but I'm afraid I can't pull it out. Later on, I did do the graduate course for various people.

SKOLNIK: There again did you depend mostly on the journal literature?

DYER: Yes. I would try to learn something about the general uses from a polymer encyclopedia and worked with journal literature and any other way that I could pick up information.

SKOLNIK: Did you know Herman Mark by then?

DYER: Of course I knew who he was.

SKOLNIK: You didn't know him personally then.

DYER: I didn't know him personally. I was lucky in being accepted for a number of Gordon Conferences on the basis of the fact that I was young and green in polymer chemistry. I learned a great deal there, talking to people about what was going on.

SKOLNIK: Did you meet Charlie Overberger then?

DYER: Oh, yes. I knew him pretty well, and one of my students finally did a postdoc with Charlie Overberger in later years. One of the jobs we did for Armstrong, probably the only thing that was of real value to them, was the effect of alkali on linear polyurethanes. They wanted to know whether there was any use in thinking about polyurethanes as floor products, which were their major products. So we did a systematic study of the effect of alkali on different kinds of polymers and learned that they were easily decomposed by alkali. Of course, this was valuable to them, because they certainly should not use polyurethanes in their floor products.

SKOLNIK: But then the housewives turned to detergents which were not alkaline.

DYER: True. It might have been all right anyway. At least it made a good thesis for a young man to do a systematic study on that (10). In 1954 we were still doing still doing things with linoleate and styrene. Armstrong wanted a patent on that sort of thing, and we patented it (11). I don't think it's any good to anybody. We also did some things on monomers supported by NSF and some other federal agencies.

SKOLNIK: You also did some work in cellulose chemistry at that time.

DYER: Yes, Harry Williams worked for me in that phase.

SKOLNIK: Was that influenced by Hercules people?

DYER: Harry Williams was employed at a local industry, but not Hercules.

SKOLNIK: Viscose was very interested in cellulose acetate.

DYER: Yes, that's where he worked. American Viscose. His Master's thesis was developed from their suggestion (12).

SKOLNIK: He had a lot of literature to go through on the acetylation of cellulose, didn't he? Even in 1957 there must have been a lot. It goes way back to the nineteenth century.

DYER: I doubt if he got back to the nineteenth century.

SKOLNIK: Oh, he couldn't read German?

DYER: Well, we tried to make our people read German. They were supposed to be able to read both German and French to get a Ph.D. degree. But you see, he wasn't a Ph.D. candidate.

We were still doing some kinetics with phenyl isocyanate and thiols. I was very lucky with my students. One, John F. Glenn, was employed by the L. D. Caulk Company in Milford. He was allowed to do his thesis work there. He was extremely able and I went down to see his work several times. We let him do his research in his own laboratory. That never happened again because it's not a good idea to have Ph.D. research away from a university.

SKOLNIK: Not that far away.

DYER: But this man had no objection to driving into Newark many times for conferences. I had inspected his excellent equipment in Milford too.

SKOLNIK: When did you stop doing polymer work? Was it in the 1960s? By that time you had a full grown course in polymer chemistry.

DYER: Oh, yes.

SKOLNIK: And the more students you got, and the better your course was, the less research you did in polymer chemistry?,

DYER: Well, I did what seemed to be important at the time.

SKOLNIK: Did you ever dig up your notes for a book in polymer chemistry?

DYER: Oh, no.

SKOLNIK: Why not? It seems to me that after you've done all that work, it's worth a book.

DYER: Well, other people were writing books, like [Fred] Billmeyer (13).

SKOLNIK: Billmeyer was oriented to the physical part of polymers.

DYER: I know it, but I didn't have time to write a book. Teaching is strenuous.

SKOLNIK: So what did you do? Were your notes typed or was it in your own handwriting?

DYER: It was in my own handwriting. I tried to improve the course every year.

SKOLNIK: Was it basically a descriptive course?

DYER: It was basically a descriptive course, although I did do a decent amount on the theory of polycondensation and vinyl polymerizations, for instance.

SKOLNIK: Did you get into molecular weight determination?

DYER: Yes.

SKOLNIK: What about viscosity?

DYER: Oh, yes. I had to do that, although I was not expert in it.

SKOLNIK: What about bulk polymerization and branch polymerization.

DYER: Oh, yes.

SKOLNIK: Did you include rubbers?

DYER: Not much. It was too much to do rubbers. I used to cover some of it.

SKOLNIK: How about the physical properties of the polymers? That's where rubber would come in very nicely.

DYER: I included viscosity relations, cross linking, and that sort of thing. It was long enough ago, Herman. I would hate to give you the contents of the course now. After all, I retired in 1971!

SKOLNIK: Yes, that's a long time ago.

DYER: That's time enough to forget.

SKOLNIK: What were your other interests during this period?

DYER: Let's see, what did I do? There was the preparation of 3-(3-quinolyl)alanine (14).

SKOLNIK: Was that because you liked heterocyclic chemistry? You liked natural products, too.

DYER: Yes, I did.

SKOLNIK: In fact, I think if left to your own devices and the war never came along, you'd be a natural products chemist because I can see this in your publications. You always leaned toward that direction.



DYER: That's true. Every once in a while I'd get into purine chemistry, and carbamates derived from amino purine, and purine thiols, and so forth.

SKOLNIK: You never had an interest in biochemistry per se, did you? You left that to Quaesita.

DYER: As long as she was on the staff, she taught the biochemistry. She wanted to.

SKOLNIK: I thought she might involve you in some of her ideas.

DYER: Perhaps you don't know that after she retired, and before they got a real biochemist at the staff at Delaware, I gave a sophomore course in elementary biochemistry to the nursing and agriculture and home economics majors. Every year that I taught, I gave the course in elementary organic for the applied people. And until they got John Wriston, I also gave the elementary biochemistry to the applied people and enjoyed it very much.

SKOLNIK: What do you mean by applied people?

DYER: I mean the people who were going into nursing, what was then called home economics, and agriculture. I tried to bring polymers into that course, even though it wasn't really biochemistry. It was important for people in agriculture and home economics. They ought to know something about cellulose.

SKOLNIK: Well, the most common polymer in this world is ice.

DYER: Well, that's true, but I never did deal with ice, more with the organic polymers.

SKOLNIK: That surprises high school kids that ice is a polymer.

DYER: Yes. That's a fun thing to do.

SKOLNIK: They have DNA and RNA too.

DYER: Yes. Those are fascinating subjects now. It seems to me the high school students are a bit young for that.

SKOLNIK: Yes, they get DNA in high school now, but they don't understand it.

DYER: I'd be a little worried for fear that you were taking the cream off college biochemistry.

SKOLNIK: You have not read a high school chemistry text, have you, recently?

DYER: No. I'm sure it's very advanced. Well, here as you see, I disappoint you in my contributions to polymer chemistry.

SKOLNIK: No. You are still one of the first teachers in polymer chemistry outside of Brooklyn.

DYER: Well, I think there were some others too.

SKOLNIK: Not many.

DYER: That man at Michigan State, though, might have been trained at Brooklyn.

SKOLNIK: Bill Bailey studied under Marvel, and he brought polymers to Maryland.

DYER: Yes, I know Bill Bailey, and I admire his work.

In the late 1960s we were still doing some polymer-type work, such as polytetrazoles and polyaminotetrazoles (15). The Armstrong fellowships sometimes went to Bill Mosher and sometimes went to me. Sometimes I had two at once or sometimes I had one and he had one. They were very kind in letting us stipulate what we would do research on. That is after the early days. They did not prescribe what we should do, as long as it was polymeric.

We sometimes ran into some very strange products. The Majewski and Travis work was on heterocyclic products (16). Dunbar worked on some phosphorus containing polyurethanes (17). Richard Dunbar eventually went to Pittsburgh Plate Glass. My last Ph.D. was Sincich, who finished two years after I retired with a ketene isocyanate problem (18). We were asked by Dr. Fettes to write it up for Macromolecular Syntheses (19).

SKOLNIK: Since you're retired, you're an ornithologist. It's more than just bird watching. This is scientific ornithology.

DYER: Well, I've done what you might call semi-scientific things for the Delmarva Ornithological Society. I participated in the breeding bird atlas census, a five-year project in Delaware, to get evidence as to what breeds in this state. This has been a very interesting project.

SKOLNIK: Do you have to climb the trees and count the eggs?

DYER: No. [laughter] You don't want to decrease the amount of nesting in Delaware. It's done indirectly. We do get indirect evidence through seeing a nest being built, or seeing the young being fed in the nest, or recently fledged young, or even if you have a pair in a certain area for three weeks in succession.

SKOLNIK: Well, Betty, does this require you to take pictures of the birds in flight or coming to the nest?

DYER: No. It's too hard to do that. Of course we have to know the birds well enough to know what it is.

SKOLNIK: Do you have to know what trees they prefer to breed in?

DYER: One of the men at the natural history museum would like it if we identified the type of tree and all of that, but actually we haven't done it with most of the species. I tried to have notes so that we could do it if I ever got around to it.

SKOLNIK: Well, Betty, of all the papers that you published, which are you most proud of?

DYER: That's a tough question. The thing that should be emphasized here is the importance of the students. Now practically everything is working with the students and the education of the students.

SKOLNIK: That was your primary objective before publications.

DYER: It was the primary objective. There's no doubt about that.

SKOLNIK: When you worked with Treat B. Johnson, did you work mostly on your ideas or on his ideas?

DYER: On his ideas, mostly.

SKOLNIK: When you had your own students, would they contribute ideas, or did you dominate all the ideas.

DYER: Actually, they contributed many times. That was especially true when we had done quite a bit of isocyanate work, because I was running out of ideas for further work with isocyanates. It was my student Sincich who said, "Why not see what ketenes would do with the isocyanate?" That was his idea. A number of the students contributed important ideas.

SKOLNIK: Now, how would the isocyanate react with a ketene? There's no active hydrogen there to switch over to the nitrogen, is there?

DYER: We did an anionic copolymerization.

SKOLNIK: Your greatest satisfaction was really in teaching.

DYER: Oh, there is no doubt about that.

SKOLNIK: Even more so than the research you did.

DYER: Oh, I'm sure that my biggest contribution was in teaching. Let's see, there were 34 Ph.D.s, and 71 Master's degree students. Now, a number of the Master's went on to Ph.D.s, so that's not additive.

SKOLNIK: But still you had to worry about their theses, and that kept you busy.

DYER: Oh, yes. Definitely busy.

SKOLNIK: Did you force your students to write their own papers for publication or did you help to write them?

DYER: I'd force them to try. Many times I made them write a first draft and then I worked with them to try to get it into better shape.

SKOLNIK: You received several teaching awards.

DYER: The Manufacturing Chemists Association gave me an Excellence in Teaching Award in 1958, and the University of Delaware a similar award in 1969.

SKOLNIK: Was the one at University of Delaware determined by the choice of the students or the faculty?

DYER: When I got it, both contributed to the selection. I guess I should tell you one more thing. There is an Elizabeth Dyer Teaching Award in our department for graduate assistants who do a good job of laboratory teaching. And I like that. I think laboratory teaching is extremely important.

SKOLNIK: I do too. It is very difficult.

DYER: Yes. I used to work hard with the laboratory instructors who taught under me to try to see that they were properly informed and doing as good a job as possible on the teaching.

SKOLNIK: Did you ever run a polymer laboratory course?

DYER: No, except for that early course where the twins and the chemical engineering students did it.

SKOLNIK: Thank you very much, Betty, for telling us about your career.

[END OF TAPE, SIDE 2]

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