THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

JOHN R. SCHAEFGEN

Transcript of an Interview
Conducted by

Raymond C. Ferguson

in

Wilmington, Delaware

on

3 April 1986

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JOHN R. SCHAEFGEN

1918 Born in Wilmette, Illinois on 9 April

Education

1940 B.S., chemistry, Northwestern University
1944 Ph.D., physical organic chemistry, Ohio State University

Professional Experience

1944-1951 Research Chemist, Goodyear Tire and Rubber Company
E. I. du Pont de Nemours & Co., Inc.
1951-1952 Research Chemist
1952-1977 Research Associate
1977-1982 Research Fellow
1983- President, ELJAY Associates, Inc.

ABSTRACT

In this interview John Schaefgen begins with his family history and early life in Gross Point, Illinois. He then discusses the development of his interest in science, and describes his education, including his professors and fellow students at Northwestern University and Ohio State University. In the central portion of the interview Schaefgen considers his association with Paul Flory at the Goodyear Tire and Rubber Company, and recalls his move to the Pioneering Research Laboratory at Du Pont. He then describes his interests and accomplishments in polymer chemistry. The interview concludes with a discussion of his colleagues, professional society activities, and views on the characteristics of innovative research.

INTERVIEWER

Raymond C. Ferguson obtained his degrees in chemistry from Iowa State University (B.S., M.S.) and Harvard University (Ph.D.). He worked in research divisions of the Organic Chemicals, Elastomer Chemicals, and Central Research Departments of Du Pont, principally in molecular spectroscopy, organic structure analysis, and polymer characterization. Currently he is affiliated with CONDUX, Inc., a consulting association of ex-Du Pont professionals.

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INTERVIEWER: Raymond C. Ferguson

LOCATION: Windsor Hills, Wilmington, Delaware

DATE: 3 April 1986

FERGUSON: John, I know that you were born in Wilmette, Illinois, on April 9, 1918. What was your father's name and occupation?

SCHAEFGEN: My father was Peter Schaefgen. He was a laborer. He worked on construction, mixed mortar, carried bricks, did anything that a laborer does in construction. He was also a part-time policeman.

FERGUSON: What was your mother's name?

SCHAEFGEN: My mother was Augusta Kasielke Schaefgen. She emigrated from Germany when she was about twenty-one years old. She was a member of a large family -- there were eight children. There were also eight children in my father's family. When they met she was taking care of the grandchildren of Eugene Field, the famous poet who wrote "Winkin, Blinkin and Nod." She cared for them in Chicago and then they moved to a northern suburb. My dad was working on construction work in the house next door, and mother offered him a drink of coffee. They got acquainted and he finally married her.

FERGUSON: Was your father born in Wilmette?

SCHAEFGEN: Yes, he was born in Wilmette.

FERGUSON: What kind of place was Wilmette in those days?

SCHAEFGEN: Well, actually, we didn't live in Wilmette. We lived in Gross Point, which is now part of Wilmette. Gross Point was sort of farm country on the other side of the tracks, as they say. Wilmette was really a rich settlement for the people who lived in Chicago. Gross Point was the ethnic German community at that time. In fact, my father went to a Catholic church and church school where they learned in the German language. He learned in German, but they spoke English, of course. In fact, in our home we spoke German when I was a small child. That's why I learned German pretty well.

FERGUSON: What about your education?

SCHAEFGEN: First of all, let's consider the conditions at that time. We were going into a depression, and the building trades simply didn't flourish at that time. Dad was out of work most of the time. He had to take anything that came up, such as parking cars, and somewhat servile work that was to be done around the neighborhood. It was difficult. We were actually on relief part of the time. It was a question of how much education one would get in those days.

I went to a local grammar school, and then I went to New Trier Township High School, which is one of the best schools in the country. It's a well known high school. I did well there. I got a half scholarship to Northwestern University after I finished high school.

FERGUSON: You went to a public school system?

SCHAEFGEN: No, I went through a Catholic school system in grammar school, but then I went to a public high school. In high school I took chemistry and was quite interested in it. I did well. I also read a lot of books. At that time, there were some books on creative chemistry by a fellow named Slosson (1), there was Paul de Kruif and his book on "Microbe Hunters" (2), and a few others of that kind. That interested me and steered me in that direction.

FERGUSON: How large was your high school?

SCHAEFGEN: It must have been a couple of thousand. It was a fairly large high school.

FERGUSON: Do you recall the size of your high school graduating class?

SCHAEFGEN: Five hundred or something of that sort. As I said, it was one of the best known high schools in the country at the time. Maybe half the graduating class went to college. It was in the elite suburbs where a lot of the rich people from Chicago lived. They commuted to the city to work. Some of our graduates went to Amherst, Harvard, and MIT.

I had a 4.0 average in high school and went on to college. At that time it was pretty hard to get scholarships. There weren't as many as there are nowadays. But I received a half scholarship, and after the first year, a full scholarship. I won

several different named scholarships to take me through Northwestern University.

FERGUSON: Who provided these scholarships?

SCHAEFGEN: There was a Marcy scholarship. I suppose the donor was Marcy. I received a University scholarship first. There were probably about ten of them. Then they had two or three named scholarships, which I received thereafter. These were full-tuition scholarships for the last three years at Northwestern, which is as much as they gave at that time.

FERGUSON: When you were in high school, was there anyone in particular that influenced your interest in scholarship or chemistry?

SCHAEFGEN: No. I just enjoyed the laboratory and I enjoyed reading about it. I liked the idea of making inventions and finding new things. I always enjoyed fiddling with things and putting things together, such as working with radios from crystal sets. We used to listen to the first radios and the news broadcast.

FERGUSON: Did your parents or other relatives encourage you to go to college?

SCHAEFGEN: No. My mother had the idea that I would be an insurance salesman or something of the sort. They really didn't think about college. My brother was the one who encouraged me the most, because he worked and went to night school to get a diploma in accounting. He didn't get a college degree, but took all the accounting courses necessary for a degree. Then he passed an exam and won the Gold Medal in accounting in the Chicago area. He encouraged me to go on to college.

FERGUSON: How many brothers and sisters do you have?

SCHAEFGEN: I have two brothers and no sisters.

FERGUSON: Were they both older than you?

SCHAEFGEN: They were both older. My elder brother went on to college, as I said. My second brother dropped out of high school. He didn't like school that much.

FERGUSON: You have a curvature of the spine. Did that develop early?

SCHAEFGEN: That developed very early. I was about three or four years old when I was diagnosed as having tuberculosis of the spine. They had difficulty diagnosing it in those days. At first, they thought I had rickets and they prescribed various things that didn't work. Finally, I went to the hospital where the cure for tuberculosis at that time was to strap you up and make you immobile. They strapped me to a frame and had me lying perfectly immobile in bed for six months in a hospital. That of course cured nothing. So they decided that the only way to immobilize the spine was by an operation. They fused the vertebrae and then put me in a body cast that extended from my chin to above my hips. I wore that for a couple of years. Because I laid in bed so long, I was also paralyzed so that I couldn't walk. In fact, they didn't think I'd ever walk.

FERGUSON: When did this all happen?

SCHAEFGEN: I was nine years old before I finally got through all of the therapy. It was a period from three to nine. I had a very unusual childhood.

FERGUSON: It must have been pretty traumatic.

SCHAEFGEN: It was. At home, my brothers didn't recognize me because they hadn't seen me for all that time. The only people who visited me in the hospitals and convalescent homes were my parents. That was once a week. It was a very traumatic time.

FERGUSON: That must have been a heavy financial burden on your parents.

SCHAEFGEN: Well, they couldn't pay for it. It was all as a ward of the state, so I had to take whatever care they were going to give. The care was not very good. I was in with a bunch of people from Chicago who were very rowdy. The whole situation was one I'd just as soon forget.

FERGUSON: That was before the crash of 1929?

SCHAEFGEN: Right. I was home for that. The first thing I remember in any newspaper was Lindy's flight over the ocean. Then, of course, the campaign in 1928. Everyone was excited,

because Smith was a Catholic.

FERGUSON: Did you live at home during your days at Northwestern?

SCHAEFGEN: I lived at home and commuted. That was the only way we could afford it. I took a chemistry exam when I started in the school. Based on that chemistry exam, in which I achieved the highest grade, they promoted me immediately to second year chemistry. That sort of jelled. My brother thought I should be an accountant, but I didn't particularly like accounting. It was just keeping books and financial records. There appeared to be nothing new in that at that time.

FERGUSON: Did you take the four basic subjects in chemistry?

SCHAEFGEN: Yes, I took the four basic subjects. I skipped the first year and took the maximum number of hours. In the last year, I took a few graduate courses, and I was in with the graduate students. At that time they had a grade point system of seven at Northwestern. A, A-, B, B-, etc. My grade point average was something like 6.8.

FERGUSON: Did you have a minor?

SCHAEFGEN: I had minors in math and physics.

FERGUSON: Were there any professors that made an impression on you?

SCHAEFGEN: Well, they were all very friendly. The one that I had as an advisor was Malcolm Dole, who is a fairly well-known polymer chemist.

FERGUSON: Yes. I know him.

SCHAEFGEN: He's still active. Charlie Hurd is still alive. He was the organic professor. I liked the organic chemistry course and lab. I believe the other people have died.

FERGUSON: What was Malcolm Dole like?

SCHAEFGEN: He was a physical chemist and a very friendly person. I took a graduate course with him on statistical thermodynamics,

as I remember. I had it in the summer in a small class and everyone enjoyed it, even though it was a difficult subject.

FERGUSON: Did he lecture from his own notes or did you use a text?

SCHAEFGEN: We used a text at that time. I think it was Slater's book (3).

FERGUSON: It could be. Did you concentrate on the academics or were you involved in school politics?

SCHAEFGEN: No, I avoided politics but I liked sports. I liked badminton particularly. It was not a recognized sport at college, but we did get a team together. We had a coach and practiced every day. We had some matches with other Big Ten schools, namely Illinois. I remember going down there and playing, because I was on the team. Also, I liked table tennis. I played a good deal of that.

FERGUSON: Did you feel sort of cut out of campus life by living at home?

SCHAEFGEN: To some extent. Northwestern was very oriented towards fraternities and sororities. They did a lot of rushing. We just didn't have the money to get into that sort of thing. The dances were closed because they were fraternity events. I went to football games and got together with crowds there. Chemistry and science students, in general, worked pretty hard in those days with many laboratory courses. We got together in our own group and talked and worked problems.

FERGUSON: You finished high school in 1936?

SCHAEFGEN: That's right. The fiftieth reunion is this year.

FERGUSON: Have you gone to any of them?

SCHAEFGEN: I'm going to this one. I went to the forty-fifth reunion at Northwestern last year.

FERGUSON: You graduated from Northwestern in 1940. Did you go on to Ohio State immediately?

SCHAEFGEN: Immediately. There were very few jobs out there at that time.

FERGUSON: Was this the motivation or had you decided that you wanted an advanced degree?

SCHAEFGEN: I think I decided that I wanted an advanced degree. The professors at Northwestern encouraged me to go on. They gave me good recommendations for several schools, and I was offered a teaching assistantship at Ohio State. In fact, at that time, the big schools like Harvard said to come for a year. "We'll accept you but we're not giving out teaching assistantships to first year students. You have to prove yourself first." I just didn't have the money to support myself.

FERGUSON: Was the teaching assistantship one of the requirements for the degree at Ohio State?

SCHAEFGEN: No, but most chemistry graduate students had one.

FERGUSON: When I went to Harvard, chemistry students were also accepted as teaching assistants, and this was part of the degree program.

SCHAEFGEN: Well, maybe. My memory is a little hazy. It could have been that one was accepted to do some teaching, but wouldn't get paid for it, or at least not paid enough to support oneself. Even the pay at Ohio State was very meager. I had to live on about a dollar a day for food and ten dollars a month for room.

FERGUSON: Did you live in a private rooming house?

SCHAEFGEN: Yes. As a matter of fact, it was a rooming house we called "Mercaptan Manor". We arranged it so that the landlord accepted only graduate chemistry students and we agreed to fill the house. So, we kept it as a chemistry house and gave it that name. Later on, I joined Gamma Alpha, the scientific fraternity, and lived in the Gamma Alpha house.

FERGUSON: Was it expensive?

SCHAEFGEN: No, because it was a cooperative house. We did all of the house-cleaning but we had a hired cook. I was editor of the Gamma Alpha magazine at that time.

FERGUSON: At Northwestern, how many chemistry majors graduated with you?

SCHAEFGEN: There were very few. I think there were about eight to ten.

FERGUSON: What was the total graduating class size?

SCHAEFGEN: It was a big class. I guess it was a thousand people if you included both the Evanston campus and the Chicago campus and all of the various degrees and schools. Within the arts and sciences school, it was a few hundred.

FERGUSON: Which campus did you go to?

SCHAEFGEN: I went to the Evanston campus.

FERGUSON: At Ohio State, how many graduating students were there in the class in chemistry?

SCHAEFGEN: I think we had about seventy in the first year class.

FERGUSON: Did your fellowship involve teaching?

SCHAEFGEN: Yes, and also lab assisting. It was a teaching assistantship. In the last year, I had a university fellowship where I did no teaching. When I was at Northwestern, I also worked under the National Youth Administration [NYA] of the Roosevelt days. My first work there was shelving books in the library. Then I went over to do chemistry projects. They got grants and the NYA students did work in the laboratory.

FERGUSON: Was the NYA work during the school term?

SCHAEFGEN: Yes, it was. In the summer, the professor (or the library) took the money out of their own funds to keep me employed.

FERGUSON: So you continued to spend your summers at Northwestern?

SCHAEFGEN: Right. I was on my own. My parents could give me nothing, so I worked my way through school.

FERGUSON: Did you go through Ohio State continuously, including the summer?

SCHAEFGEN: Yes, I did. In this way, I made it in three and one-half years.

FERGUSON: You chose physical organic chemistry. Which professor did you work for?

SCHAEFGEN: I worked for two professors. Mel Newman was an organic chemist and Frank Verhoek was a physical chemist who was interested in kinetics. Newman was involved in synthesis.

FERGUSON: Was organic chemistry your first choice?

SCHAEFGEN: I don't know that it was my first choice. I was interested in chemistry generally. That's probably why I went into polymer chemistry. It involves all facets of chemistry.

FERGUSON: Are there any classmates at Ohio State that you remember?

SCHAEFGEN: Well, there was one classmate at Northwestern. Lew Sarett was the Carothers lecturer last month. He was a year ahead of me at Northwestern. Paul Morgan was just ahead of me at Ohio State. There were a couple of people who worked for Melville Wolfrom who did well. One was Dave Weisblatt who eventually had a high position in one of the drug companies. Also, Dave Braithwaite was well known for his work on organometallic chemistry, and became chairman of the board of Nalco.

FERGUSON: You got your Ph.D. in 1944. What was the job situation then?

SCHAEFGEN: The job situation was excellent. There were lots of interviews during the war years. As a matter of fact, I selected one company to work for, but before I accepted their offer another company said, "Come on up anyway, if you haven't accepted." They were anxious to get people in those days. You could get almost as many job offers as you had interviews.

FERGUSON: Did you consider teaching?

SCHAEFGEN: I considered teaching, but I think the thing that simply looked the best at that time was to go into industry, because there were so many jobs. In teaching, there weren't that many, because people were going off to the war and not going to graduate school. The situation in teaching wasn't nearly as good as it was in industrial work.

FERGUSON: What was your first job out of graduate school?

SCHAEFGEN: My first job was with Goodyear Tire and Rubber Company. The person that got me to go there was Paul Flory, who interviewed me. In my estimation, when I went to the various companies that I interviewed, there was just no one that compared with Flory.

FERGUSON: Why?

SCHAEFGEN: He had a certain charm about him, besides having a reputation. There was no other choice. I interviewed Du Pont also. I liked Du Pont, but Flory was the thing that swayed me towards Goodyear.

FERGUSON: What was his position at Goodyear?

SCHAEFGEN: He was my supervisor. Of course, if I hadn't worked for him, it wouldn't have been the attraction it was. The idea of working for Flory was the primary consideration. He outlined the things that he was working on and the fundamental nature of the work that he was doing very convincingly. In other places, such as oil companies, they were working on additives. It was rather empirical research. He was the one person who was working on something that had a scientific goal. Also, the polymer chemistry field was just starting then. He was one of the great movers in this field. The combination of something new, something scientific, and something that could lead to worthwhile industrial products was unbeatable.

FERGUSON: Where did Flory go when he left Du Pont in 1938?

SCHAEFGEN: Well, he went from Du Pont to the University of Cincinnati. He taught there for a while, but he felt that he could achieve more with people who had already gotten their

training. So, he went from there to Esso Research, where he worked and published on the experimental verification of the viscosity equation. He showed that the Mark-Houwink relationship was an exponential function, rather than an equation to the first power as Staudinger had proposed. There was still some argumentation on that point at the time. He studied a wide range of molecular weights of polybutylene. Then he went from Esso to Goodyear. I suppose this was a promotion since he worked more or less as a chemist at Esso, and went to Goodyear as a supervisor.

[END OF TAPE, SIDE 1]

FERGUSON: I have heard, perhaps incorrectly, that there may have been some disappointment or hard feelings that led to Flory's leaving Du Pont in 1938. Did he ever indicate such to you?

SCHAEFGEN: No, he never did. In fact, he didn't speak very much about it. We wanted to know what happened. Why did Carothers commit suicide? He simply didn't say much about that. He also didn't say why he left. When I was here [Du Pont] I looked up some of his early work, including his letters to Carothers and his reports. About the only thing that I noted is that perhaps he became more involved in practical work at the end of his career at Du Pont. This may not have particularly suited him, because he wanted to continue in the fundamental work that he later made such a career of. He may have felt that he could progress better in other organizations.

FERGUSON: Did he ever talk about Dr. Stine or Dr. Bolton?

SCHAEFGEN: No.

FERGUSON: I think in 1938 there was a change in research policy when Elmer Bolton took over the Chemical Department.

SCHAEFGEN: As I said, all that I did was read between the lines of the reports and patents to look at the type of work that he was engaged in. He had a patent issued on polymerization. I suppose that they were channeling him into more practical work. That probably wasn't the sort of thing he wanted to do in the long run. These are my own presumptions.

FERGUSON: Did he have a pretty free hand at Goodyear?

SCHAEFGEN: He had a very free hand. He did formulate some new theories, and he wanted to test these out in the laboratory. He always wanted to make his theories applicable to practical situations. He would do the laboratory work to make sure that

the formulas weren't simply pure mathematical formulas that were rigorous and couldn't be used. He had someone work on the melting points of copolymer systems to check out his melting point theory. We derived the viscosity average molecular weight relationships. I did some work with him on that. We looked at branching and the effect of branching on the solution viscosity behavior. These are some of the publications I had with Flory (4). He was always trying to get at the very basic concept of any polymer theory, and trying to verify it and to make his formulas applicable to real situations.

At the same time, he realized that you had to do work that could justify the fundamental work that you were doing. So, at the time, we were making polyesters for fibers. We made the Dacron composition, poly(ethylene terephthalate), among others. We also made poly(tetramethylene terephthalate), which just recently, of course, is a plastic being widely accepted in the marketplace. We did the first work there. We had the first patents on it (5).

FERGUSON: Is poly(tetramethylene terephthalate) one of the most low shrink amorphous resins?

SCHAEFGEN: I think poly(butylene terephthalate) will crystallize readily; that is, more easily than poly(ethylene terephthalate).

FERGUSON: Isn't there a General Electric low shrink polyester resin?

SCHAEFGEN: You mean the polycarbonates or Norel?

FERGUSON: No.

SCHAEFGEN: I think GE does put out the poly(butylene terephthalate) as well. That's one that we worked on. Back at that time we were working on it for fibers. We were also working on poly(ethylene terephthalate). Goodyear, of course, is a rubber company and they were interested in new tire cords. The difficulty is that if we made tire cords for our own tires, we couldn't go out and sell them too well. At that time Du Pont was selling fibers. Fibers were in demand. If Goodyear didn't buy fibers from Du Pont and other suppliers and found that they needed a supply greater than their own, they may not have been able to get them. Fibers were an allocation. There was some politics in that too.

FERGUSON: Between Du Pont and Goodyear?

SCHAEFGEN: Right. We worked on polyesters, but we never commercialized them. Eventually, of course, Goodyear commercialized polyester resins for bottles. That came long after Flory left. I think one of the reasons Flory finally left Goodyear was that unless you can show some positive contributions from a profit standpoint of what you're doing in research, it must come to an end. It's a natural consequence. He realized this and had a combination of basic and applied research that worked out pretty well.

Flory was well thought of there. In fact, he was frequently consulted at the corporate level. The chairman of the board would have him in and would talk to him. He was recognized, even at that time, as being a real giant among chemists.

FERGUSON: Had you been introduced to polymers at all in college or graduate school?

SCHAEFGEN: Not at all.

FERGUSON: So Flory was your polymer teacher?

SCHAEFGEN: My teacher, my leader, my idol. We thought a lot of him. We thought at that time that he would be a Nobel Prize winner.

FERGUSON: Was your work for him done mostly in the synthesis of polymers?

SCHAEFGEN: Mostly in synthesis. He supplied much of the theory. He would work it out. He would frequently ask the people working for him to check through what he had done and make comments and corrections. Even though he had done things very well, he was not loath to accept criticism, and to ask advice from people working for him. We would have weekly conferences and present our work. Other people would criticize the work and ask questions. It was a very fruitful way of conducting research. We shared results, whereas in the rest of the laboratory they tended to work by themselves and do things rather secretly. To find information, you'd have to go talk to them.

One of the big changes at Du Pont was that people had to write reports, so we could find out what was going on very easily. At Goodyear, they tended to be somewhat secretive about what they were doing in the different groups.

FERGUSON: What were the other groups?

SCHAEFGEN: Well, they were working on rubber chemistry and compounding. These things were somewhat different, but even there we did have an influence. They would come around with some of their problems and ask advice. I think one of the contributions Flory made was to the technology of rubber heels which were introduced at that time. These were highly vulcanized, highly cross-linked systems. He recommended they cross-link it to a greater extent to get greater hardness.

FERGUSON: Was Flory's group a corporate research group?

SCHAEFGEN: Well, it wasn't a big enough organization to subdivide it the way that you do here. It was called the Fundamental Research Group.

FERGUSON: How many people were there in this?

SCHAEFGEN: Oh, I think, at the highest point they had about ten people.

FERGUSON: Are there any others in that group that are notable?

SCHAEFGEN: Well, the other person was Tom Fox, who went on to become quite well known in the polymer field. He went with Flory when they left to go to Cornell. Harold Mighton went to Du Pont and worked in the Film Department. Norm Rabjohn went to the University of Missouri and taught. I've lost track of the others.

FERGUSON: When did Flory leave Goodyear?

SCHAEFGEN: I think it was in 1948.

FERGUSON: During this period, the government rubber project was going on. Were you involved?

SCHAEFGEN: I was not involved with that, but we knew about it.

FERGUSON: Was that in another group?

SCHAEFGEN: The Goodyear contingent was in another group. A lot

of it was centered at the University of Akron, so it really didn't influence our group to any great extent.

FERGUSON: Burt Nichols told me that Flory contributed in some way to the light scattering method, but you did solution viscosity work?

SCHAEFGEN: Viscosity and synthetic work.

FERGUSON: How did you determine your data for developing the Mark-Houwink equation?

SCHAEFGEN: Oh, we did it by end group analysis to get molecular weights. We didn't have good light scattering.

FERGUSON: Were you working with polyesters?

SCHAEFGEN: We were working with polyamides, so we could titrate the end groups. My contribution there was to make the first synthetic branched molecules of the star type with four or eight branches. This work preceded later work on such molecules.

FERGUSON: I believe the theory was that the slope of the viscosity plot is affected by branching. Is that correct?

SCHAEFGEN: That's right.

FERGUSON: This at least worked for polyamides?

SCHAEFGEN: Right. After Flory left, I did some work on the polyelectrolyte effect of polyamides in formic acid and sulfuric acid. That was the first work on polyelectrolyte effects in synthetic polyamides.

FERGUSON: What do you think your most important contributions were to polymer chemistry?

SCHAEFGEN: Well, there were a couple of things -- the derivation with Flory of the viscosity average molecular weight, work on branch polymers, and the polyelectrolyte effect. Then, later on at Du Pont, I think the most important thing I did was to work with the anisotropic melt polyesters. I started the work at Du Pont in this area.

FERGUSON: When was that work started?

SCHAEFGEN: About 1972.

FERGUSON: Well, that's during the tail end of your career.

SCHAEFGEN: Right. Of course, I worked on several things along the way at Du Pont.

FERGUSON: Let's go back to why you left Goodyear and came to Du Pont.

SCHAEFGEN: One reason was, of course, that Flory was no longer at Goodyear. The group that we had on fundamental research simply broke up. Almost everyone that was associated with that group left and went elsewhere. T. G. Fox went with Flory. H. Mighton went to Du Pont. N. Rabjohn went to the University of Missouri. F. Leutner went somewhere else. R. D. Evans and I left.

FERGUSON: Did you look at other companies as well as Du Pont?

SCHAEFGEN: Yes, I did. It was a close struggle to decide between GE in Schenectady and Du Pont. GE also had a very fine reputation at the time. I finally chose Du Pont, thinking that it is a chemical company and there should be more opportunity for a chemist there.

FERGUSON: This was in 1951?

SCHAEFGEN: Yes. I was very favorably impressed with Hale Charch when he interviewed me at the time I went to Goodyear. In fact, Du Pont was my second choice at that time. When Flory left, Charch simply contacted me again and asked if I was interested in a job with Du Pont. So I went to Du Pont and interviewed at GE, as well. Really those were the only choices at the time. I really didn't consider anyone else.

FERGUSON: Pioneering Research Laboratory was at the Experimental Station in Wilmington?

SCHAEFGEN: Yes. They had come down from Buffalo during the

previous fall, and I started in the spring of 1951.

FERGUSON: Who did you work for initially at Du Pont?

SCHAEFGEN: I started out working with Carl Black. He was a physical chemist.

FERGUSON: How would you characterize the group? What were their responsibilities?

SCHAEFGEN: The responsibility was to develop a new textile or industrial fiber. At the time, we had gotten into interfacial polymerization. Paul W. Morgan and Emersen Wittbecker of Du Pont had pioneered this field, so I started there. A very short time thereafter, they had the polyparaxylylene work. I started to work in this area. As a co-author I published some of the first papers in the area (6). I isolated various side products and finally decided that this method (starting with paraxylylene and simply pyrolyzing it to come up with the polymer), although it appeared cheap, did not give the fiber quality one needed nor did the economics justify any sort of scale-up. So we stopped with just doing a fundamental study of decomposition of xylene and polymerization of the paraxylylene (quinoid form) that formed as a result of the pyrolysis reaction.

FERGUSON: Can you give a brief description of the Pioneer Research Laboratory under Hale Charch? Didn't he report directly to a vice president?

SCHAEFGEN: No. I think he reported through the normal research organization, but he was a personal friend with general manager Andy Buchanan. At that time they didn't call them vice presidents. Charch knew him quite well, so in a way, he reported directly to him. The research management couldn't tell Charch exactly what to do.

He was a very independent operator, and he justified that, because he came up with a number of profitable products. He had a way of inspiring people to do their best work, and also had a very good idea of what things could be used for. He would start the marketing end by fostering that research that he thought would lead to products. He had a way of inspiring people by coming around to the laboratories and talking to them, sitting down on a stool and saying, "Hey, what are you doing now?" He would give his idea of what he thought ought to be done or what it might be useful for. He was just a tremendous person. He operated independently. He shielded the research organization from the people above him, so that people were a lot freer in their choice of objectives and in carrying out the work. He

would take responsibility to transfer this information above him, and to be solely responsible for what the laboratory did. I think nowadays they are feeding a lot of this responsibility down even to the bench chemist.

FERGUSON: How much freedom did you have in selecting your own projects?

SCHAEFGEN: Well, they encouraged everyone to select their own projects. They had to stand up against what the management could give you to do. Any time you could say, "I think this other project is better and it is something we should be working on." If you could convince them that it had more potential than the project they assigned you, you could spend full time on it.

They encouraged people to spend up to twenty percent of their time working on what we called bootleg projects. These were projects that weren't related to your assignment. At times people spent even more than that. I remember one fellow that spent a good deal of time on another project. It didn't turn out well. Finally, they had to convince him to stop it and do the work that was more important from an industrial standpoint. But we were encouraged to do a lot of work on our own ideas.

FERGUSON: Whom else did you report to after Carl Black? There were several other groups.

SCHAEFGEN: Yes. I reported to Wittbecker for quite a while. I reported to George Lanzl. I thought he was one of the best managers that I reported to. He had a way of encouraging people to do independent thinking. He would get everyone together in a meeting and say, "Here's a problem we're faced with. What are your solutions?" He would point to each member. He would write the solutions on the board and think about them, then say "We'll select this route." But every one of us had a voice in the decision of what to do to solve the problem.

FERGUSON: Were Wittbecker and Lanzl research supervisors?

SCHAEFGEN: Lanzl was a manager at the time. I was promoted after about a year to Research Associate.

FERGUSON: Did you still report to a supervisor?

SCHAEFGEN: No, I reported to a manager. Black was promoted to manager about the same time that I was promoted to Research Associate, so I was reporting to Black. Then I reported to

Wittbecker when Black was promoted further. Wittbecker was also a manager. I think I reported to Black, then Lanzl, then Wittbecker, Tod Campbell, Eugene Magat, and then John Griffing. I worked on polypivalolactone and polypivalolactone fibers for a while.

FERGUSON: I remember that one. It was a very interesting fiber with an unusual crystal structure.

SCHAEFGEN: Yes. It had a helical structure, but it also had a zigzag structure, which was not as stable. It also had two types of structures -- alpha and beta. If you had it in one structure and it went over to the other, then it would induce some permanent fold wrinkling, as they say, and you simply couldn't get these wrinkles out. "Box wrinkling" was the Achilles heel of that fiber.

FERGUSON: I did a little polypivalolactone work later. The monomer was also classified carcinogenic, wasn't it?

SCHAEFGEN: That's what really killed the whole thing for good. In other words, people always thought that there might be some possibility of resurrecting it. One neat thing about polypivalolactone is that you can get very high molecular weight. By simply refluxing the monomer in a cheap hydrocarbon solvent you can get over a million molecular weight. You would then collect it. There was no viscous solution to deal with. It was then melt spun. It's very hydrolytically stable because of the hindered nature of the ester linkage. It's also highly crystalline. It approximates the crystallinity of polyethylene, eighty percent or more. It has a lot of interesting attributes.

FERGUSON: Were you principally involved in pioneering new fibers and compositions?

SCHAEFGEN: Yes, new fibers and new compositions. I worked a good deal on polyacrylonitrile. There it was more polymercharacterization. I worked with Conrad Bohn and William O. Statton. We published a paper on it and its laterally ordered structure (7). We concluded at the time that one simply couldn't make a polymer that was highly three-dimensionally ordered and would have the properties, let's say, of the isotactic polyolefins. If you made isotactic polyacrylonitrile, it wouldn't have similar properties, because the nitrile group controls the structure, rather than the stereochemical configuration of the carbons along the chain. People disagreed with us at the time. Apparently our conclusions have held up because no one has succeeded in preparing a highly isotactic polyacrylonitrile.

FERGUSON: I thought the only successful preparation involved the urea canal complex.

SCHAEFGEN: In this case, it is still questionable whether they achieve very much isotacticity. You know, with the poly(alpha olefins), you might get 96 or 98 percent. If they achieved 80 or 90 % with polyacrylonitrile, I'd be surprised.

FERGUSON: Well, you're right on that. I measured it.

SCHAEFGEN: You see, I think you need something that's 95% or more stereochemically pure before you get into the high properties. It's something that goes up very quickly, asymptotically, when you get up to very high configurational purity.

FERGUSON: Actually, Orlon polyacrylonitrile has done fairly well over the years.

SCHAEFGEN: Yes, it has. On and off, I have worked on it. I worked in the early days of the isotactic polymers, trying to apply it to polymers with functional groups. A lot of this work was not published.

FERGUSON: Was this in polyolefins?

SCHAEFGEN: No. It was in other things, such as isotactic polystyrene, polyacrylonitrile.

[END OF TAPE, SIDE 2]

FERGUSON: How long were you in Central Research?

SCHAEFGEN: I spent a year in the Central Research Department. That was back in 1965 or so. There I worked on some polyhydroborane chemistry. It was too expensive to be considered for fibers. We made some films from it, but it simply wouldn't make the grade for any industrial use. We explored a number of possibilities.

FERGUSON: Earl Muetterties was the borane chemist. Were you involved with him?

SCHAEFGEN: No. William A. Sharkey was the supervisor and Vaughn Engelhardt was the associate director. I think it was Engelhardt, but it might have been Burt Pratt.

FERGUSON: Probably Engelhardt. That period was sort of the beginning of interchange of personnel between Central Research and the operating departments. Until then, the operating department research laboratories were pretty independent and didn't interact a great deal with Central Research, did they?

SCHAEFGEN: Except that we did sponsor projects in Central Research. The people that were on projects would come over to Pioneering Research to report on what they were doing. I think Charch operated this project system fairly well, because he would have people come over, especially when they asked for more money to continue sponsorship. They would give a report. At that time he felt that after six months something practical should be on the horizon. Otherwise, he didn't feel inclined to support it again. When they asked for money and they put forth their various plans, he would ask a very leading question. He would say, "Well, just suppose that you succeeded in doing all of these things that you plan to do. Where would you be then? How would it show any potential for giving us a new product?" If they couldn't answer that question very positively, the chance of continued support was very slim.

Charch was a very bright fellow and could see where things were going. He would encourage people, but still, he had the industrial background and viewpoint that had to be satisfied before you began to spend more money on a project and increase the personnel.

FERGUSON: Did you have to write quarterly reports on each project?

SCHAEFGEN: I think that's right. I think it was two or three reports a year initially. At that time, Central Research had four reports a year, but that has gone the other way around now. Central Research writes fewer reports. Pioneering Research requires, supposedly, at least two reports a year. They give oral reports about every three or four months.

FERGUSON: Each researcher?

SCHAEFGEN: Each research man.

FERGUSON: We even wrote weekly summaries, when I first came.

SCHAEFGEN: We had weekly summaries, too. I think that went out. The supervisor could require it, simply as a way of monitoring research. It was a convenient way. We had what we called monthly letters that we had to write. These were intended for higher management, but they were very terse summaries. I think the best way of keeping track of research was the oral reports, and the so-called Pioneering Research reports. People had to think about what they were doing and summarize their thoughts. I think this is the best way of bringing home to them the important contributions that they might have made. You had to put in a summary and conclusions of exactly what you did. This required a good deal of soul searching and asking, "Am I on the right track, and am I doing it correctly?"

FERGUSON: Did you work on nylon at all?

SCHAEFGEN: Very little, perhaps in a consulting capacity.

FERGUSON: How about Dacron polyester fiber?

SCHAEFGEN: I did very little on that. It was mostly exploratory work on new fibers.

FERGUSON: You mentioned Orlon and polyacrylonitrile.

SCHAEFGEN: I did work on Orlon, because it perhaps needed more work. It was the weak sister of the fibers. We wanted better properties, higher molecular weight, higher tenacity, higher modulus. I was usually involved in the really pioneering type of work on new fibers, changing fibers drastically to alter properties. I was involved in making new polymers -- the polyamides, polyesters, new vinyl polymer types.

FERGUSON: Were you involved in the linear polyaramid work?

SCHAEFGEN: I worked to some extent on it. I was working on some new spinning systems, using anhydrous hydrofluoric acid to dissolve the aramids. That was pretty close. I had the idea of making more concentrated solutions in hydrofluoric acid, because it was a very much less viscous solvent to start with, so the polymer solution was less viscous. You could build up a higher concentration without increasing the polymer solution viscosity. The only trouble was that when you heated these solutions in order to get lower viscosity, it degraded the polymer. Hydrofluoric acid degrades the polymer much more quickly than 100 sulfuric acid. Had this succeeded, I may have had the same sort

of success as with sulfuric acid.

FERGUSON: Then you got involved in the melt anisotropic polymers?

SCHAEFGEN: Right. The idea was to make the structure stiff enough, but simply introduce substituents or use copolymerization to reduce the melting point, or make it more amorphous. If the polymer is still linear, it should have high properties. I think the linearity of the structure is the more important than, let's say, crystallization or perfection of the structure. You can achieve the high properties simply by having a linear structure, no matter what the nature of the microstructure is. A copolymer can have various substituents as long as you don't disrupt it so much that it can't form liquid crystalline phases. That was the basis of this idea. At the time, the thought was that the solvent separates the molecules and prevents three-dimensional crystallization. If you work with the neat polymer, it's going to crystallize before it will form liquid crystallization phases. If it can get ordered enough to form a liquid crystalline phase, it's simply going to crystallize. Flory even expressed this idea, but we tried it anyway and it worked.

FERGUSON: Have you publications or patents on this area?

SCHAEFGEN: We have patents but we never did publish it (8). There are some publications coming out now (9). I'm giving a paper on the symposium we're planning for Princeton in August of this year. We're having an international symposium on ultimate properties of polymers.

FERGUSON: Do you recall when Flory started back with Du Pont as a consultant?

SCHAEFGEN: I arranged to have him come back. It was in the 1955-1960 period. He couldn't consult when he was working at the Mellon Institute. He was full time at Mellon. It was a quasi-industrial organization. After he left Mellon he started consulting with us.

FERGUSON: He was at Mellon before Cornell?

SCHAEFGEN: No. He went to Cornell first. We must have had him when he was at Cornell, and then he couldn't consult while he was at Mellon.

FERGUSON: I don't think he consulted with Central Research until recent years.

SCHAEFGEN: No, he didn't. I don't know why that was. He was a textile fibers consultant all the time, but he didn't like to go out to the outlying laboratories. He said their problems were too applied and he didn't feel it was worth his while. He was very jealous of his time. He didn't have that much, so he didn't want to consult in fields where he felt he couldn't make a good contribution. He thought it was a waste of their money and his time.

FERGUSON: In truth, Central Research wasn't doing much in polymers from the late 1950s to mid 1960s.

SCHAEFGEN: That's right,too.

FERGUSON: One of the reasons you and I were invited to Central Research was the need to do more basic research on polymers, because the operating departments were cutting back.

SCHAEFGEN: Right. They were getting more into modifying existing polymers to make new products. They were not making new structures or doing basic research. That gap had to be filled by someone else.

FERGUSON: Were you ordinarily Flory's host when he came?

SCHAEFGEN: Yes, I was his host until I retired.

FERGUSON: Did you maintain a close personal friendship with Flory?

SCHAEFGEN: Yes. We exchanged Christmas cards. We talked and met frequently. I knew his whole family.

FERGUSON: How about other consultants that you worked with?

SCHAEFGEN: I knew Marvel pretty well and acted as his host at times.

FERGUSON: Did you use [Walter] Stockmayer at all?

SCHAEFGEN: I have talked to Stockmayer and I thought he was also an excellent chemist. He lacks the breadth that Flory had.

FERGUSON: What function do you feel the consultants perform?

SCHAEFGEN: That's a difficult question to answer. Why don't I speak in general terms? I feel most people thought that consultants were useful as sounding boards. In other words, you could talk about your ideas. They would tell you whether you were on the right track. Flory, of course, had a very keen insight. If you were promoting something on the basis of an inadequate theory, he would tell you right off that you just couldn't do this sort of thing. In addition, consultants inspired you, too. They had a different viewpoint. They brought in their experience in other fields, so you were inspired talking to them. As far as help on the individual projects, you frequently didn't get too much of this, because you knew the subject better than they did. To think that you could bring in someone for a day, tell them completely what you're doing and then expect them to make a worthwhile contribution, is just expecting a little too much.

FERGUSON: Now you're a consultant. What are the problems on the other side of the business?

SCHAEFGEN: You really ought to ask the people that consult with me, shouldn't you?

FERGUSON: I'm asking you.

SCHAEFGEN: I have one advantage. I do keep up with all the work that's going on, so they don't have to fill me in with the background. I have the industrial viewpoint of what they're after and how one goes about it. I have some advantages over the person coming from the university. I also work a little bit differently. I will read up in areas, in which I know I'm going to consult, in advance. I will have follow-up work in which I will bring things to their attention. I will think about their problems in between. So, in fact, I will have some ideas to start out with, whereas a consultant from the university will come in cold.

FERGUSON: When did you retire?

SCHAEFGEN: The end of November in 1982.

FERGUSON: Was that part of the Voluntary Retirement Incentive?

SCHAEFGEN: Yes, the first one. Since then I formed my own consulting company, which I call ELJAY for Laura and myself.

FERGUSON: Are you consulting entirely for Du Pont?

SCHAEFGEN: I consulted for an oil company for a day. Unfortunately, oil companies have fallen on bad times, so I never went back there. I think they dropped the whole research idea that they were working on. But I have consulted with a company called "SAIC" who had a government contract from NSF to evaluate Japanese technology versus American technology in the field of advanced materials. I filled a niche with a group of other people, and we're putting out a report in a couple of months (10). We made an oral report in Washington before a large number of government scientists and administrators.

FERGUSON: I know you've been a leader in the American Chemical Society. Did you join the ACS in college or graduate school?

SCHAEFGEN: I joined in graduate school. I've been a member for over forty years.

FERGUSON: And you're approaching the fifty year mark.

SCHAEFGEN: Well, it will take a few more years.

FERGUSON: You've been a counselor?

SCHAEFGEN: This is my fifteenth year as a counselor. I've decided to leave it for younger people, so I'm not running again. I've been on the National Committee on Economic Status for several years. Before that I was on the Professional Relations Committee at the national level, and on several subcommittees of these council committees.

FERGUSON: Were you a member of other societies as well as the ACS?

SCHAEFGEN: I've been going to Gordon Conferences in polymers for a number of years now and was chairman of that conference in 1970.

FERGUSON: Have you gone frequently or just occasionally?

SCHAEFGEN: Since I was chairman in 1970 I have been going every year, and I went a number of times before that.

FERGUSON: Have you ever gotten involved in the Winter Gordon Conferences out in California?

SCHAEFGEN: I've been there only once, but I didn't get involved in an official capacity.

FERGUSON: Was that separate from the Gordon conferences in the summertime?

SCHAEFGEN: It is separate. They elect their own officials and they run entirely separate. It's run in the same way. They get funds and arrange the program. The conference chairman is purely on his own. He's responsible for the whole conference, including the organization and getting it running.

FERGUSON: How about your local ACS participation?

SCHAEFGEN: I've held the office of treasurer, secretary, and chairman of local sections. I was treasurer of the Akron section when I was at Goodyear. I was secretary, alternate counselor, counselor, and chairman of the Delaware section. I've been on some committees as well.

FERGUSON: Has Du Pont been supportive of your activities there?

SCHAEFGEN: They were supportive, providing clerical help and covering telephone calls. I've been working to some extent during working hours on local section business. So, they've been supportive.

FERGUSON: Let's talk a little bit about publications and publication policy. Were you encouraged to publish at Goodyear?

SCHAEFGEN: Flory encouraged people to publish. I don't think Goodyear cared. They were sort of passive on the subject. Flory published almost everything that he could publish at the time. There it was a wide open policy of publication. Du Pont, of

course, is different. They have a reviewing system. Anything that has any potential commercial value has to be withheld. We have so many operating departments interested in polymers, and any of them can withhold publication. The publication rules that you have to satisfy are simply more and more difficult to fulfill. There's more editing of what you publish, so that it's much more difficult at Du Pont to publish.

FERGUSON: Did you find this inhibiting? Did it discourage you from publishing?

SCHAEFGEN: No, not really. We tried and if we didn't succeed we had to accept it and went on. The thing that's most difficult is that you find that if you start something and do some work, other people will get in on it. They do notice patents. So, when you get around to having publications cleared, you find that most of the things you want to publish have already been done by somebody else. This is a little bit difficult to accept, but you're being paid to put forth inventions. You have to accept that. If you want to publish, you don't go to industry, you go to a university.

FERGUSON: Do you feel that Du Pont rewarded people for publishing? Was this considered to be negative or positive?

SCHAEFGEN: I think it's neutral. I thought that Stephanie Kwolek has achieved a good deal of honor in her field. I don't think that she has received the same sort of treatment from the company. I think she should have been promoted.

FERGUSON: She did too. She should have been promoted much sooner, I think. For a person who had only a bachelor's degree, she has achieved significant recognition.

SCHAEFGEN: That's right, but I think it's pretty much neutral. If there is a question on the fence, I think someone that has achieved a reputation outside the company might gain value from this.

FERGUSON: I frequently felt many of our outstanding people were not recognized within the Du Pont company as well as they were among their peers in the outside scientific community. Have you had that feeling?

SCHAEFGEN: Somewhat, but it really wasn't that important. I think that people were recognized within the company if they did work that was worthy of publication. If you do publish, do

conduct meetings, and you're active in society affairs, it shows a competence that should be recognized within the company too. It shows a degree of leadership. It shows a degree of scientific competence that has to be recognized. Someone that publishes and is subject to a reviewing system other than within Du Pont has to be more careful in what he does, to have a higher degree of competence than for many of the things that are published within the company. I think it's worthwhile.

That idea was even expressed by some of the higher people in Central Research in a series that I had in the DelChem Bulletin some years ago. I asked certain questions. I think it was Ted Cairns who thought that someone who had published outside subject to a peer review system showed a competence beyond the person who only publishes within the company.

FERGUSON: What are your feelings about the changes in the professional status of chemists, or the approach of chemists to their work, from the time that you were starting out to the present time? Are there any significant changes that you see?

SCHAEFGEN: Are you talking about changes that should be made or are being made?

FERGUSON: First, about changes in research policy in industrial companies, Du Pont in particular.

SCHAEFGEN: There has been a great deal of work and many inventions made in the field of chemistry, from the time when I started. The need to become even more inventive and more innovative is even stronger today. A number of inventions have been made, so the field that's available is not as great. You have to give more freedom to the individual chemist to do his own work. I don't think that you can direct research the way you did previously. You don't have the number of projects that have to be manned and specific directions given for development work. So, we have to allocate more funds for innovative work and continue it for a long time. I think if we don't, we're going to run afoul of foreign competition, such as they have in Japan and Germany and other countries where they will show more persistence in a given field and more work to achieve success. We tend to go into something, and if it doesn't succeed in six months, we drop it. I think the time is coming when we'll have to devote more time to it, and encourage people to do more individual work, and to exercise their greatest ingenuity in order to be competitive in innovative research.

Innovative research is where we're going to keep ahead of the foreign competition. If you look at Nobel Prize winners in the U.S. versus other countries, if you look at the number of significant inventions and where they have been made, they've

been made in the U.S. for the most part. That has kept us ahead because when you come to applied research, lower cost foreign work, and lower cost foreign research is a formidable problem. They're going to beat us out economically in this field all of the time. We can stay ahead innovatively, because we have the system here of encouraging people to be innovative from the universities on.

[END OF TAPE, SIDE 3]

SCHAEFGEN: The message I'm trying to get across is that we need people who think broadly, try to get at the very basic concepts, and aren't afraid to tackle problems that look very difficult. A lot of industrial research people think that if a problem is difficult, they're going to get a bad performance review if they haven't made sufficient progress. Everyone tends to look at problems that can be solved easily. Even in graduate school, they tend to work on problems that can be solved so you can get your degree and go on.

But we're competitive now with the whole world, and we have to stay ahead of them. I think the field in which we can stay ahead is in the innovative, basic research area. We have to encourage that sort of thinking. We have to encourage people to tackle very difficult problems and come up with solutions. We have to be persistent enough to continue to provide the money and research facilities. We need supervisory and managerial people who are also very technically competent and can recognize the types of research that have to be done. Perhaps their role would be to steer people clear of getting up blind alleys and getting into areas that yield only mediocre results. As long as you encourage people to go along the right path and leave it up to them to determine how to get there, I think that we'll keep ahead of competition.

If we still make the innovative discoveries and have a good patent system to protect them, we're going to stay competitive in the world market. The other countries may have some advantages in the applied, development and production ends by being more efficient, and especially with cheaper labor costs.

FERGUSON: Do you think that's the way things are going? It seems to me that there is a lot more emphasis on "research by objectives," as it's called, or on "mission-oriented research," as the government calls it.

SCHAEFGEN: I think you need a combination. You can have this, but we certainly ought to allocate our resources in the innovative and new areas as well. This is no different than before except that perhaps it takes more people and more brighter people to make these discoveries. So they have to put more effort on this. I think that this is being done now, say in the biological field, at Du Pont. They have allocated many more

resources. I see in Pioneering Research that there isn't as much detailed direction from the top. It's up to the people themselves to formulate their objectives and how to get there. I think this is important.

So, I think that the free enterprise system will swing to that which is successful, and they'll recognize that they have to go in this direction.

FERGUSON: How about talking a little bit about your family. What was your wife's maiden name?

SCHAEFGEN: Her maiden name was Laura McConathy. She went to school at Kentucky and we met at Ohio State where we were both graduate students.

FERGUSON: What was her field?

SCHAEFGEN: Her field was physical chemistry. She was working on a rather new field involving properties of gases above the critical temperature. This required some relatively heavy new equipment. The difficulty was that the professor she was working for, Edwin Lassettre, went on the Manhattan Project and left. No one else really took over the project. So she settled for doing all of the course work for a Ph.D. but never finished the research. Then, she went to Goodrich and I went to Goodyear. We dated and decided to get married. It was rather interesting. Of course, they were two rubber companies that were in competition. In fact, three weeks before we were to be married her boss came to her and said, "You know Laura, we discussed this matter at the staff meeting and we decided that it's all right. You can go ahead and marry that fellow from Goodyear." [laughter]

FERGUSON: They didn't force her to make a choice then.

SCHAEFGEN: No.

FERGUSON: What year were you married?

SCHAEFGEN: We were married in 1945.

FERGUSON: You were both in Akron for about a year?

SCHAEFGEN: Yes. About a year.

FERGUSON: She went to school in Kentucky. Was this an undergraduate college?

SCHAEFGEN: Yes, the University of Kentucky.

FERGUSON: Where's that?

SCHAEFGEN: In Lexington. They have a basketball team, you know.

FERGUSON: Where was her hometown?

SCHAEFGEN: It was Lexington. She lived on a farm.

FERGUSON: Her background sounds very Irish.

SCHAEFGEN: Scotch-Irish. We were married in Akron at a very small wedding. It was during the war. We flew off to New York afterwards and honeymooned. She continued working at Goodrich until she was pregnant with our first child, John, Jr. That was in 1948. Thereafter, every couple of years, we had a child. We had nine. John, Jr., is a lawyer in Washington. He got a degree as a physicist at Georgetown University, and then went to Georgetown Law School. After doing graduate work in physics, he decided that wasn't what he wanted to do. He did work at the Bureau of Standards, and he worked while he went to law school. Now he's in a public law firm dealing with energy issues.

FERGUSON: Who are your other children?

SCHAEFGEN: Our second one is Betty (Elizabeth). She wanted to become an M.D. She graduated in nursing. She wasn't accepted by colleges and universities here so she attended medical school in Capetown at the University of Stellenbosch. She studied in a different language. They speak Afrikaans at this school. She interned there and then did a residency at St. Frances Hospital in Wilmington. She is working in Atlanta in the emergency room at an Atlanta hospital. She has three children. She married a South African.

Susie is the next daughter. She majored in English. She got her master's degree in Library Science and is a librarian for a large law firm in Columbus, Ohio. She has one child and her husband is teaching English and writing at ohio State and ohio Wesleyan. His hobby is amateur astronomy. He's well known in this area.

Bob is a mechanical engineer and works for the government in the naval shipyard in Philadelphia. He is unmarried.

Madalyn is an M.D. She went to Jefferson University in Philadelphia and she now works in family practice in the Air Force. She paid them back for their support of her expenses at Jefferson. She has one child.

Mary is working with retarded adults at Elwyn Institute and is married. Her husband does the same work. She has an infant son [born in 1988].

Kathy carries mail. Her husband works at Du Pont in Pioneering Research. They have two children.

Caroline majors in computer engineering at Auburn University. She has a year to go.

Peter dropped out of school and is working with telephone wiring and other jobs in the local area. That completes the children.

FERGUSON: How many grandchildren do you have?

SCHAEFGEN: Seven grandchildren. The oldest is nine.

FERGUSON: So with two doctors you have some medical advice in the family.

SCHAEFGEN: You realize how much there is to do in the field of medicine when you talk to them. There's an awful lot that we don't know. The medical horizon and the fields of biochemistry, molecular biology, and chemistry are still wide open. This a frontier that has great promise for its ability to help mankind.

FERGUSON: Did Laura get a chance to practice any chemistry after the children started getting older?

SCHAEFGEN: No, not while the children needed attention. She now helps in our joint consulting firm, ELJAY Associates, Inc.

FERGUSON: I see she shows up at many of the ACS meetings.

SCHAEFGEN: Well, she's also an employee of the ELJAY Corporation. She helps me in making reports up and looking up some of the literature. She's also active in the League of Women

Voters, Pacem in Terris, and the Nuclear Freeze Movement.

FERGUSON: Is there something that you'd like to talk about that we didn't cover?

SCHAEFGEN: Of course, I still like sports. I play golf and swim. I've played bridge over the years at various levels.

FERGUSON: Will you mention others of your scientific colleagues?

SCHAEFGEN: Well I've been good friends with Paul Morgan, Stephanie Kwolek, Emmie [Emerson] Wittbecker (who's retired), and people in other departments, including yourself. Also, there are people from ACS that I've worked with.

FERGUSON: How about Don Niederhauser, Warren's brother? Don was a physical chemist, wasn't he?

SCHAEFGEN: I think he was more of an organic chemist. Generally, one speaks of polymer people as polymer chemists. It transcends any discipline in organic or physical. You do what has to be done. I certainly knew Don and talked to him a lot. He had quite an interest at one time in polymerization of acrylonitrile in the presence of zinc chloride and spinning these solutions or casting films. The polymerization was very fast and initiated by light and by a catalyst.

FERGUSON: What about interactions with the people at the plants. Did you go down to the plants on occasion?

SCHAEFGEN: Very seldom. All of the work I did was in the primary stages, so I didn't work on any of the development projects at all. I did not do any of the scale-ups.

FERGUSON: If you had to do it all over again do you think you would pick chemistry?

SCHAEFGEN: I would think so, especially in the times we grew up in. Chemistry was just starting to expand and show its value. It was a good field. Those were fine working times we had. We saw the field grow. We saw chemical meetings of two or three thousand go up to ten thousand. There was a great proliferation of the number of conferences held. There were books and literature expansion. We witnessed the growth of the field.

Now whether you would advise people to go into that field at the present time is questionable. I think if you're good and want to get into new things, chemistry still has a lot of promise. Even the old fields of polymers and fibers and plastics are still growing. There are still inventions to be made and one sees that they're being made. It's not as wide open as it used to be, but there's always room for good people in these areas. In the new fields like biological chemistry, the opportunities are many and varied. Chemistry is still a good field to be in.

FERGUSON: Who helped you particularly in your career? You mentioned Flory, of course.

SCHAEFGEN: There was Flory, of course, and [Malcolm] Dole at Northwestern. [Charles] Hurd at Northwestern was another influence. There was Newman, who was my preceptor, and Verhoek at Ohio State. At Goodyear it was Flory and the people that I worked with too, such as Rabjohn, Leutner, and Fox. Fox was a good friend for many years until he died. I knew [Herman] Mark fairly well, and there was Stockmayer, Harold Scheraga, and many others.

FERGUSON: Scheraga was never a regular Du Pont consultant.

SCHAEFGEN: No. Well, I knew him and Emil Ott, [Harold] Spurlin at Hercules, [Arthur] Tobolsky at Princeton, and Bill Culbertson at Ashland Oil. He is very competent.

FERGUSON: Dr. Malcolm Dole is a very courtly gentleman. He was fairly active in the Polymer Division, wasn't he?

SCHAEFGEN: He gave papers in the polymer division, but he wasn't involved in the governance of the society. I think Bernhard Wunderlich, now a Du Pont consultant, worked for Dole. Leo Mandelkern, Jim Mark, and Jim Economy are also people I know well.

FERGUSON: On the average, how many meetings did you attend during a year?

SCHAEFGEN: Oh, it probably only averages out to one or two, but there have been a lot of years. And recently, of course, as a counselor, I've been to almost every ACS meeting. Including Gordon conferences, in the last fifteen years, I've probably been to three meetings a year.

FERGUSON: How many years total were you at Du Pont?

SCHAEFGEN: 1951 to 1982, so that's 31 years.

FERGUSON: Well, John, for the Center for History of Chemistry, I certainly appreciate your giving me your time. It's been very interesting.

SCHAEFGEN: It's been a pleasure, Ray.

[END OF INTERVIEW]

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