PROFILES OF SWE PIONEERS

ORAL HISTORY PROJECT

Thelma Estrin Interview

March 16, 2006

Reuther Library Oral History ID: LOH001952.11

Thelma Estrin

Thelma Estrin became interested in engineering after taking a three-month training course at Stevens Institute of Technology in 1943 and working as a machinist at the Radio Receptor Company. She later enrolled in an undergraduate program in electrical engineering at the University of Wisconsin, and by 1951 had earned her doctorate degree. Estrin was a pioneer in the application of engineering and computer electronics to medicine. She developed an interest in biomedical engineering in 1951 while working as a research assistant at the Electroencephalography Department at New York's Columbia Presbyterian Hospital Neurological Institute. In 1955 Estrin settled in Los Angeles and taught engineering courses at Valley College. She joined the Brain Research Institute in 1960 and was named the director of its Data Processing Laboratory ten years later. In 1982, Estrin was appointed the Director of Electrical, Computer and Systems Engineering at the National Science Foundation. She began teaching again as a professor in residence at the UCLA Computer Science Department in 1980, a position from which she retired in 1991. Estrin served as President of the Biomedical Engineering Society, and was a Fellow of IEEE and the first woman to serve on its Board of Directors. A Fellow of the Society of Women Engineers, she received the SWE Achievement Award in 1981. Estrin passed away in 2014.

In her 2006 Profiles of SWE Pioneers Oral History Project interview, Estrin discussed her career, including her work in biomedical engineering, her research work, and her teaching experience; her involvement in professional organizations, including SWE and

IEEE; and her thoughts on women in engineering. Her husband, Jerry Estrin, also shared his thoughts on Thelma's career and women in engineering.

- July 2016

THELMA ESTRIN

DR: All right. This is an interview with Dr. Thelma Estrin, or March 16th, 2006. And we're here in Santa Monica, California. And this is for the Society of Women Engineers. The interviewer is Deborah Rice.

Okay, Thelma, can we talk first about your family background, about your parents, and what your early childhood was like.

TE: Okay. I was an only child. I think I may have been a twin, and the twin died. And my mother also had given birth before, and they died. So I was an only child. My parents were born in this country. And my mother was very interested in me having a career, or possibly being a lawyer. And either she had worked with lawyers, or knew them. And she was active in politics locally. And I just went to school. Unfortunately, she died when I was about seventeen.

And right after that I met Jerry. And actually, we were married before I was eighteen, and I am now eighty-two, so we are married quite a while — if you can subtract eighteen from eighty-two.

DR: That's wonderful.

TE: My father died a couple of years after we were married. And I was close to Jerry's family. But I had, as I say, no sisters or brothers. And I was brought up by my mother to know that I was to have an education and be a teacher or doing something, and certainly career oriented.

DR: So very early on.

TE: Yeah.

DR: Very early on, you understood that that's what...

TE: Yeah.

DR: So you grew up in New York City.

TE: Yes, I grew up in Brooklyn, yeah, New York City, Brighton Beach.

DR: And it was during the Depression era?

TE: Yes, yes.

DR: How did that affect, if at all, your (Inaudible)—

TE: Well, it did, in a sense, because I think before the Depression we had lived in what is now Harlem, but at that time, was sort of like 112th Street, I gather it was a well-to-do neighborhood. And I think when the Depression came they moved from there to Brooklyn, Brighton Beach, a new community that was just starting right near the beach. And I think we went from a big apartment with help and whatever to a small apartment for the three of us. And that's where I grew up, essentially, from five until college, was in the Brighton Beach, Brooklyn area.

DR: Sure. So you said your mother was involved in political activities.

TE: Yeah. She was active in the Democratic Party. And she clearly wanted me to be something.

DR: What about your father?

TE: He traveled a lot, was a traveling salesman, in a sense. And he always brought me presents, every night or every day, or whatever. (laughs) And I don't think he cared, much, though — he cared about me in terms of, you know, bringing

presents (Inaudible). But my mother, you know, instilled the idea that I was supposed to do something significant in the world.

DR: Sure. That's wonderful. Do you remember having any early experiences with math and science in elementary school or—

TE: No. I was always good in math. I don't even think I took science in high school — maybe a little. I took Latin. But yeah, and I was always good in math. I don't think we had physics at all. But I was always good in school, and that wasn't an issue.

DR: You had mentioned that in high school you took what would be termed, these days, college prep courses, instead of more of a vocational—

TE: Yeah — no, no, no. I was definitely supposed to go college. And actually, my mother died just about when I was graduating from high school. And I had a very good friend whose father was a physician. She was an only child, too. And I guess they steered me to go to City College downtown. There was a City College uptown, which was academically oriented. The one downtown really produced a lot of people who would go into business, and follow that kind of career. So I went to City College downtown, to get a degree.

And when I was there, I don't know, three or four months, I met Jerry, who was a student there. And we got married, actually, a few months before I was even eighteen. And so we've been married quite a long time.

DR: Right. So you had originally thought then you were going into some kind of business field, and that's why—

TE: Yes. When I went there, that seemed more logical than being a teacher. I don't know why — why I went downtown, I can't tell you. I think maybe I felt that employment was better. I probably would have gone to a place — Brooklyn College, where many people were going to, and I guess they would become a teacher. I don't know why I went downtown to this school, which was more business oriented. But that's where I went.

DR: So you didn't really, at that time, have any interest in becoming a teacher?

TE: I guess not really.

DR: Right. Then I think World War II kind of entered the scene when you were at City College, correct?

TE: That what?

DR: World War II began when you were at City—

TE: No, later — yes, it began while I was at City College, yeah. And that's where I met Jerry.

DR: So you quit college to start work, correct? You attended

TE: Yes, I — let me — (to Jerry) Jerry? (back to interview) I can't remember. Oh, am I interrupting? (INTERRUPTION IN RECORDING)

DR: Well, it says here you that took a—

TE: But I took that realizing that there were better jobs — I think I was planning to become an accountant, because I was

always good in math. And I think I went there thinking that's what I'd be.

DR: To City College.

TE: Yeah, downtown.

DR: So did you know at that point anything about engineering?

TE: No, never, no. I hadn't the vaguest idea about engineering.

DR: Okay. So then you quit City College to attend a three-month training course at Stevens Institute of Technology?

TE: Yeah, that was to train people. Then I got married pretty young, and Jerry went into the Army, and I went to this course, this war training course. And that's when I went to work at a place called Radio Receptor, which built electronic devices. And that was where I got interested in engineering.

DR: So that's when you first found out what engineering was all about?

TE: Yes.

DR: Do you remember, were there a lot of women in the program?

TE: No, no, no. Very few. Very few, really.

DR: And the training—

TE: I took this war training course, which was a three-month course. And from that I got this position. And I can't remember if there were — I think there were women in the course. But most of the women that I met in my first job were mostly

draftsmen, people who, I guess, had been good in drawing, and then through the war had gotten into drafting.

DR: Okay. So what were the courses that you took, and what was the training for that you—

TE: Like to be an engineering assistant, a little bit of physics. I was always good in math, so that was a big help.

DR: Sure. Okay, so you went to work for the Radio Receptor Company for about two years.

TE: Yeah.

DR: What kind of work did you do there?

TE: Helping engineers building little pieces of equipment, not for production, but for study in the engineering department, for testing, test equipment. And so I got familiar with the machine shop where I might go to do something. I got familiar with that world, in this Radio Receptor Company.

DR: Did you enjoy what you did?

TE: Yeah, yeah. I liked it. Mostly the other women I knew there, a few, they did drafting. I think I was the only one who was an engineering assistant.

DR: Was that ever a problem with you, working with men, being the only woman in that capacity?

TE: No, no, no, no, no.

DR: Okay.

TE: I'm trying to remember when met Jerry. But anyhow...

DR: So Jerry was in the Army — or was it the Air Force?

TE: No, not yet, no. See, when we got married, I was not eighteen, and he was about twenty. So he wasn't in the Army, either. I met him at school, I suppose.

DR: Right. So after Radio Receptor, you kind of went — you traveled from base to base with your husband as he got transferred?

TE: No — a little bit. But I mostly worked while he was in the Army. In the beginning years he was in the Army, and I continued to work. And then I joined him, I guess, at the end.

DR: Did you work while you were with him at the bases?

TE: I think I did.

DR: In the same sort of position that you had at Radio Receptor?

TE: Yes, sort of being in an electronics lab, or doing some work like that.

DR: Okay, then after the war, both of you made a decision to—

TE: Yes. Now, he also was at City College, planning to be an accountant. And he got into basic training, and got into some engineering training, and that's how he got into engineering. Now, probably if the war had not happened, we'd probably be accountants somewhere. (laughter)

DR: So neither of you, then, got any sort of degree from City College?

TE: No, no, no, no, no. That was just at the beginning, and the war broke out, and that was the end. And the war continued, and we then went to the University of Wisconsin

because a friend of ours had gone there, and we thought it seemed like a nice place.

DR: And how did you both arrive at the decision to be electrical engineers?

TE: I guess through our work during the war. The places I worked as an assistant, I think the people who designed the equipment were electrical engineers. And I think he got into it also during the war.

DR: So you would say, then, that the work that you did during the war definitely inspired you to become an engineer.

TE: Oh, there's no question. No question.

DR: Sure. Do you remember—

TE: And also, Jerry, he wasn't going to be an engineer, either.

DR: Right. So you'd probably be accountants, then. (laughter) Do you remember how many women, if any, were in the engineering program?

TE: No — maybe one. I remember one woman. I don't know if she finished, or didn't, but...

DR: Do you remember any responses from your classmates or specific professors to your being a woman in (Inaudible)—

TE: Yeah. You know, a lot of them, they thought it was strange. The professors were fine. One or two I became friends with, and were supportive and nice. And the rest just sort of was, you know, a little odd, but there I was.

DR: Right. And did you and your husband Jerry study together and help each other along, or—

TE: No. We did our work together, but we didn't study together. I'm not the studying with type. I don't think we were even in the same classes together. But we did do our work together, and had a lot of work. When he comes out, I'll ask him. But we didn't work together. I think we worked separately. I'll have to ask him. Go ahead.

DR: Okay. So you mentioned a couple professors, that you became friends with, and really helped encourage you.

TE: Yeah.

DR: Can you elaborate on that a little bit more?

TE: One in particular, who I went on — and then we decided to stay and get Ph.D. degrees. And my professor was a very nice man, and interested in helping me in getting a degree, and you know, was very supportive. And I guess so was Jerry's professor, though he wasn't mine. And that's what we did. We liked Wisconsin, and we stayed there, and we went on and got our degrees.

And then Jerry got a job. He had heard about the Institute for Advanced Study in Princeton, which is a scientific research institute, mostly for mathematicians and physicists. And they were going to build a computer there. And he had heard about this place, and he got a position there.

And I still had another year to finish my degree. And so I finished it and commuted. And then when I finished, I guess I could have worked on that project, but I didn't want to. So instead I — this is in Princeton — and actually, RCA, which was in Princeton, were not into hiring a woman engineer at the time.

So I commuted to New York for about two years, and got into biomedical engineering, because a friend of mine, a male friend, was doing that at Columbia University Medical School. And so that's how I got into biomedical engineering.

DR: So for a whole year, then—

TE: For about two years, yeah, well, I commuted.

DR: You commuted between Wisconsin and Princeton?

TE: No, no. Between Princeton and New York City — or Wisconsin, Princeton, and New York City.

DR: Yeah, when you were finishing your—

TE: Yeah, that's right. It was like about a year. You know, it was like about an hour and a half, two hours. But that's what I did.

DR: Sure. Do you remember, when you were at the University of Wisconsin, belonging to any student groups? Did you belong to IEEE [Institute of Electrical and Electronics Engineers], for instance, back then, or—

TE: I may have belonged to the IEEE, if they had a student section. But other than that, no, not that I know of.

DR: This was in the late '40s, early '50s, right?

TE: Early '50s, yeah.

DR: What about Tau Beta Pi, do you remember—

TE: Yeah, I was in Tau Beta Pi. I got elected, some way, to Tau Beta Pi.

DR: Do you remember whether — I think back then they were just giving women's badges?

TE: Or something. As a matter of fact, I'm not even sure — I'll ask Jerry. He might remember. I'm not even sure if that's when I got into Tau Beta Pi, or when I was a graduate student, or a post-graduate student. But I know I was in Tau Beta Pi. How I was in there, I can't really tell you anymore.

DR: Okay. That's fine. So when you graduated, then, when you finally got your Ph.D., did you have any aspirations to be in academia, or—

TE: No.

DR: — were you actively trying to find a job in industry.

TE: No. He heard about this job at the Institute for Advanced Study, which seemed like a great place to be. Einstein was there, and — I mean, not that we had much do with him or anything (laughs) — but they were building a new computer.

DR: And this was associated with Princeton University?

TE: Not really. But it was sort of an off-shoot. It's a research institution that I guess maybe sprang out of Princeton. But anyhow, he heard about a position there, and that's how he went there. I don't even know if I wanted to go there and they didn't hire women. First of all, when he got the job, I still had another year on my degree. So I finished my degree. And then after that I decided to work in New York City, where a friend of mine was working at Columbia, in medical electronics. And I was interested in that, and so that's what I did.

DR: Can you talk about that first experience with biomedical engineering, what was that like? It must have been a relatively new field, right?

TE: Yes. Yes, because I did work for Columbia Medical Center. And it was keeping — being responsible for the electronic equipment that was used in testing the labs, and so forth. That was what I did there. And you were sort of responsible for the integrity of it and what it did.

DR: So you kind of got the job through knowing somebody. But did you end up really enjoying what you did?

TE: Yeah, yeah, no, no, I liked it. I didn't get it through knowing — I applied for it and was hired (Inaudible). Actually, at that time, not that many people were going into electronics for medicine. I mean, now it's a big thing. Then it was not.

DR: Right. But do you think if you hadn't known somebody that was doing that that you would—

TE: Well, yes. There was somebody, and I even know the man — the person — two people who were doing that. And they told me about it. And then, as opposed to doing that, you could have gone where it probably was easier to get a job — I don't want to say in a war plant, but in doing something that had to do with work for the government at the time. And I preferred to work in medical electronics than working at a base. Because the way—

DR: In the defense industry?

TE: Yeah, Jerry was in the Army, and you know, the Army was finished, and we were like finished with the Army, and wanted to not go back. (laughter)

DR: I understand that. So shortly after, then, both of you went to Israel to work on one of the first computers.

TE: Yes. But first we came here. He got a job at UCLA, and took a position at UCLA. And I had a child in my last year at Princeton, and then had a child here. And I taught in the junior college, at a 2-year college.

DR: At Valley Junior College.

TE: Yeah. I did that.

DR: So you had had some teaching experience as a grad student, correct?

TE: Yeah, yeah. And actually, I don't think you needed teaching experience, but whatever. So that's what I did for a while.

DR: And how did you enjoy the teaching side of—

TE: It was okay, nothing special. It was nice meeting the kids or helping somebody. But I was not thrilled with it. It was a job, better than not doing anything.

Then Jerry had the opportunity to go to Israel to build the first computer that was built in Israel. So we went with our very little baby who was less than a year, to Israel, to build the first computer there. And then I worked on that part-time with him. And then I had another daughter while I was in Israel.

DR: So what was that like working — how was it different working in Israel as an engineer than working in the United States?

TE: Well, it just was that everything was much closer. We lived on the grounds that were attached to where the Weizmann Institute of Science was. And so housing was right there, and you could just walk to work in a few minutes. And it was easier to get help. There were a lot of people looking for work. And then, as I say, while I was there I had another child, in Israel. And then after about two years, we came back.

DR: How was the atmosphere among colleagues? Was it any different in Israel than in the United States?

TE: Not really, because again, I was really a mother with the kids. And whatever I did at that time was not a major — I think I worked part-time doing some work, but it wasn't a major position.

DR: So what was it like being involved with the first computer (Inaudible)—

TE: That was very exciting being there. Even though we're Jewish, we really knew very little about the country. It was just that at the Institute for Advanced Study, Jerry had met somebody who was head of the math department there. And he convinced Jerry that it would be fun to come to Israel and build a computer.

And it was quite a different world, because it was a new country just getting started, and very different from the United States then. And we liked it. And we weren't particularly Zionists, or attracted, though we were Jewish, but not really religious or committed to it. But we really learned, you know,

to like the country, and love it, and like the people there. And we enjoyed it.

DR: Sure. So when you were done with that project, you came back to Los Angeles?

TE: Yes, to the Institute for Advanced Study. And then Jerry heard about hiring in Los Angeles, I think.

DR: And that was with UCLA that he got a position?

TE: He heard about that. Excuse me a minute, I want to—

DR: Sure.

(INTERRUPTION IN RECORDING)

DR: Okay. So you came out to LA when Jerry got the position at UCLA, around 1956. And you taught at Valley Junior College.

TE: Yes.

DR: Was that part time or full time?

TE: No, part time.

DR: Okay. So you were still raising your family.

TE: Well, half-time, I would say it was a half-time position. And then after about a year or two, I got a job in biomedical electronics, working with Molly Brazier, who was a woman scientist from the East Coast who came out here to sort of, I guess ultimately retire, and whatever. But she set up a lab in the Brain Research Institute, studying electrical activity in the brain. And that is in the ‘50s, probably sometime like ‘56, or something like that.

And actually, as I'm talking to you — when I was in New York, when I commuted from Princeton to New York, I worked at the Medical Center at Columbia.

DR: Right.

TE: Did I tell you that? 168th Street.

DR: Yes.

TE: So I was sort of in biomedical electronics, getting whatever electronic equipment was there, getting it operating, setting up new equipment. So when I came to Princeton, a friend that I had met then got me a position in New York, where I continued to work in that field for a little — maybe a year — or I'm not even sure. I think the biomedical engineering work was before I went to Israel.

DR: Yes.

TE: When I came back from Israel I had Judy and Margo, and that was the end of that. I didn't do anything, I don't think — oh, I know what I did. I taught. Yeah, I taught. The reason I remember this (laughs) is I taught in New Brunswick. There's a university or something there. Because I remember a young man being very nasty to me because I was a woman and I was teaching some math related course. And he was very nasty and mean about it. So I remember that.

So I guess when we came back from Israel where I had worked with Jerry in building this first computer there, and then when we came to Princeton, the opportunity was to teach — not at Princeton, but at some state college close to Princeton. And

that's where I taught some math. And somebody took care of the two children I had. But it was a part-time job.

And then while we were there, which was about a year, Jerry was looking for other work, because the Princeton computer was sort of finished.

DR: That's what he was working on there.

TE: Yeah. They had done most of the work. And so he heard about a position out at UCLA. So that's how we came out to UCLA.

DR: So when you were teaching in New Brunswick, you mentioned that you had a problem with a male student.

TE: Yeah, yeah. I remember that.

DR: How did you deal with that? Do you remember?

TE: He was just very nasty.

DR: He just didn't want to be taught — he didn't think —

TE: He was just nasty.

DR: — a woman could teach—

TE: Definitely not, yeah. And I think on an exam, he didn't pass it, and he may have even cheated on it. And you know, you had a whole episode out of that.

DR: Right.

TE: That's all I remember about it now.

DR: So when you came to LA, and you were teaching, then, again, at Valley Junior College, did you again teach math or—

TE: No, no. It's something in engineering.

DR: But not biomedical engineering.

TE: No, no.

DR: So you kind of got away from that after Columbia University for a few years?

TE: It was just elementary, like the course you teach if you're in engineering school, one of the basic courses that you teach.

DR: Sure, sure. Okay. But did you always know that you wanted to get back into doing biomedical engineering?

TE: Yes, I did want to do that.

DR: So that was your ultimate goal?

TE: Yeah, that was my ultimate goal.

DR: So how did you balance kids —

TE: But then, ultimately, as the kids got a little bit older, I was able to get a job in biomedical engineering at UCLA.

DR: So while you were raising your family, then, the solution for you was to work part time.

TE: And even my third child — I was working then, and had my third daughter, Deborah (phonetic). But I was in the Medical School, in the Brain Research Institute.

DR: Oh, by that time you were—

TE: I was at the Brain Research Institute. I guess I got there in the '60s, something like that.

DR: So how did you deal — how did you balance, then, your family life with your career? Was it something difficult that you had to work at planning out, or—

TE: (to Jerry) Jerry?

(INTERRUPTION IN RECORDING)

(back to interview) They were then beginning to start the Brain Research Institute at UCLA.

DR: So you were recruited for that?

TE: Yeah. And I went to work with a woman, Molly Brazier, who was well known in the field. And that's how I got to the Medical School, where I was for a lot of years.

DR: And you started out as a research engineer, correct?

TE: Yeah.

DR: Okay. So you worked in the Neuroscience Lab, and that sort of thing.

TE: Yes. Yeah, studying — using computers to — and we were sort of the first to do this — taking signals from the brain, which are electrical, and then trying to feed them into a computer and analyze what was happening.

DR: Now, how difficult was that to get — to work with scientists and get them to accept computers in that field?

TE: Oh, a few of them did. And I don't think we did anything, really. I mean, it was like an introduction to the field. I don't think anything we found was significant. But you would write it up as if you thought it was significant, or maybe then we thought it was significant. But that was sort of how it got introduced. And actually, the Medical School was sort of one of the first to really use computers to analyze medical data.

DR: So did you enjoy, then, more the research side of engineering than — this would have been more research oriented than applied engineering — or do I have that—

TE: Yeah, but it was both. Because getting a computer and getting the equipment into the computer, and using it and analyzing it, it was sort of both. It was new to even analyze things by computer then.

DR: So can you talk about, then, just for somebody who might not know, what the difference was between your work as an engineer and the scientists that you were working with at the Brain Research Institute?

TE: Well, because the thing that I'm working with is electrical signals that you record from the brain. When you put people who have an electroencephalogram, they record various positions on the brain, and their different waves, and what they mean. We were trying to analyze those waves mathematically, and trying to find some deeper meaning than what you could see with the eye. And we thought we were getting somewhere. Whether we were or not, I can't really tell you. But we thought we were.

DR: So your role, then, was to apply computers to elicit that data…

TE: To electrical activity that you recorded from the scalp.

DR: And then the research scientists were the ones that analyzed the data?

TE: Yeah, or we would all try to analyze to see what was the significance of the physical condition and the electrical signal that we got.

DR: Sure. So was UCLA, at the time, then—

TE: Yes, this is in the Brain [Research Institute]—

DR: — one of the only places that were doing this type of work?

TE: Well, no, other people were doing — some of it was done at MIT — not a lot of places. But places were doing this. And so that was what we were doing.

DR: Okay. So what is your feeling — I know that you've talked about in the past the differences between scientists and engineers. Let me just read you a quote that you said in 1984 for a Society of Women Engineers keynote address, in which you said, "In science one deals with things as they are. In engineering, one deals with things as they ought to be." Can you elaborate on that a little further? Is there any difference between scientists and engineers, or should they all be assessed equally?

TE: No — well, there is a difference, though. I don't know if that statement makes much sense to me now. (laughter) But engineers build systems to do what the person who wants the system has to do, while in science you are just studying natural phenomena that occurs, and from that phenomena, trying to figure out something about the body or how it works. While in engineering, when you build something, you know what you want to build and what you want it to do. So if that's what that means — that's the best I can tell you right now. (laughter)

DR: Okay, that's good. So while you were at the Brain Research Institute, you became the Director of Data Processing.

TE: Yeah.

DR: Can you talk a little bit about what your role was as the director?

TE: Well, the only thing it was was to - making people there who recorded all these electrical signals, that if you were going to use the computer, and use sophisticated mathematics to try to find something out about the brain from these signals, that's what we were trying to do. How well we did, I can't really tell you. I mean, people saw some activity in some of the things we did, measured a condition, but how significant it is, I can't tell you.

DR: Okay. So I guess I'm interested in how you moved upward in your job, in your career, from a research engineer to a director. As a woman in academia, was this something that was hard to accomplish?

TE: Director of what?

DR: Director of the Data Processing Lab — because this was—

TE: It wasn't hard to accomplish, because nobody in the medical field were using computers. So there wasn't anybody who really had the joint experience of using the computer, or experience with the computer world who had some experience in the medical world. And that was just coming into being. And so that was—

DR: You naturally just kind of fell into that type of position, because you had that experience.

TE: Yeah. And Jerry was in computing. It's just that my background was in engineering, and I picked up the biomedical

part because when I lived in Princeton he worked at the Institute for Advanced Study, and I didn't want to work at the same place — I could have — as he did.

DR: Right. That's how you -

TE: And then there was the school — Rutgers was there. And I began to teach at Rutgers. And I had one or two unpleasant experiences with some of the men there, who were sort of boys, really. And then a friend of mine worked at Columbia, an engineer, in the medical school. And that was how I got into biomedical engineering.

DR: Right. So that must have been why they recruited you at UCLA for the Brain Research Institute, right, because you already had some experience?

TE: Yes. Well, they didn't — that's how I got into the Brain Research Institute, because I had had that experience before.

DR: Sure, okay. Now, you were involved in analog to digital conversion technology?

TE: Yeah.

DR: Can you talk—

TE: Well, because analog signals are continuous. Computers use digital signals, zeros and ones. So the whole field — the whole idea of taking these analog signals and converting them to digital signals and analyzing them and then coming out with a result that somebody could understand just fell into place from that.

DR: Okay. So what was it like being a part of such cutting edge technology at the time, in the application that you were using in it? Was it exciting?

TE: No, it was just interesting. I mean, it was just interesting. And then we had to keep ahead with being sure that the analog to digital conversion of taking this ongoing signal and converting it to something digitally, which you did, and then came back again… It was a nice — you know, it was an interesting experience to be part of.

DR: Sure. Well, you were among the first, definitely, to apply computer techniques to analyzing electrical activity in the brain.

TE: Yeah, yeah.

DR: Do you see yourself as a pioneer of the use of computers in neuroscience?

TE: I mean, I certainly was one of the early users of computers in the field. I mean, if I didn't do it, somebody else would have eventually done it. (laughter)

DR: Okay. Now, during this time when you were working at the Brain Research Institute for a couple decades, were you teaching at all at UCLA, or were you just working in the research capacity?

TE: There I was in a research capacity. Eventually I would give a lecture or two. But then after I left there, I began to teach at a junior college. I guess maybe I had another child, Deborah. And then I began to teach at a junior college for a couple of years. But then after that—

DR: Well, then after the Brain Research Institute, you became a professor in the School of Engineering and Applied Computer Science Department, correct?

TE: Yeah.

DR: So you must have done — at that time, this was 1979—

TE: Yeah, I did publish things that we had — oh, what I did at the Brain Research Institute was introduce computers to analyzing the electrical signals from the brain, and that's where I had some papers.

DR: Sure. Okay. So you wrote some technical papers.

TE: Yeah, I did.

DR: So when you became a professor in residence in the Computer Science Department, was that the same department that your husband was working in?

TE: Yes.

DR: Okay. So the whole rule — the nepotism rule that didn't allow you to join UCLA when your husband Jerry began working there in the '50s, obviously they didn't have that anymore—

TE: I don't think so.

DR: — so you could both belong to the same—

TE: (To Jerry) Jerry?

JE: Coming.

(INTERRUPTION IN RECORDING)

DR: Okay. So when you moved, then, from the Brain Research Institute to the School of Engineering, was that when you began teaching courses in computer science?

TE: Yes.

DR: Okay. And you at one time became Assistant Dean of Applied Sciences? Do you remember that, being Assistant Dean?

TE: I was for a while.

DR: Yeah. I think it might have been on a temporary basis, even?

TE: Yeah, something like that.

DR: Did you know, at that time, many other women who held that kind of position?

TE: No. There are still a very few women in engineering. Actually, my daughter is a professor in computer science at UCLA.

DR: Oh, really? Oh, wow.

TE: She used to be at USC. And I don't know, she switched about four, five years ago, to UCLA.

DR: Which daughter is this?

TE: My youngest daughter. But there are a few women in the engineering school, but none of my age. There are still a few probably in their fifties, sixties. And she's been there about four or five years. She switched from USC to UCLA when we left.

DR: Oh, okay. She sort of took over for you, then.

TE: Yeah, yeah. (laughter)

DR: Well, you always hear — you still hear today how hard it is for women to break into the higher positions in engineering academia. So that was quite an accomplishment, I would think, for you to have been at that position at that time.

TE: No. I guess the only thing you could say is who knows where I would have been if I were a man in the same position? Maybe I would have been dean of the school or something — I don't know.

DR: You never know.

TE: You never know.

DR: So you were teaching not just computer science classes, but also computers, and how they can be applied medicine?

TE: Yeah, medical applications.

DR: Was that the first time that they'd had courses that specifically dealt with that?

TE: No. But I had done a little bit of that in my first job at Columbia. I was in the Medical School. And I was, you know, trying to encourage people in medicine to use the computer. It was not a big turn-on — I mean, I don't say I was very successful. But people began to use the computer, and the computer became easier to use, and the access to it became easier to use, and so forth.

DR: So it was somewhat of a slow process, you think, to get the medical community to turn over to that?

TE: Yeah, yeah. Then it became part of the — I mean, by now, everything is computerized.

DR: Exactly, yeah. Which have you enjoyed more, do you think, the research end of your career, or teaching at UCLA?

TE: No, research.

DR: Definitely research, okay. Can you elaborate on why?

TE: I'm just more interested in research and finding things out. I'm not particularly interested in teaching, I don't think. But it's fine. I mean, if you have a class that's exciting, and people are interested, the interaction — I like that better than standing in front of a class and just talking at them.

DR: Yes, I agree with you. I have the same experience. (laughter)

TE: Yeah.

DR: You did introduce — you taught some courses on women in engineering, correct?

TE: I may have. I've given some lectures on it, but not a lot.

DR: Is that important to you, though, to talk about women in engineering?

TE: Yeah, it certainly is. But by the time I came along and by the time people were interested, I'm now like in my forties, fifties. There were a lot of younger women who were very active in the Society of Women Engineers, who I think keep it going. I think of it sort of as having a community which I never really had, while some of the younger people, you know, have a community, and can keep going with it. And when you're sort of out there by yourself, unless you're going to become a speech maker, it just — you know, you just didn't have the Society that exists now. And actually, the Society of Women Engineers is very popular, and a lot of women like it a lot. And I think if I were younger I'd be active in it.

DR: Sure. During your tenure as – well, I shouldn't use the word "tenure" – but while you were teaching at UCLA for ten or so years, do you remember seeing very many women in your classes?

TE: No, no, no.

DR: Do you ever remember seeing an increase from–

TE: No.

DR: Did that bother you that you weren't–

TE: I guess I was used to it. I have two daughters who are engineers in computer science, and one is a physician. I would love to see more women in the field, but you still don't really, you just see a couple.

DR: Right. Well, there's just a few other things I wanted to touch on concerning your career. One was when you went back to the Weizmann Institute in 1964 as a Fulbright Fellow. Can you talk about how you got that position, and what you did there? Was it more – were you continuing your work with biomedical engineering at the Weizmann Institute?

TE: It had to do more, I think, with interacting with computers and biomedical data. Wait a minute. (to Jerry) Jerry?

JE: Coming.

(INTERRUPTION IN RECORDING)

TE: – signals from the brain, or signals from the body, and trying to use mathematical techniques in the computer to analyze them, to try to find out something about the function

from the signals. I don't think we did anything with it, but that's what we tried to do.

DR: Okay. So it was an extension, then, of the work you had been doing at UCLA.

TE: Yeah.

DR: And we just talked about the fact that you went over to Israel with your husband Jerry. He had had a Guggenheim Fellowship at the same time.

TE: Yeah.

DR: So you both went over together.

TE: Yeah.

(INTERRUPTION IN RECORDING)

DR: This is tape two of the interview with Dr. Thelma Estrin. And we were going to move on now and talk about the National Science Foundation, when you took a two-year sabbatical from UCLA in the '80s, to become the Director of the Electrical Computer and Systems Engineering Division. Can you talk about how you gained that position at the NSF?

TE: I must have applied for it, or somebody asked me to apply for it. I can't tell you.

DR: Do you remember why you were interested in taking the position?

TE: Oh, yeah, yeah, because at the time I was interested in an overview of how the signals we're measuring really affects us, and what its broader meaning is. And then I guess I also was teaching a bit, and you know, you become more interested in the whole field. I was just interested. I just became

interested in the sense — in the electrical activity of the nervous system, and what it could tell us about other factors in our lives. But I don't where we got with it. (laughs)

DR: Do you remember what your priorities were when you were the director at the NSF, what you worked on?

TE: I'd have to look it up and tell you.

DR: Well, I think you—

TE: What did you say to me in the very beginning, when you mentioned NSF a few seconds ago?

DR: I asked you what interested you in taking the position, why you wanted to go work for the NSF.

TE: Well, probably because they're the source of funding for research. And if you're interested in research, it just gives you a view of the field and how you could interact with it.

DR: Well, I think that is one of the things that you did while you were there, was you drew attention to women and grad students in academia.

TE: Uh-huh.

DR: And you were responsible for an increase in research grants to women engineers. Do you remember that?

TE: Yeah. No, no, that sort of has always been part of the agenda, is to try to get more women to come into engineering.

DR: Sure. So that was one of your focuses, then, when you were at NSF?

TE: Yes, yeah, definitely.

DR: Do you remember getting a special grant to MIT for women in engineering while you were at the NSF? Does that ring a bell? That just happened to be one of the research grants that—

TE: No, I definitely tried to pursue getting women into important or into significant positions in brain research, or in the medical system, using computers. That was another point, was also using computer analysis to analyze signals that were recorded by physicians.

DR: Do you think that at the time there was a problem for women to get research grants? Do you think they were mostly going to men, and that's why you—

TE: No, I just think that more — there just were not enough women in the field to warrant — I mean, there may have been some discrimination, but I don't think there were enough women really interested enough, yet, in going into the field. And it just, I guess, takes time for it to happen.

DR: Okay. Well, while you were also at the NSF, you established a new program of bioengineering and research for the handicapped? Do you remember that?

TE: For what?

DR: Bioengineering and research program for the handicapped?

TE: Oh, for the handicapped, yes.

DR: Can you talk about that a little bit, what that was all about?

TE: No, only that having been at UCLA and in the Medical School, I probably knew more about handicapped people, and possibly how the computer could help facilitate some of the work there. And that probably was an interest of mine, of trying to get some funding to see how it could help people who had problems physically. But other than that, I can't tell you anything. Too long ago.

DR: (laughs) The last thing I wanted to ask you about your tenure at the NSF was an appearance on the Phil Donahue Show. You were a part of a panel on computers. Do you remember being on that show?

TE: (shakes head, no)

DR: No? (laughs)

TE: (laughs) How do you know about it?

DR: Well, it was in your bio. It was in your biographical file.

TE: And what did it say?

DR: That you were part of a panel of experts on computers, and because of your position at the NSF, you were asked to be on that, that that particular show was centered on computers, and so you were one of—

TE: No, I was on a couple of shows like that, but...

DR: (laughs) So they didn't really mean a whole lot to you.

TE: When you are eighty-two, you remember what you did now.

DR: (laughs) Okay.

TE: You won't — well maybe you will, but I don't know. No, no, no, I don't remember.

DR: Okay. All right. Well, now, just some broader questions about your career: How hard was it for you to balance your career with your home life, with raising three children along the way? How were you able to accomplish that, have both a career and a family?

TE: I can't answer it. I could say my husband helped me. But I would say he helped me only as that he was committed to my career, and he would do anything I asked him to do. But other than that, I can't tell you. I just worked hard and (laughs) hired whoever I had to when I had to, and had a lot of luck. I can't tell you anything more than that.

DR: Okay. Well, I just asked because the whole issue of work/life balance is just something that is very paramount to women in engineering.

TE: Well, I think if you're married to somebody who agrees with your working, and wants you to work, and is even willing to do his share — though I can't — and Jerry certainly is, but you know, the responsibility was really mine, and I just did it. That's all I can tell you. (laughter)

DR: Okay. Did you have anybody that you would consider a mentor along the way, during your career, that really helped you in your career at all?

TE: Not really. The only one I can think of — but she died just before I was married — was my mother, who definitely wanted me to grow up and do something important. She was active

in the Democratic Party. And she wanted me to be something in the world. And as I said, I was only child. But she died just before—

DR: She really gave you the drive to do what you've accomplished.

TE: Yeah, yeah, yeah, yeah.

DR: What do you think she would think about the fact that you became an engineer?

TE: Well, I think she'd be proud of it if she — but at that time, I would doubt if anybody knew what an engineer did, (laughs) you know, from the kind of world that I came from. But she was active in politics, and was sort of a leader. She was in some organization that all women belonged to — I can't remember. And she was head of the chapter, and head of this and that.

DR: The National Organization of Women?

TE: No, no. This is—

DR: League of Women Voters?

TE: No, no. No, not like that. It was a social—

DR: Well, it doesn't matter.

TE: (to Jerry) Jerry? (back to interview) I don't think he knows, either. But yeah, she was active in the things.

DR: So do you think that influenced your politics and your view on things as well.

TE: Yeah, yeah, yeah.

DR: Okay. We talked a little bit about this, but you know the concept of the glass ceiling, for women, how it's sometimes

harder for women to progress in their career than it might be for men? Did you ever encounter—

TE: What did you call that?

DR: The glass ceiling?

TE: Oh, the glass ceiling.

DR: Did you ever encounter anything like that in your career?

TE: Yeah, oh, yeah. Yeah, there's no question that people in general — I don't think it's as true today — but in my going through my career — rarely expected women to really rise to the top. I mean, you felt that it was there. I can't say how it deliberately hindered me. And I should ask my two daughters that. I don't think it hindered them, either, but I don't know.

DR: It doesn't sound like it anyway, with the success that they've had.

TE: Yeah, they've had quite a bit of success.

DR: Do you think it still does exist today for a lot of women, though?

TE: Probably it still does to some degree. Like in our department, in Computer Science, there are just two women — actually, one of them is my daughter, actually. But there aren't a lot of women in the engineering school, very few. I think it just takes a century of change.

DR: A few generations or so?

TE: Yeah. It just takes time to change. But I mean, it's happening, and it'll eventually happen.

DR: Well, I hope so, right?

TE: Yeah. (laughter)

DR: Well, let's switch gears, then, from your career over to SWE. Do you remember when you first heard about SWE? Was it when you were at Princeton?

TE: When I was where?

DR: At Princeton, when you were working in New York City with Columbia University?

TE: I don't think there was — when was SWE started?

DR: SWE was founded in 1950, in New York, it began, mostly.

TE: Oh, I must have heard of it, then, when I was in Princeton.

DR: So it was after you were out of college and you were in the workforce.

TE: Yeah, definitely.

DR: Okay. Do you remember what made you decide to join a Society of Women Engineers?

TE: Oh, I wouldn't think of not joining it. (laughs) I was probably very glad it was formed, and I was hoping that it would attract many more women to engineering.

DR: So were you kind of surprised that an organization like that existed?

TE: No, I wasn't surprised. I was glad that it was formed. And I think I had had more to do with it years ago, which I just can't remember, here in LA.

DR: Yeah, you did become part of the LA Section. But going back to the beginning of when you first were involved with

SWE, there probably wasn't too many other members that were in the same field that you were, correct?

TE: No, no.

DR: So was that hard, or was that not part of what being a member of SWE was about?

TE: No, I don't have any — I mean, there weren't women in engineering, to begin with. And when the Society of Women Engineers was formed, I remember I was thrilled, delighted, very pleased. And I think I did go to some meetings in the beginning.

DR: So it was just simply the fact that you had similar experiences as women in engineering, then.

TE: Interests, yeah, yeah. And I was glad for the publications they put out, and always... But by then I was older already, you know, and had children, and so forth. So I think if it had happened when I was younger, I might have become more active in SWE.

DR: Sure, yeah.

TE: And I think I did go to a few things in the beginning.

DR: Well, what can you get from a society like SWE that you don't get from, say, a more technical society like IEEE? What is the value or the benefit to belonging to SWE over a technical society?

TE: Well, it's just different because you are in a group of people who are struggling to be sure they get what they deserve, which they normally don't get. And it's the same thing

of when you have a bunch of friends who are women, you have many more relationships because you're women, than having to deal—

DR: And common experiences?

TE: — yeah — than you do with the men.

DR: So it was sort of a support group, in way?

TE: Yeah, yeah. No question. How many women are in engineering today? Do you know?

DR: I don't know the total number. SWE has about 19,000 members at this point. So it's larger than that, but I'm not sure of the exact numbers.

Okay, so when you did come to LA, you were part of the LA Section for a few years.

TE: Uh-huh.

DR: But you did help charter the UCLA Section in 1974. Do you remember that?

TE: (Shakes head, no)

DR: Okay. Do you see student sections as one of the strengths of SWE, as opposed, maybe, to the professional sections? Is there a difference of—

TE: Yeah, no, I think it could be, but I can't really tell you. What do you find? Do you find that the SWE members are friends, and help each other, and so forth?

DR: Yeah. Sure, yeah.

TE: Yeah. I sort of have that feeling. But I'm like too far removed to really know. I know a couple of SWE members at UCLA.

DR: Well, you were saying if you had discovered — or if there had been a SWE when you were a student, you might have been more active in the organization.

TE: Oh, yeah, yeah.

DR: So SWE's reaching out to students, then, you would consider to be an important part of the goals for the organization, to really help-

TE: Yeah. But you see, then I think of my daughters. And see, they don't see it that — I'm sure they joined SWE, there's no question.

DR: As students?

TE: Yeah. But I don't see them becoming active in SWE. I don't know why. Maybe — I don't know why. I can't tell you. But I think it's great for people — for women who don't have a relationship with other people to meet each other. And I know a few of the women from SWE at UCLA. I mean, I don't know them well, but I've seen them. And I think they enjoy having a little nucleus of their own to do something with.

DR: Sure, sure. Did you find that the value of SWE for you changed over the years at all, from when you first became a member, until now?

TE: No. I'm just glad whenever they publish anything or do something, you know, I always pay attention and look at it. There's still not a lot of women in engineering.

DR: So you think that there's still a need, then for SWE today.

TE: Oh, yeah. You just don't see many.

DR: What are your thoughts on — this is sort of a quirky question — but your thoughts on SWE's new focus in reaching new audiences through computer technology? Since it is, you know, somewhat of your field — they're doing a lot of web seminars, for instance, online.

TE: No, I certainly think they should use anything that they can, and see what happens with it.

DR: Right. Do you think that's the way to go, then, to reach the youth today?

TE: Certainly, if that's being — see, I have a daughter who's here, but I don't know — I wish you could ask her those questions. I'm wondering how she would answer them. I must ask her. I don't think she feels discriminated against, or that there's a special problem. She went to MIT.

DR: So you think she might answer differently than you have?

TE: Yeah, I think so, but I don't know. I'll have to ask her. Now, what was the question you just asked me?

DR: We were talking about how SWE is using computer technology to reach a larger audience. They've developed a Women in Engineering website devoted to that.

TE: It's funny. Now, I wonder why I'm not on it, or I didn't know they had—

DR: It hasn't officially been launched yet. Any day now it'll be out.

TE: Oh, because I — no, I think that'll be a big help. I think it should be a big help. I don't know, like when I think

of my daughters, it's not a good question, because I'm in engineering, her sister is in engineering. I must ask them how they feel about it.

DR: Okay. Now, you were involved, also, to a great extent, with IEEE, correct?

TE: Yeah.

DR: You held several positions; President of the Engineering in Medicine and Biology Society; you were the chair of the Committee on Professional Opportunities for Women. Do you remember that?

TE: Uh-huh.

DR: Can you talk a little bit about what was involved?

TE: No, I can't. Nothing much happened with it. We tried. (laughs)

DR: What about being the first female vice president in 1982, of IEEE? What does that mean to you to be the first? Was it a significant milestone at all?

TE: No. I liked IEEE. I liked the people, and I liked being active in IEEE. And I wish there were more women in IEEE. But I guess it takes a long — a couple of generations to change, that's all. I can't tell you. I've always liked IEEE.

DR: Well, they do now have a women's group within IEEE that focuses on women in electrical engineering.

TE: They do?

DR: Uh-huh. It was probably the website that your transcript is, part of the website that your transcript is on?

TE: Really?

DR: Yeah.

TE: See, I'm not even...

DR: So I think that might signify that they're making inroads, so to speak.

TE: Yeah, no, that would be great. So how did you find it? What did you look up?

DR: Your name.

TE: And then you found that there.

DR: Yeah.

TE: That's interesting. No, I liked IEEE. I had very good experiences, and met very nice men there. I didn't meet a lot of women — a few. But I liked it. And as I say, I have two daughters who are engineers, and that's — I don't know, I can't think of anything else to tell you about it.

DR: Okay. That's fine. Can you talk a little bit about how you became a board member on the Aerospace Corporation? How did that come about when you weren't really involved in the aerospace industry?

TE: I don't know. Somebody probably who was on the board or somebody who knew me suggested I be on the board. And I enjoyed it. It was interesting. I liked it. I don't know what else to—

DR: And that's where you met Shirley McCarty.

TE: Shirley, yeah.

DR: Do you think that you had — do you see yourself as a role model, or as having been a mentor to other women engineers like Shirley?

TE: Well, I suppose I must have been, but I can't really say that I know about it, other than my two children.

DR: Well, that's something. (laughter)

TE: Yeah. But I can't really – you know, I like women's organizations, and I like the Society of Women Engineers. But since it's gotten active, like in the last ten or fifteen years, I'm not really – I'm just too old to – you know, most of the people there are in their twenties, thirties, forties. And I like it, and if they have something I would go to it. But that's about it.

DR: Okay. I just wanted to quick talk about another first that you had was becoming the first woman Certified Clinical Engineer in 1976. Do you remember achieving that distinction?

TE: No, but I must have applied for it. (laughter)

DR: Okay. Now, you did receive the Achievement Award from SWE for being a pioneer in the computer and the biomedical engineering field. What do you see as your greatest contribution to engineering? I know it's kind of a hard question there.

TE: I don't know. Just saying that women can be as successful as men in the field, and that there really isn't any sex difference between the two, other than the general psychological things that people find. I think it's mostly the environment we live in, and where women in the past, I guess because of the lack of technology and the ease to have a professional life and have a home life just never really existed before. And it, you know, came about, I suppose, in my

generation. And I think you see a lot of women realizing they can do both things at the same time, even though it might be a little more difficult. But I think before the technology wasn't there. Now the technology is here, and it's possible for women to do both things.

DR: So do you see your involvement with computers in the biomedical field as having been a significant contribution to the field of engineering?

TE: Yes, yeah, yeah.

DR: Okay.

TE: But if I didn't make it, somebody else would have made it. You know, the field was growing, and I was able to do that. And part of why I was able to do that — which is another point — I didn't want to work in the defense industry. Now, I think if I had wanted to work in the defense industry, I would not have gone into the medical field. But I didn't want to work in the defense industry, because at that time, a number of people I knew were having problems with it, if they were more left-wing than what the whole emphasis was. And I didn't want to get into that. And so that's part of why I went into biomedical engineering, or else I probably would have gotten a job in a war plant, you know, or a defense plant and done that.

DR: So it was sort of a political issue for you, then?

TE: Well, it was sort of a social issue. And then I liked what I saw was being done outside of the defense industry, in the healthcare industry.

DR: So you saw that as more of a positive effect that you could—

TE: Well, I preferred it, let's say that. Let's say I preferred the effect.

DR: Okay. So do you have any particular advice for women today that are considering a career in engineering?

TE: Just if they are they certainly should do it. I think there's lots of opportunities and lots of fields in engineering. And I would certainly encourage them to do it. As I say, I have two daughters who—

DR: Took after you.

TE: Yeah.

DR: Do you feel that the public, even today, still understands what an engineer does?

TE: Still understands?

DR: Do you think the public understands what an engineer is, what they do?

TE: The public in general, I don't think — not really, but partially. But not really.

DR: So you think that's a problem, then, that might hinder some women because there's—

TE: No, I don't think so. I think women can find out about it. But I guess there not being more women or possibly in schools not being encouraged, or not seeing — like a lot of men see their fathers as engineers, or their uncles, or whatever, women don't see that as a role model as they grow up, and so forth. So it just doesn't become part of their agenda. Or they

may not have developed an interest in drafting or whatever — not that I was any good at drafting.

DR: Do you stay involved today, in any capacity, with engineering? You mentioned that you were on your way later today to some function at UCLA? Is that associated with—

TE: Well, yeah, with engineering, but not with women in engineering. No, I don't do anything with women in engineering anymore. But I'm going to something in the department. Yeah, we sort of keep up with what's going on in the field.

DR: Well, do you have any other further experiences that you'd like to talk about that we haven't touched on yet?

TE: No — other than I wish there were more women like Shirley in engineering. But I haven't met them. (laughter) So that's all I can tell you. There are a few like her, but not many.

DR: Right. Okay, well, thank you so much, Thelma, for agreeing to sit for this interview.

TE: Okay. I wish I had something more exciting to exchange with you, but I don't. (laughter) It's like, you know, it was a long time ago.

DR: Yeah. Well, I think we covered a lot. So thank you very much.

TE: You're welcome. Can I give you—

(INTERRUPTION IN RECORDING)

DR: Okay, we're now talking Jerry Estrin, Thelma's husband. And I just wanted to ask you what your general perspective is on your wife Thelma's career, and what she's been

able to accomplish, not only as an engineer, but as a woman, in what was really seen as a man's profession.

JE: Fabulous! (laughter) And you know, there were a lot of difficulties in getting recognition. One of the things I still look back on as one of my biggest mistakes, even though I had a wonderful career at UCLA, was accepting a job where, you know, it wasn't straightforward for Thelma in her career to get onto the faculty.

I mean, it was just so silly. And in a sense, if I did it over again, I wouldn't have done it. I would have fought more. But we've been very, very fortunate. And Thelma made her way into brain research, and that was just great.

But there is one thing that is really clear when it comes to women in engineering, and particularly in academia, that if you don't get on the track, the tenure track of teaching and research and working with graduate students, it is very difficult. And you really have to be a sort of super person to get into a position of getting your work done. The whole amplification of your work with graduate students is very different than when you're working in the research part.

Now, there are many times I think that Thelma enjoyed that, in a sense, more, the focused research in the area that she wanted. But it is tougher in academia to get on that path, yeah.

DR: So you witnessed that first-hand, then, being yourself in academia.

JE: Oh, yeah, there was no question about that. I mean, a lot of graduate students, and it really amplified everything I wanted to try and do and think about, yeah.

And so that is something you have to learn how to — it isn't just a glass ceiling, it is a breaking through in a way that would take advantage of more than fifty percent of the population, yeah.

TE: I was just thinking about something. You had one woman graduate student?

JE: No, more, Thelma. The—

TE: Didn't one kill herself?

JE: One died. I don't think she — no, she had cancer and died.

But if you're considering a masters, don't even talk about the doctorate, then there were three or four, you know, out of the—

TE: For masters degrees.

JE: Huh? No, doctor — Ph.D., there were three or four women.

TE: You had three or four women?

JE: Yeah, sure.

DR: Did you find in your career at UCLA that there was more and more women entering engineering, or not so much?

JE: And particularly in computer science, there was real surge in the '70s. You know, we got up into the twenty-something percent. But that — you know, it didn't hold, and for a lot of complex reasons. And you know, very good, good people.

There was just no question. So if it didn't hold, it was our fault — I mean, something of not learning how to do that well. Carnegie Mellon learned how. (laughs) Yeah.

DR: What about in terms of, you know, you both got your electrical engineering degrees from the University of Wisconsin at roughly the same time—

JE: Right.

DR: — and your career paths pretty much followed very closely, in terms of where you worked and—

JE: Right, uh-huh.

DR: And what was it like having a two-career family, and being able to juggle the responsibilities that that entailed?

JE: Which Thelma did, you know, much more successfully than I did, because she was much better at multitasking than I was. I was sort of focused on things, and tried to be helpful. And I think it had an influence on our kids growing up. But Thelma was the mainstay, doing all that, and her career, yeah. You know, a super mom, it was the story over and over again, yeah.

DR: Right.

TE: That's if you believe him.

DR: (laughs) I think I do. Do you have any final thoughts or anything you might want to reflect on about Thelma?

JE: I think we were very lucky, you know, all through this time. Not everybody is so fortunate in having the breaks go their way. And you know, growing up with three remarkable kids, I mean, women who—

DR: Two of which that went into engineering, right?

TE: Two of our daughters in engineering.

JE: Yeah, yeah. And our oldest is a physician. But they're wonderful people. You know, we were really lucky, yeah. And it seems to be, you know, continuing on in the trip with the grandchildren. So we have nothing to, you know, be sorry about in that. It all worked.

And I still remember, you know, when we married, very young, and we didn't know what it meant to — career planning never entered our mind. It was day-to-day, and making decisions, and taking them. And both having come from families who weren't particularly wealthy or anything like that, it wasn't that any red carpet was laid down. But we were fortunate. And the military service supporting our education at Wisconsin — it just wouldn't have happened without that. And I think it was one of the greatest things that happened for the country, in terms of the skills that were embodied there. So no, we were very lucky, and we were, I think, competent in using that luck.

DR: Sounds like a lot of hard work in addition to luck.

JE: Yep.

DR: Okay. Well, thank you for talking with us.

JE: Yeah.

END