Computer
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Oral History of Ann Hardy

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Brock: Well, Ann, thanks again for agreeing to sit with us and talk with us.

Hardy: And I want to thank you--

Brock: Oh. <laughs>

Hardy: --for getting me to do this because I have finally gotten some of my personal history together in one place, which I've been promising my daughters I would do for about 30 years.

<laughter>

Hardy: They are very happy with you. <laughs>

Brock: Excellent. Well, I'm glad. I thought we could begin at the beginning, and I know that you were born in Chicago--

Hardy: Right.

Brock: --in 1933, and I was just wondering on what day you were born and what your given name was.

Hardy: Well, I was born on April 20th and my name is Ann Caryl, and you spell Caryl A-N-N, C-A-R-Y-L.

Brock: And you grew up in Evanston, Illinois, is that correct?

Hardy: Yes, we moved to Evanston when I was five so I could go to kindergarten in Evanston schools, stayed there until-- well, my mother stayed there until she died. I left--

<laughter>

Hardy: --but it worked.

Brock: Well, could you tell us a little bit about your family of origin, about your mother and your father and their family backgrounds?[1]

Hardy: They both grew up in Chicago and they were both from very religious families, but their children didn't turn out too-- <laughs> but that influenced enormous amount of their attitude. And you've probably read a little bit about my mother's <laughs> attitude on some things, and that was all from her very, very religious background.

Brock: Very conservative, I would describe it, about--

Hardy: Evangelical.

Brock: --gender roles. Oh.

Hardy: Sort of the right side of evangelical. <laughs>

Brock: Okay.

Hardy: I mean this is really conservative in a way that we don't see it today. I mean today's culture doesn't allow the conservatism that existed back then.

Brock: Were they part of these large kind of Baptist kind of revival--

Hardy: They were Methodist.

Brock: Interesting.

Hardy: They were Methodist but they just happened to belong to, believe in a very conservative, very conservative flavor of Methodist.

Brock: And was that something that they shared with their parents and their extended family?

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[1] Please note that all comments to Ann Hardy's father refer to her step-father.

Hardy: Well, my parents' parents, my grandparents, that's where they got the conservative from. <laughs> My father's father was a minister in the church, and my grandmother on my mother's side was very active, in charge of the women's program and, you know, traveled some for the Methodist church for the women's programs, so it was very intense. <laughs>

Brock: Was there a community of their kind of co-religionists <laughs> in Evanston? Was that part--

Hardy: No.

Brock: No, so they were isolated from that?

Hardy: They moved away from that. Now, they didn't get-- my father got much less conservative, but my mother to the extent she could and raise five children, <laughs> do all the other things that-- you know, in the 1930s and '40s, being a mother and working in a house was more than a full-time job, and I was the oldest of five kids, so she was really busy. And there weren't washing machines. That took a lot of hand labor. <laughs> And there were no dryers, and this is Evanston where it freezes in the winter, so you have to run out in the middle of the day and bring in your clothes before they freeze on the drying line, so it's a full-time job, so she was very busy. And so when we all left home, then she went back and volunteered at the church and was part of the board of the local Methodist church, but in between <laughs> she was kind of too busy to be active.

Brock: Was that something that you as a girl were called upon to help your mother with, running the household?

Hardy: Yes, very much, very much. There were years where I basically cooked the dinner every night because my mother was pregnant and not feeling like cooking dinner, <laughs> and so, yeah, I was very much involved with raising the kids, which I probably wasn't the-- wouldn't have been my first choice of childhood, but it turned out it was great experience for being a manager. <laughs>

Brock: Interesting. <laughs>

Hardy: And later on it turned out it wasn't so bad after all.

Brock: Well, before we lose that train of thought, could you talk about some of the ways in which helping raise your siblings gave you important lessons for being a manager?

Hardy: Well, it helped being a manager, it helped raising children, my own children, and you just learn how to have people who are at each other's throats, how to calm them down and talk to them until they can come to some compromise. And after you've done that 1,000 times, why, it begins to sink in what the routine is. <laughs>

Brock: Interesting. And is there any particular-- is it a technique that you could describe or is it kind of a tacit knowledge that you gain about how to--

Hardy: I think you listen. I think you listen. You just listen. Let them talk and talk and talk, and it turns out that if people talk long enough they can figure out what the problem is.

Brock: So it's really allowing them to figure it out.

Hardy: Uh-huh.

Brock: <laughs> That's very wise. Your father worked in advertising.

Hardy: Yes.

Brock: Did he work in advertising in the city? Did he commute there?

Hardy: Yes, in Chicago. He had his own business. He had his own company in Chicago, and back in those days most of the days he took the train into Chicago. Transportation in those days was very good between Evanston and Chicago, and his office was close to the train station.

Brock: And was that mostly print advertising or what sort of work was it?

Hardy: Yes, yes, lots of ads in the newspapers and magazines in the day and on the bill boards, yes.

Brock: Did that world of advertising that he was involved in, did that interest you or did that touch your life very much at all?

Hardy: Well, maybe we should step back. <laughs> Before I was five I did a lot of modeling as a child. <laughs> I was very cute as a little girl.

<laughter>

Hardy: And so I had a lot of experience with what it meant to be in the ads and that meant I learned that I wasn't a natural for that. I didn't like sitting around all day while they spent two minutes taking your picture when they got around to it, so <laughs> I was never attracted to being in advertising. And my mother didn't, as you probably know, believe that women should be in business, so letting my father take us to his office was just not in the cards. Now, I turned around and did the complete opposite. Both of my girls worked in my businesses--

<laughter>

Hardy: --and it set them off so they could do their own thing. They knew what was coming. But that wasn't my mother's approach.

Brock: Was it your father who realized that you were so photogenic for your early modeling?

Hardy: No, that was my mother.

Brock: Oh, she had realized that. Interesting. So that was okay.

Hardy: They needed money.

Brock: Oh, right.

<laughter>

Brock: It was a practical matter.

Hardy: Sell the daughter off.

<laughter>

Brock: So that was when you were very young.

Hardy: Very young, yes, before I was five. After we moved to Evanston it was all over.

Brock: And Evanston was in part, I was hearing that it was for you to go to this--

Hardy: To go to school.

Brock: And the schools there were very good because of the universities, et cetera?

Hardy: I don't know why the schools were good but they were very good schools for the day, and I'm sure there were a lot of influences, partly the professors, I'm sure, but they were just good schools, you know. It's like moving to Palo Alto or something. It's just good schools.

Brock: Well, could you describe a bit of what your education was like before high school and in grade school, in middle school, whatever those years?

Hardy: Well, except for the fact that we didn't begin to learn-- <laughs> now I'm watching my grandson go through school. He just got out of second grade. He's going to be in third grade. He's learning things in second grade that we didn't get till-- I mean some of the things he's learned in second grade we didn't get till high school. They are just fabulous. Not only did he learn all this regular curriculum. He's now fluent in Spanish in addition.

Brock: Wow.

Hardy: <laughs> And I have to say watching this is just like a miracle, and they obviously know how to do this if they put the money into it. He's in Mountain View Public School District. They obviously can take kids who know nothing and make them fluent in Spanish by the end of second grade, give them all this enormous background. I wish we would put the money into every school district. It's so great to watch him and so sad to talk to other people whose grandkids are not in such a good school district.

Brock: Right. But for you, yours was--

Hardy: You know, it was a neighborhood school. We all walked to school. I'm still best friends with a girl who lived across the alley and we walked to school together every day for six years.

Hardy: So, yes, they're thinking of having another high school reunion in the fall back in Evanston, so, yes, a lot of us have stayed good friends for many, many years, and it was that kind of community. It was so homogeneous. Now, there's downsides to that, but at the time it was great to be a very homogeneous community. Everybody was friendly.

Brock: And what was school like for you? Was it something that you liked, hated--

Hardy: No, it was fun.

Brock: --thrived at? Okay. <laughs>

Hardy: School was fun and I had all these friends. And we got to walk home for lunch and go back to school, so at least half our day-- even though <laughs> we were in school, half our day was playing with our friends. We walked back and forth to school, so how can you beat that?

<laughter>

Brock: And by the time you got to, let's say you're starting high school, schools and your neighborhood are obviously big parts of your daily routine. Were there other places like athletics or the library or were there other important places that you recall from those days?

Hardy: Well, when we were all kids, younger, pre-high school, turned out we lived on a street with enormous front yards. I mean they were big enough for another house. And so after school everybody would come over and play baseball. So this was life in the forties. <laughs> Everybody, the whole neighborhood came over to play baseball every afternoon.

Brock: Hmm. And was that-- you shared that as a hobby, baseball? You enjoyed playing it?

Hardy: Oh, yes, yes, everybody pitched in. <laughs>

Brock: And what was--

Hardy: And the Cubs, of course, was our favorite team, which they have never won but they are still our favorite team.

Brock: Did you go and watch them play?

Hardy: Occasionally.

Brock: Yes. I was wondering what your family's experience, you, your family, and your community's experience of the war was like.

Hardy: World War II was very difficult, I mean not nearly as difficult for us as it was for the Europeans, but it was difficult. There was only one day when the stores had any variety of food or laundry soap or soap of any kind or sugar, any of these things. That was Saturday morning. I used to go out and stand in line at quarter of seven to be able to get a number to get into the store because we had five kids to feed, and if you weren't there for an early number there was nothing left. Now, we all had what we called victory gardens, <laughs> and so during the summer we had plenty of fresh veggies and we learned a lot about gardening in those <laughs> years. And of course at the end of the summer you spent weeks and weeks canning everything so you would have something to eat all winter. It was very difficult. There was almost no fuel, so you couldn't drive a car anywhere. My dad took the train because you couldn't drive a car that far, and that's very close. It's like driving from here to Palo Alto, and you couldn't waste that kind of fuel. There was no fuel. It was a very-- you know, personally it was a hard time, and then of course as you walk to school every day they had those flags. I don't know if you're familiar with the flags they put in the windows?

Brock: I'm not.

Hardy: They had flags in the windows of every family that had a son in the military, and they would put blue stars on these flags as they went into the military, and those stars changed to gold if the son was killed. And so we would walk to school and worry every day about having one of those stars change to gold, so it was traumatic the whole time.

Brock: Right, so how old were you, like 10 or something like that?

Hardy: Uh-huh.

Brock: Yeah, so a tough age for that, you know?

Hardy: A tough age.

Brock: You're fully kind of aware of what's going on but probably don't-- yeah, I could imagine it was terrifying.

Hardy: Yes, it was a very difficult time for everybody. And, of course, I'd come home for lunch and my mother would be listening to the news because everybody was terrified. I have one funny story about my conservative parents.

<laughter>

Hardy: One of the things you're not supposed to do if you're behaving properly accordingto the church is talk to anyone except family members or church members if you're at church on Sunday.

Brock: Wow.

Hardy: Now, it turns out that Japan bombed Pearl Harbor on a Sunday morning, and I was standing on our front porch when my neighbors came out, with whom I was friends, and said, "You've got to tell your mother they've bombed Pearl Harbor." And I didn't know how to tell her because if I told her they had bombed Pearl Harbor she would know I had talked to somebody who wasn't in the family, and I couldn't decide for which I would get more punishment. <laughs>

Brock: Oh, my goodness. What did you decide?

Hardy: I went in the house and said, "Have you turned on the radio this morning, mother?"

<laughter>

Brock: Good strategy.

<laughter>

Hardy: And I walked over and said, "I'm curious to know what's on the radio this morning."

<laughter>

Hardy: So I didn't exactly have to admit anything.

Brock: Right.

<laughter>

Hardy: But just to give you an idea how conservative the religion was, I mean you can't even-- I was afraid to tell her. And I knew she'd been watch-- not watching, listening to the news and worrying about this for months and months, and so I knew she would want to know, but I was terrified of the punishment if I had talked to somebody outside of the family on a Sunday. <laughs>

Brock: So as a teenager going into the public high school, which I imagine must have been a sizable school--

Hardy: Yes, it was a big school.

Brock: --I guess especially your mother, how did she approach the fact that you were going to be going into this big environment, if she had all these beliefs about--

Hardy: <laughs> Well, the interesting thing about my mother, people are self-contradictory, okay?

<laughter>

Brock: That's for sure.

Hardy: Interesting thing about my mother is that she had taught at that high school, so she was friends with many of the teachers who were there, and so she kind of encouraged me to get into this class or that class and get this teacher or that teacher <laughs> that would be conservative enough for her.

Brock: What had been her subject?

Hardy: She's a math teacher, and she was a very good math teacher. You know, later on, many years later I came home one time and she was teaching. After my dad died she went back to teach. And so I got a chance to sit in on her class one day. She was a phenomenal math teacher. But I asked her-- and she loved teaching and she was really good at it, and so I said, "Why did you stop teaching?" And she said, "I couldn't work while your dad was alive because it would've been such an embarrassment to him that his wife needed to work." So,here we go with the conservative world again. She had to give up her favorite occupation, the favorite thing she loved to do in all her life, the real meaning of her life, and she had to give it up to look proper in the community.

Brock: For how long, then, did she give up teaching?

Hardy: Well, she gave it up when they got married, or at least when we moved to Evanston she gave it up, and he died when I was, I don't know, 25 or something, so 20 years.

Brock: Oh, okay, so sort of frustrating herself in a way by those strictures, too.

Hardy: Absolutely.

Brock: Interesting.

Hardy: Absolutely was, yes.

Brock: Did she bring math into the household, though?

Hardy: Oh, yes. <laughs>

Brock: Could you talk about that?

Hardy: We did talk about math, yes, and I think all the kids have a good math background.

Brock: I would imagine that was something that you enjoyed that really you connected with--

Hardy: Oh, yes.

Brock: --in school and with your mom?

Hardy: Yeah, yeah, yeah. I always enjoyed math, never had a problem with it, always thought it was fun, and I think my kids are the same and my grandson's the same. It's just sort of a part of the way our family operates. You know, you manage to explain fractions when they're trying to figure out how to do a recipe or something, and it's just automatic. It just becomes part of their life, and that's the way I grew up, too. It was just every time we'd learn something new in school like fractions I already knew about it because--

Hardy: --it was just part of the family.

Brock: Did that go along with-- it seems there are sometimes associations between mathematics and music in the household or mathematics and puzzles. Were there any of these?

Hardy: Oh, yeah.

Brock: Could you talk about those?

Hardy: Well, we had a really nice piano, a really nice grand piano for virtually as long as we lived in Evanston, and we all got piano lessons. And my sister—and brothers-- you know, we all played an instrument. I played the violin. My sister played the flute. She got good at it. I never got good at it. <laughs> And, you know, puzzles and games of that sort. They have much better examples of these things these days. <laughs> But we all-- that was just the way it was. That was life, yes.

Brock: Well, could you tell us a bit, then, about how your experience in high school unfolded and what that was like for you in the classroom and outside of the classroom?

Hardy: I was just like every other-- I was just like all of my friends from grade school, and we were all together. Back in those days they had groups called Y-Clubs for the YMCA or very much like our Y over here, organized groups, and so they had Y-Clubs for girls and Y-Clubs for boys, and so we all managed to maintain the same friendships all through high school, and it just went along like that. In the summer-- we'd all had this good education. We'd all gone to some of the best-- you know, my friends had gone to some of the best grade schools in town, and so we followed through. We were always-- at that point in time they had levels. You could take advanced math, advanced English, advanced whatever, and so we were always all of us together <laughs> in the advanced classes, we were close the whole time. In the summers, after my freshman year in high school, turned out my friend Annie across the alley, <laughs> her mother actually worked, so she was the only person I ever met who wasn't part of the community because she worked. However, it turned out she did a lot of social work, and one of the things she knew was that the Girl Scouts were starting a new camp and they needed counselors, so they hired four of us who were friends to go and be very, very junior counselors. So starting in the summer after my freshman year in high school until I was out of college I was a camp counselor, taught swimming every summer, so that, again, was a great experience for being a manager.

<laughter>

Hardy: But, you know, I just kept falling into these kinds of jobs working with people.

Brock: Was that in Wisconsin or nearby?

Hardy: It was in Wisconsin.

Brock: Yeah, that seems to be the-- in southern Wisconsin?

Hardy: It was kind of in the middle of Wisconsin, definitely middle south, not middle north. <laughs> And on our day off, this was back in the forties, on our day off, you know, a couple of us would get together and we'd hitchhike all over Wisconsin to these different cities. You wouldn't think of doing that around here these days, but back in those days it was safe and we all traveled all over and nobody ever got in any trouble, and we got to see a lot of Wisconsin, so very different world.

Brock: Was reading a big part of your life as a young person?

Hardy: Reading.

Brock: Yeah.

Hardy: Yes, of course. As I had told somebody just recently, I would read a lot of books. My dream when I was in sixth grade was to be a cowboy and take all the sheep out on some mountain in Wyoming and live all summer without being responsible for anybody else.

<laughter>

Hardy: So you kind of know where that came from.

Brock: Yeah, that seems very straightforward.

<laughter>

Hardy: But, of course, we read all the books, and there was a great public library. I read books for class and never had a problem with reading and always enjoyed it. And the only thing I miss about my current life is I don't travel anymore, and I used to read books. I used to travel all the time, so I read tons of books because I was always on an airplane. And I haven't quite reorganized <laughs> my life to take five hours <laughs> out of the week every week or five or ten hours out of every week, which is supposed to be reading time. <laughs> So I don't do as much now, but it's my plan to start again.

Brock: <laughs> If you think about your high school years, in addition to this mother of the friend who got you the summer camp counseling jobs, were there other important adult mentors or teachers that come to mind that were important to how your life played out?

Hardy: Well, I don't think anybody paid very much attention to me. You know, I was kind of quiet. <laughs> I wish I could still remember where I had this, but back in my-- this is going way back. Back in first grade-- when we were clearing out my mother's house, my daughter came across my first-grade report card, and at this point I'm a VP in a Fortune 500 Company and the report card says, "Ann will never be a leader. She's too quiet." So <laughs> don't predict what your kids are gonna be, <laughs> what your kids are gonna do. But that wasn't a problem. I mean I wasn't paying attention to my report cards at that age.

<laughter>

Hardy: But it set my mother's expectations, which was somewhat of a problem. And when I graduated from high school, of course, I was looking about places to go to college, and I was not getting along well with my family for a wide variety of reasons, even worse than most teenagers, so I wanted to go as far away as possible, <laughs> so I thought Stanford would be a good idea, <laughs> and I got accepted to Stanford. But, again, my mother thought that big colleges wouldn't be good for me, so I went to Pomona instead. And because these big colleges, Harvard, Stanford-- she had a brother who she thought didn't turn out well because he went to Harvard, and so she wouldn't let me go to Stanford. My brother, who is far and away the smartest of the five kids, she wouldn't let him go to Harvard. You know, it--

Brock: For social reasons?

Hardy: Just because she was afraid that these schools made you non-religious and because they gave you facts, <laughs> and so it was very hard. So she got one of the counselors at high school to tell me that I wasn't fit for Stanford and that I ought to go to a small school. <laughs>

Brock: Well, what were you thinking of with the desire to go to college? Did you have a particular-- what were you hoping for your life at that age when you were graduating? Did you have ideas about what you wanted to do? Some people have strong ideas; others have hazier ideas. Where did you fall?

Hardy: I came in the middle.

Hardy: I wanted to have a job which would make me self-sufficient so I would not have to stay home and wash dishes like my mother. <laughs> She really wasn't happy in that role, and so I wanted a job that I could do something with, and my interests were all math and science. And I'd had a woman for my chemistry teacher in high school and she was very encouraging, and so when I went to college I wanted to be a chemistry major.

Brock: And is that what you did once you got to Pomona?

Hardy: Oh, no, because I went to college and, unfortunately, my advisor, who had to approve-- you know, colleges are organized--I supposed they still are--so your advisor has to approve the classes you select.

Brock: Right.

Hardy: My advisor was the chairman of the chemistry department, and he would not let me sign up for chemistry because he said, "Women in advanced chemistry labs are too distracting, and I will not have a woman chemistry major in my school."

Brock: So there were no women chemistry majors--

Hardy: Right.

Brock: --during this person's--

Hardy: Tenure.

Brock: --tenure.

Hardy: <laughs> Can you believe this? <laughs>

Brock: Well, you know, I mean some of that same attitude is still evident in the things that are in today's headlines about sexual harassment and things going on in the lab.

Hardy: Absolutely. Things are better but they are not fixed.

Brock: <laughs> That's a nice way to put it. Wow.

Hardy: So, anyway, so what did I do? So I went to the catalog <laughs> and figured out what I could major in that would let me take the most math and science without getting caught at it by any of the math and science-- it turns out, the way to do this was major in physical education. So I got a woman for an advisor, and she didn't care. <laughs> She wasn't worried about distracting the men. And it turns out, physical education, if you look at it in the right way, you worry about physics because you worry about how your muscles work and how to build strength--and so you have to worry about chemistry, you have to worry about biology, and so it turned out that I managed to take a lot of very interesting science classes in spite of this other Professor's best efforts. <laughs>

Brock: wow. <laughs>

Hardy: Now, the problem is, you know, they ask you on your resume, "What did you major in?"

Brock: Right.

Hardy: So it's a little hard to explain, "Well, I majored in phys ed," because nobody thinks you know anything when you major in phys ed, but I took it so that I could get a science background because I couldn't get a science background by actually majoring in science. They wouldn't allow that.

Brock: How were you financing your college education?

Hardy: Fortunately, my parents paid for that.

Brock: Oh, great, so their fortunes had turned--

Hardy: Why they didn't object is beyond my comprehension, but I mean in my day if somebody had told my daughters that, "You can't take chemistry. You're a woman. You can't take chemistry," I would demand my money back. <laughs>

Brock: Absolutely.

Hardy: But, you know, it was a different time, and so they paid for my tuition. Now, of course, when the college calls me and wants more money these days they don't get it from me.

<laughter>

Hardy: I said, "I already paid my dues. My parents paid my dues, but I didn't get the education."
<laughs>

Brock: Had your mother gone to college?

Hardy: Yes, yes, both my parents had graduated from college.

Brock: Right, so there was a tradition of that and there was an expectation that you would go?

Hardy: There was an expectation we would all go to college, which we all did.

Brock: I was just thinking of-- what year did you graduate from high school?

Hardy: Fifty-one.

Brock: Nineteen fifty-one. I was just wondering if any of that close cohort that you had from the neighborhood and all through school were other young women going to California to college or were you unusual in going so far?

Hardy: I was unusual. Nobody else came out. <laughs>

Brock: Yeah. Were other of your friends-- how unusual was it to go to college?

Hardy: Everybody went to college. Everybody in the group went to college, and of course, Northwestern is there so a lot of them went to Northwestern, and others went back east to various colleges. The east coast is not nearly as far away. <laughs>

Brock: That's true. Well, outside of that discrimination about being able to take science courses, were there other big differences between the experiences of the male undergraduates and the female undergraduates at the college?

Hardy: I don't know. I don't know that I paid much attention to that--

<laughter>

Hardy: --except being annoyed that-- you know, except having to figure out how to get around the attitude. <laughs> Other than that, I don't think I paid much attention to any serious differences while I was at Pomona.

Brock: Well, you know, in succeeding in taking this coursework, how did your personal interests develop in terms of science and math during those years?

Hardy: Oh, I loved it. I'd gone into college thinking I would love it and I came out loving it. The biology teacher-- I was looking around for what do you do with this random set of science classes, and he suggested I do physical therapy, and so I went back to Columbia to take physical therapy, which was supposedly the best physical therapy school at the time.

Brock: I was wondering about that because that's a big jump from southern California to New York.

Hardy: I have moved around.

<laughter>

Brock: And I was wondering if it was the attraction of New York City.

Hardy: Of New York City. I wanted to live in New York City, so I did, yes. And so I went to Columbia and I went to physical therapy for a semester, but one of the classes they had-- <laughs> here we go again. One of the classes they give you in physical therapy is that you must follow the doctor's orders even if he's wrong. And this probably isn't true anymore but it was true then. And at this age I sometimes see my physical therapist and he feels free to overrule the doctor, <laughs> you know, not exactly overrule him but at least discuss something with him about why his ideas are better. <laughs> But in those days you weren't supposed to do that and you just followed the doctor's orders, 'cause all the doctors were men and the vast majority of the physical therapists were women, and so our job was to follow the doctor's orders. Well, we had enough overlapping classes and overlapping studies that it was perfectly clear to me they weren't any smarter than I was, and so I rebelled again <laughs> and dropped out of physical therapy and stayed one more semester at Columbia. I went to Columbia Teachers College, which was great, gave me some chance to take a little more chemistry. <laughs> And fortunately my life has -- well it was unlucky in some ways, had a lot of good luck. Fortunately, one of the guys from Evanston, one of the friends from Evanston in the neighborhood, was an engineer. He was an engineer at IBM in Poughkeepsie. And we were both sort of loners on the East Coast. So once in a while, we got together. And I told him how frustrated I was. And I needed a job. And he said, "Become a programmer." And so, I

had never heard of IBM or programming. And the word computer was not in my college dictionary. So, he had a take an afternoon or so to explain to me what a computer was, what a programmer was, what IBM was.

Brock: Well, Ann, before we get into that sequence with your friend from Evanston that got you into IBM, I just had a couple quick questions just about-- well one, I was interested where you were living in New York City while you were at Columbia and just what you made of that environment.

Hardy: I loved it. Upper West Side near Columbia area, and I moved around a couple times, for various reasons. But Upper West side, and had a fabulous time. And when I finally got a job, I continued to live there for a while, another year. And I had a friend who'd come with me from Pomona to do physical therapy. She stuck it out. We were at the show every night. There was the theater, the ballet, the opera. It was just never-ending, all the museums. I took full advantage of living in New York City. And I loved it.

Brock: Less pleasantly, this is very kind of scary time on the world scene with the kind of the heights or depths of the Cold War, depending on the way you look at it, I guess. What was that-- can you talk about what that Cold War central period was like for you?

Hardy: The-- I don't think the Cold War impacted what I was doing very much. The Korean War, I had to take-- there were no flights. So, I had to take the train from Chicago to L.A. And of course, the trains during that period were primarily filled with soldiers.

Brock: Wow.

Hardy: So, I definitely knew a lot of the guys who went off to Korea. And one of the interesting things about the guys who came back that came up in a conversation just yesterday was that so many of them had-- I guess I learned this because I'd lived in New York, but they'd grown up in Brooklyn or Bronx, which were not wealthy areas. They were marginal. And they came back and their whole perception of the world had changed because they said, "Discovered that I'm just as smart as the wealthy White guys who live in Manhattan."

Brock: From serving together?

Hardy: From the service because they were all in it together. And you had to-- the service in that war was brutal. And you had to protect everybody who was with you. And they-- and you had to make decisions in a hurry. They all learned they were just as good at all of thisplanning and everything as the rich White guys. And yet, they were supposed to live as second class citizens. And that's what had been happening before the war. And they all lived in, not slums, but definitely not Evanston. And so, it was a big change

for them. Fortunately, the country was, at that time, the only advanced economy that wasn't completely mangled and destroyed. So, the economy here was expanding at a great rate. There were more than enough jobs for everybody. So, these guys came back from the war, knew they were just as smart, and went after the good jobs just like the wealthy White guys. We don't do-- that's not true anymore. The veterans who return today, there are not enough jobs for the ones that came from poverty. And yet, they have been there and learned they are just as smart as the guys who are getting the jobs. So, I think you were asking about turmoil and social turmoil. Having listened to it after World War II and listening to it now, I think that's a huge difference in what's happening to people and why there's-- one of the many reasons, but one of the many reasons why there's so much anger.

Brock: The frustration.

Hardy: Frustration.

Brock: To have that realization and then not be able to act on it.

Hardy: And then not be able to follow through and have the opportunities.

Brock: Very interesting. Your friend, the engineer with IBM, who suggested that you become a programmer, had you had-- surely, you knew of the existence of computers before that? Or had you--?

Hardy: I had a math teacher in college who devoted about ten minutes one day in class to explaining to us that there was such a thing as a computer. And that was my experience with computers.

Brock: <laughs> Okay.

Hardy: So, fortunately, I listened to my friend in spite of the fact that I didn't know anything. And so, I walked down to world headquarters, which if you knew anything, you wouldn't do, but since I didn't know anything, I just walked into world headquarters and said, "I want to apply for a job as a programmer."

Brock: And where was the world headquarters?

Hardy: Madison and 57th.

Brock: Okay. And this is the-- that is, then, the very building that you had your training, etc. in after you-- well, describe that. You walk into the lobby. I imagine it's a big New York office building lobby.

Hardy: Yes, and IBM has it set up so that it's on a corner, one of the busiest corners in Manhattan for business people. That whole area is big business. And so, two sides of the building on the first floor, not all the way up, were totally glass. And in that space, was a 705. And so, that's why it was set up like this, so people could see, could walk by and see what a computer was. I wasn't the only one who didn't know anything about computers. So, I walked in and said I wanted to apply for a job. And they said, "Well, personnel is on the tenth floor," or whatever it was, "Take the elevator over there." So, I went up. So, I sat down and chatted with the personnel person. And we were doing really well until she asked me what I'd majored in in college. That didn't go over too well. But then I talked to her about, "But look at all the math and chemistry and physics classes I've taken. I really can do this," because she said, "You're supposed to be a mathematician to do this stuff." And so, I said, "Yeah, but I've taken those classes. I just didn't take them under the right labels, but they're all here." And so, she said, "Okay, well." Grudgingly, she allowed me to take their aptitude test.

Brock: Did you take it right then and there?

Hardy: I can't remember if I took it right then and there or came back for it. I wouldn't be surprised if I didn't take it right then and there. And it's a typical aptitude test. And it was, in my opinion, a very good aptitude test for programming once I learned what programming was. So, yeah-- so, I passed the aptitude test. And so, they said classes start on June 5th or whatever it was, come back. And--

Brock: And were you, at that point, an employee?

Hardy: Once I started class.

Brock: Okay.

Hardy: And it was a six-week class. Four weeks of training in general about-- first of all, we had to learn all the EAM [electronic accounting machine] equipment, the sorters and the keypunches and all that stuff. And you had to-- of course, you had to know how to-- you had to know how to punch a Hollerith card if the best keypuncher you had was a model 10, which means it doesn't have letters on it. It just has numbers. And if you wanted to put in like an instruction with alphabetic characters, you have to know which numbers to punch.

Brock: To represent that character.

Hardy: To represent that character. So, we had-- this is the kind of thing we had to learn in our first four weeks. And we tried-- and we had to learn-- so, we learned all that EAM equipment, wired all the boards.

And they kept giving us, of course, challenging--make it do this, make it do that. And we had to wire the boards.

Brock: This was sort of a plug board operation, is it not, to have that sorter, tabulator perform some sorting operation or mathematical functions?

Hardy: Right.

Brock: So, did they consider that to be programming those machines? Or how did they speak about that?

Hardy: Okay, it turned out that this is world headquarters. And they're trying to train you to be either-- their goal was to train you to either be, as I found out later, a salesman or a system service girl, which meant you had to go out and help the customer--

Brock: Run their machine?

Hardy: Wire their boards. So, you had to know-- so, one of the things they wanted you to learn was how to program in case the customer needed that. But most of their customers still had EAM equipment. So--

Brock: So, that was more the centerpiece. And then--

Hardy: That was definitely a centerpiece. It was definitely important to learn how to-- and I was-- got very good at wiring boards in a hurry. And but then we also programmed. We programmed the 650. And we programmed the 705, which was down in the-- Now, the good news about being a woman—[for] once, there was good news, is that they wanted to make it look easy to use a computer. And so, the women got to do all their debugging and testing on the 705 downstairs. And since there were almost no women in the class, we really had great access.

Brock: By being on display in the window.

Hardy: For being on display in the window.

Brock: And so, for that reason, you all had way more computer time than your male--

Hardy: We had more computer time.

Brock: Oh my god. What was the, I mean roughly, the fraction of men and women in your--

Hardy: There were about twenty people in the class of which three were women.

Brock: Okay. Did you-- did the women in the course form any sort of esprit de corps?

Hardy: There were two of us that are still friends. The other woman was-- she was great. But she had, for some reason or other, had a lot of family or something in the Caribbean. And so, she left and went back. So, I don't know her anymore. But the other woman, we're still friends. And so, yeah it was a good deal for the women. It was. We stuck together. The interesting part about this class, well there's this first part. And then there was two weeks at the end where we actually had to do real customer support on programming the 705. And so, we really did have to write payroll programs. And that was the big thing at the time was getting payroll automated. It helps a lot to have accurate payroll.

<laughter>

Hardy: And as soon as we got accurate payroll, then we started automating banks because it also helps to have accurate bank statements. So, we did that. And then, it turned out at the end, they gave us all a test. How much did you learn? Going into the test, they told us if you're in the top ten percent or something, you get to go into sales. And everybody else can be a support or system service girl or go into programming or something. But we took the test. And unfortunately, some of the women came out in the top ten percent. This they had not counted on.

Brock: Encountering that situation, they hadn't thought it through.

Hardy: Never crossed their mind. So, they had to read us a letter from Watson, who was the president of the company, who wrote a letter to be read to the women in the class explaining that women could not be in sales. It doesn't matter how good you are. You cannot-- I cannot-- he said things like, "I cannot send a woman alone into the office of a corporate officer."

Brock: Hmm.

Hardy: Yeah. So, that was so much for that. So, system service girl didn't sound like it was a long-term career. So, I decided to be a programmer. And it turned out that was great because once I really got to program, I loved it. You know how some people like to do Sudoku or puzzles or other things like--? I loved programming. So, if I had to do it twenty-four hours, it was OK.I was doing programming during theday.

But it was easier to get computer time at night, so I'd work at night, too. I just thought this was such fun that it didn't bother me if I had to work ten hours, twelve hours a day. I just liked it.

Brock: Well, I want to talk to you about, to the extent that you're able to articulate, what about it was a pleasure? It just seems like since they hadn't anticipated that women could do so well on the test that they ran, literally, the question all the way up to the head of the organization to see whether or not you should be made a salesperson.

Hardy: Yes, right.

Brock: That's fascinating.

Hardy: It's fascinating that they had-- yes, they had never anticipated that women would-- I'm not sure, would do so well. I'm not sure that they'd ever actually had a class, that had women in it before.

Brock: Well, that's what I was wondering, how many-- if you had a sense of how many iterations of the class they had even had.

Hardy: I had a feeling that we were very early.

Brock: It must be.

Hardy: And that they just-- they'd never had this happen before. So, here we were. And so-- And this is the '50s. This is 1956, long before there were any-- anybody'd even thought about non-discrimination laws or anything. So--

Brock: Well, could you talk about just your impressions of the firm in that first year that you were involved with it, just what it was like to be a part of the organization? Did it give you a feeling of pride? Were you-- was it something you were eager to tell your friends about? I'm just wondering what it meant for you to be a new employee of IBM in 1956.

Hardy: Well, everybody was curious. I have to say that. I mean-- do you remember the 705 at all? It was just a character-- had character addresses. And I forget exactly how many characters it had. But it meant you could have really, really long numbers. And of course, I would try to explain this to my mother who was a mathematician and knew that you didn't have accuracy to anywhere near that length of number, and thought it was fun trying to explain computers to people who had no clue, who just-- most of them had-- most people were like me. They'd never heard of IBM. They-- you didn't-- it was-- computer wasn't

in their dictionary either. So, it was not that I got anything special. And so, it was fun to explain to people. And I, as I say, I loved programming. And I got transferred into, right off the bat, I got transferred into research working for a man, Dr. Paul Roth, who did-- who was developing some algorithms -- to analyze circuits, and reduce the number of components because, back in those days, we had discrete components. If you could take a few components out, you'd save a lot of money. So, I got to program all these. And since I liked-- since it turned out I liked programming, I had a great time. And that's why I was working night and day. It didn't bother me. And so, it was great. It was-- I was sort of in awe of being in research because there weren't, when I started at least, there were no other women in research except for secretaries. So, nobody quite knew what to make of me. But I had a good time.

Brock: Now, I believe there was a-- there's this Watson lab at Columbia.

Hardy: Yes.

Brock: Was that where you had gone? Or is that a different--?

Hardy: No, that was different. My other friend, my friend that I'm still friends with my class, she was from there. But I just came out of the blue, walked in the door. And then I got sent to Poughkeepsie to IBM Research, which was in Poughkeepsie at that time, and then moved down to Lamb Estate inOssining. And then eventually, they built the real research center. But by that time, I was transferred out.

Brock: Okay, so it was in Poughkeepsie where you were working with IBM.

Hardy: Poughkeepsie and Lamb Estate in Ossining, yeah.

Brock: Okay.

Hardy: So, people ask me where did you live. And I say up and down the Hudson River. When I worked for IBM, I worked from-- I lived in several places starting in Manhattan and ending in Poughkeepsie, all up and down the Hudson River.

Brock: You just got an apartment nearby to each place?

Hardy: Just gotapartments nearby. That's right.

Brock: Well, it's interesting that you went from doing these like payroll programs, you know the first programs, which-- well, I was-- the question I had written down was how did IBM frame the world of computing to you, office automation, or scientific computing. And it seems like the first two things you did were office automation and scientific computing.

Hardy: That's right.

Brock: So, were those the--

Hardy: They didn't know what they were doing any more than I did. It was just so early, you know. It was so early that nobody knew exactly how to explain anything. And I just happened to fall into a job I really enjoyed.

Brock: So, the Sage effort must have been going on at this time. Did you--?

Hardy: I wasn't involved with Sage.

Brock: Okay.

Hardy: I knew about it, but I wasn't involved.

Brock: So, this would have been the-- was that also kind of the-- the Sage programming was done out at Rand. So, that wasn't with IBM?

Hardy: Yeah, it wasn't.

Brock: Okay.

Hardy: It certainly wasn't in any parts of IBM where I was. And it was not in Research, where I was.

Brock: Okay.

Hardy: And then after Research, I transferred into the Stretch project, Stretch/Harvest project. So, it wasn't-- I wasn't involved with it.

Brock: Well, in thinking-- well, if we could talk about the IBM Research experience a little bit more, could you just-- so, I imagine Research had their own computer or computers.

Hardy: No.

Brock: No? How did it work to do the circuit job?

Hardy: <laughs> Well, they had re-- computers were scarce. There was one computer in Poughkeepsie that Research got to use and a whole bunch of-- and everybody in Poughkeepsie got to use. Everybody who needed a 704 got to use this computer. And so, that's one of the reasons I worked at night because all the rest of these guys got priority on the 704. And they got it during the day. And so, I went in at night.

Brock: Were they using-- what were the other people using the computer for?

Hardy: A lot of it was circuit design, engineering design. They were-- that's where the engineering -- was happening for the-- for all the computers in those days.

Brock: So, using the computer to build the next computer.

Hardy: Build the next computer.

Brock: Interesting. So, this-- the research project, the circuit emulation, or circuit design program that you were working with is kind of-- was of a piece--

Hardy: Of a piece of the whole thing, exactly.

Brock: Okay, interesting.

Hardy: And notice that I went from the 705 to the 704.

Brock: You went back a step.

Hardy: The 704 looks a lot more like recent computers than the 705.

Brock: Could you talk about that? I don't--

Hardy: Ah, the computer design. Well, the 705, as I said, was character addressing and -- there's nothing like that anymore. It-- do you have a question?

Hsu: What's character addressing?

Hardy: Well, normally, we went to-- normally we-- after that, it was-- the 704 was word addressing. And then you had-- sometimes, you got to bytes. But so, character addressing was-- they didn't have bytes, but that's basically what it was except in the early days, there were six bits. So, you didn't have-- all you had was capital letters and very limited special characters. We've improved.

Brock: Did the 704 come earlier sequentially than the 705?

Hardy: No, they were basically together.

Brock: At the same time. And the 704--

Hardy: The 704 was-- 705 was specifically designed for business applications. It was a decimal machine. It was-- and it was specifically designed for business applications.

Brock: Okay.

Hardy: And the 704 was specifically designed for scientific applications. That's the difference, sorry. And as it turned out, it's just as easy to do business applications on a 704 as it is on a 705. But they didn't know. One of the things I wish somebody would do is write up some of these-- some of this history of as you go through these different computers I had, their designs, their memory design, and their architecture, they kept trying all these different things. The 650 is different from the 705, which is different from the 704, and of course and the Stretch was different. And the 7090 was different. And it's-- and the 360 was different. It's such-- I've had a good time trying to remember all of this stuff because it's fascinating how we had to try so many different designs to come up with the 360, 370, the computers we have today. And eventually, they all sort of came similar-- became similar. But it took a long time and a lot of designs to get there. And nobody knew. Nobody knew which was going to work out.

Brock: Half searching in a way.

Hardy: Yeah.

Brock: Yeah.

Hardy: And so, it was-- so that's how come I wish somebody would-- I think it would be great if somebody would-- some good historian went back and did this because it's fascinating.

Brock: Yeah, to explore all those options that were--

Hardy: All those reasons why we thought the 650 was the right design, why we thought the 705 would be the right design for business applications, why we thought you needed the 704 for scientific applications, and how the word length moved around and why. And it's a very interesting history.

Brock: It is. Well, when you were doing this work with Paul Roth programming the 704, to the extent that you can recall working on that project, what was-- I'm just interested in what that meant. What did you do? Where were you sitting? What were you using? What language or-- was it octal encoding? Or just what-- how did it go?

Hardy: They did make us, in class, write our first program in octal so that there was-- nothing was relative addressing, which means that if you had left out an instruction, you had to go down and change everything after that by hand. So, I think they made us do that so we would appreciate assembler.

<laughter>

Hardy: Which we did. So anyway, by the time I got to Paul's project, it was assembler. And he had another guy working with him named Eric Wagner. And I shared an office with Eric. And so, we discussed-- so, I often discussed with Eric how these algorithms would work in a program, just sort of what priorities should take place, and what do you optimize because I don't know anything about--

Brock: About the circuits.

Hardy: About the circuit design. And so, it was another one of these absolutely fascinating jobs. It just went from one interesting thing to another. And most of the time, we were in Lamb Estate, which is where I was sharing an office with Eric.

Brock: And were you writing things out on legal pads or scribbling on a chalkboard?

Hardy: No, they had special coding pads.

Brock: Special printed pad of paper.

Hardy: Printed pads for coding, right. So, you had-- yeah, so you had a fixed number of columns in case you wanted to put an address in there, and then the fixed number of columns for the instruction, and the fixed number of columns for the next address, and another fixed number of columns for the comments. So, you could have-- that was a coding pad. Do you have some of those around?

Brock: I don't know. I would hope so. I would-- I imagine that we do. But I'm not sure. That's something that we can look up right afterward.

Hardy: Yeah because those-- we used those for years. They were the same everywhere, and everybody who programmed in those early days used it exactly like that. They were all the same.

Brock: And you're using a pencil to fill it out?

Hardy: Yeah.

Brock: Okay, yeah.

Hardy: So you could erase it.

Brock: And then once you have some--

Hardy: Once you do that, then either you can go to the keypunch, or you can get, if you're lucky, you get a secretary to do the keypunching. One of the interesting things, skipping ahead a little bit, on the Stretch project, we had a secretary[, Jeanne Senk,] who had just a high school education. But she was doing all the keypunch for the whole group. And after a few months, she started correcting our errors.

Brock: Wow, from just-- from reading it?

Hardy: Just having read so many programs. She was awesome.

Brock: Wow.

Hardy: Yeah.

Brock: Did she tell you? Or did she--?

Hardy: Yeah, she would say-- she would come over, "Did you really mean this?" Oh, you'd go, "Oh no."

Brock: What a great safety net to have.

Hardy: Yeah, it's really nice to have your software debugged before you even get to the machine.

Brock: Before you got to the coding pad, did you--?

Hardy: Oh, we had flow charts.

Brock: Okay.

Hardy: Yeah, we had flowcharts and —templates for people who needed beautiful flow charts.

Brock: These were things that you would draw, pencil and paper.

Hardy: Yes. Well, I'm sure you've seen the flowcharts. Yeah, that's exactly what they looked like. You'd put in every different function and what you'd do if it worked or didn't work or whatever.

Brock: To establish the kind of overall logic of it.

Hardy: To establish the overall logic and it caught a lot of bugs in your thinking because you had to write down everything. And if you came to a dead end, it was easier to figure that out then than after you were on the computer. So, yes so flowcharts were very helpful.

Brock: Did you have a process for kind of saying okay, we like this flowchart? This looks good. We're going to move on to getting the coding pads out of the drawer and going.

Hardy: I wasn't very organized about that.

Brock: It was up to you, in other words?

Hardy: It was entirely up to me. And once we'd agreed on how to-- sort of the design of the-- big design of the algorithms, then everything after that was up to me, code it, flowchart it so you know what you're doing, code it, get it keypunched, run it, see how good you-- see whether or not you got that right.

Brock: So, if it was you or the secretary who had done the keypunching, you have then the stack of cards, or the deck.

Hardy: One of those big card boxes, do you have some of those around?

Brock: We do. We do. Who then takes that-- or how does that thing get to the computer?

Hardy: I carry it.

Brock: You carry it.

Hardy: And that's why it was really lucky they had long words because you could take the end of the-- you know, you use seventy-two columns. But you had eighty column cards. And those last eight columns were sequence numbers. So, when you dropped the deck of cards, you could put them back in the sorter. And this happened a lot.

Brock: It did? It was com--

Hardy: Yeah.

Brock: Yeah because you had to carry these--

Hardy: Everybody was carrying these things around. And every once in a while, somebody would trip. Or you'd bump into something, and yeah the cards were on the floor. And you'd just-- so, that's why I learned how to wire sorters really.

Brock: And then what was the turn around? Like what would come back to you?

Hardy: I was there.

Brock: Oh you stood there while it ran.

Hardy: I was the only one in the room.

Brock: Oh, you were running the machine?

Hardy: Yeah.

Brock: Okay, you had control of the machine.

Hardy: Total.

Brock: Okay.

Hardy: Total control. Nobody else was there. So, put your cards in, read the cards. You watched the lights on the console, see if it was doing the right thing. And yeah, and then--

Brock: Were there like vis--

Hardy: There were printers so you could get printouts. You could-- yeah, basically, pretty much the printouts came out on the printer.

Brock: Would you always do a printout?

Hardy: Well, unless it crashed.

Brock: Right. I was wondering if there-- like while it was running, there are certain things going on. There's of course the display lights, but I was wondering if there were any other sort of like physical clues about if things were going right or wrong, like if you could tell something was going wrong by a sound or--?

Hardy: You could tell from the lights.

Brock: From the lights. And were there-- could you talk about how that worked? What did you see?

Hardy: Well, when you get into a loop, it's really obvious.

Brock: Just a repeating pattern?

Hardy: The repeating pattern. And the other thing that people spent a lot of time doing was writing to mag tape, reading and writing from mag tape because there were a lot of data out there on mag tape. And that was the other thing that was so fascinating about watching other people's programs, is that I could watch—and I'd get there early in the machine room. They'd have the machine. And so, they would-- every once in a while, they'd get this little blip that they actually did some computing. And all the rest of the time was reading and writing from mag tape. And you could see this on the console lights. So, you could see exactly how much was going on -- in anybody's program. Yeah so, the console lights were pretty good, pretty good tool.

Brock: I heard the talk from a historian who was talking about earlier computer systems. And people were wiring into the machine kind of a loud speaker. Was that--?

Hardy: Yeah, I heard that talk.

Brock: Oh yeah.

Hardy: And I--

Brock: Did that--?

Hardy: Never ca-- I never saw that.

Brock: Okay.

Hardy: And he thought it was very useful. I did fine with the lights. What can I say? I didn't know about loud speakers. And the lights worked really well.

Brock: Okay. Let's see. So, was the circuit optimization programming your major task while you were with research?

Hardy: Yes.

Brock: Okay. And I guess there's this question about when Fortran starts to come into the picture. Was it with research? Or--

Hardy: Well, I'd started programming in octal. So, I was perfectly happy with assembler. But while I was in research, they did want me to try using Fortran. So, I did do some Fortran. It was beta-- they considered it a beta site. And it was fine. But I was so accustomed to assembler by that time that it wasn't-- later on, when I had to do-- start from scratch, then I was happy to use Fortran. But right then, it was all in assembler. And the assembler, I was so familiar with it. It wasn't a big deal for me. But Fortran, they did the I/O for you, which I did appreciate because back in those days, all you got was the computer. You didn't get any I/O routines. You didn't get anything. You just got the computer.

Brock: Oh. So, would you have to-- in let's say with your circuit emulation program, you would have to tell it-- you would have to--

Hardy: You would have to know--

Brock: Tell the computer how to read from the tape or use the printer? You would have to--

Hardy: You had to know that.

Brock: And you would include that in your deck of cards.

Hardy: Yeah. It was way back.

Brock: Did you save those?

Hardy: Oh yes.

Brock: Yeah.

Hardy: Of course.

Brock: So, you had your-- so in a sense, you had your own library.

Hardy: You had your own library, right.

Brock: Hmm. And how many of-- you were exchanging-- were the programmers in research sharing card decks and exchanging libraries? Did you get cards from other people or copies?

Hardy: Well, eventually, there were three of us working for Paul doing this stuff. Two other people came later. And of course I shared all my data, all my subroutines with them, and so we all used basic drivers the same and as much as they were interested in any of the other stuff I'd written. But outside of that, I didn't do much with any of the other groups in research. And at the time, of course, I'd heard about all the wonderful things they were doing, but I didn't-- you know, as I say, when I arrived in research I was probably about the only woman in the organization that wasn't a secretary, so I don't think they knew how to talk to-- you know, they just didn't know what to say.

Brock: Hmm. So perhaps maybe the other male programmers in Poughkeepsie may have been more chummy--

Hardy: They might've been more community--

Brock: --and sharing their works, right.

Hardy: I just really don't know.

Brock: Right, hard to tell from where you were.

Hardy: Hard to tell from where I was, right.

Brock: Hmm. Well, Stretch comes along pretty quickly.

Hardy: Yes.

Brock: Could you talk about how you came into the Stretch effort and give us a sense of your impression of how important Stretch was for the company at the time and just kind of introduce us to you coming into it?

Hardy: Well, I'm not sure how I managed to get lucky enough to get transferred except that I had really done my part of what Paul wanted done, needed. They were using it in engineering, and so they didn't need me anymore.

Brock: They had the tool, in other words.

Hardy: They had the tool, and so it was a good time to move to another project so I moved to Stretch, which was in Poughkeepsie, and that was nice. And that was a much more-- well, Fran Allen was on that project with me, and so it was nice to have another woman. The first thing we did was write a Fortran compiler. Now, Stretch wasn't built at that point. There wasn't a Stretch. We used the simulator, which-- oh, man. I looked up this guy's name. [Tom Apple]

Brock: I think I looked it up, too, John Cocke and Harwood Kolsky, does that sound right?

Hardy: Those are two great guys, but they aren't the guys who wrote the simulator, and if you want me to send that to you I'd be happy to--

Brock: Sure, yeah.

Hardy: <laughs> --if I don't think of it before I leave. But, anyway, the guy who wrote the simulator, the Stretch simulator, was really good, really good, and so that's what we used to debug all the software. As long as I was on Stretch that's what we used. They never did get a real machine up and running while I was still there.

Brock: Okay, can I ask about how that worked because I'm not-- so were you using, again, like a 704?

Hardy: A 704--

Brock: And you would--

Hardy: --with a Stretch simulator, and then it was just sort of like today. The Stretch simulator worked just like an operating system works today, and then we would feed it our applications, whatever, our Fortran compilers or whatever.

Brock: And so it would be operating much slower than--

Hardy: Than the Stretch.

Brock: Correct, but you could tell if your software would work properly.

Hardy: Yes, but the simulator was so good you really could debug your software. So when they finally got a Stretch and put the Fortran on it, it worked, so, yeah, it was really good. He really-- I wish I could remember his name because he really did a good job. So, yeah, that's what it was like as long as I was there. It was a simulator.

Brock: I was wondering if-- I know Stretch seemed like it was a major, a very large hardware effort.

Hardy: Yes.

Brock: I wonder, was it an equally large software effort?

Hardy: Well, this group was Stretch Harvest, and the Harvest was a major software effort.

Brock: And, now, Harvest was the special machine for the NSA to do whatever--

Hardy: Decryption.

Brock: Okay, decryption, so pattern matching and statistics and stuff like that.

Hardy: And for its day it was very good. I hate to think what NSA could do now.

<laughter>

Hardy: Yes, it was so good for its day and I'm sure they have kept up. I'm sure they're just as far ahead of the world now as they were then. [Harvest was in production for 17 years, a period of productivity that is almost unheard of today.]

Brock: Well, I think they are like the largest employer of mathematicians or something like that. <laughs>

Hardy: Yeah. Did you know that Tom Lehrer used to work at NSA? Do you know Tom Lehrer, the music--

Brock: The humorous-

Hardy: Yeah.

Brock: --music guy? No, I had no idea.

Hardy: Yes, he worked at the NSA.

Brock: <laughs> He also worked out of that company, Baird and Associates, which is a Cambridge, Massachusetts place.

Hardy: Yeah, he was from that area and then he is a professor at Santa Cruz, or at least he was when my kids were there. He's probably retired by now.

<laughter>

Brock: Well, I had no idea.

Hardy: It was great because my kids had grown up with Tom Lehrer music because we were all there together, and I mean he had left by the time I got there, but he had instilled Tom Lehrer attitudes.

<laughter>

Hardy: And so my kids grew up with Tom Lehrer music and so they went to Santa Cruz and took math classes from Tom Lehrer. <laughs>

Brock: Oh, my gosh. I had no idea. Well, did you know him then on this Harvest project?

Hardy: I did not. I did not know him on the Harvest project. He had already left NSA by the time I got to NSA, but of course everybody around knew him. He was mythical.

Brock: Well, NSA was later?

Hardy: No, the first thing we did was the Fortran compiler so we could do anything.

Brock: Okay.

<laughter>

Hardy: Okay? And then we wrote editors and, you know, just sort of system tools that ran on Stretch. I wrote the stuff that would run on Stretch. Fran Allen had a lot to do with what actually ran on Harvest, but the fundamental part of that I think was still done at NSA because it was all classified.

Brock: Right, so they would use the tools to do whatever-

Hardy: We produced the tools and they did the magic.

Brock: Okay, and Harvest itself was a gigantic adjunct piece of hardware to the Stretch.

Hardy: Much bigger than Stretch. And you know about tractor tapes?

Brock: I think. This was a machine that was feeding the stuff into Harvest, is that correct?

Hardy: Yes, yeah, and I think there might be a picture of tractor tape somewhere here, but they had all these tape drives in a U shape and they could manage which one-- from the machine, from the Stretch you could manage which one would be active at the moment, and it would load or unload tapes. It could move them around and was actually fascinating to watch. <laughs>

Brock: It was kind of an automated tape system, then.

Hardy: It was an automated tape system, and I forget how many tape drives there were but there were quite a few.

Brock: And Harvest, was it kind of like a gigantic main memory in a way?

Hardy: It was a big processor.

Brock: It was a processor, interesting. Oh, I guess it had to hold all this--

Hardy: It had to analyze all the stuff that was streaming through.

Brock: From those tapes, yeah.

Hardy: Yeah, yeah, yeah.

Brock: Well, did you have to get a security clearance, then--

Hardy: Yes.

Brock: --when you went on to that?

Hardy: Yes.

Brock: Was that a big deal? Was that trivial for you? Was that just paperwork to fill out?

Hardy: That one was-- you know, they did, what do they call them, interviews--

Brock: Yes.

Hardy: --for those, and so I had to go down and get interviewed, whatever they do for you. But that wasn't very hard. They ask you a lot of questions--

<laughter>

Hardy: --and you tell them the answer. They either say yes or no, and so I got a clearance so I could go back and forth to NSA.

Brock: Was that more kind of like client meetings that you were doing when you went to visit with them?

Hardy: Yeah.

Brock: They were telling you what they needed in terms of the tools?

Hardy: What they needed in terms of the tools and how they were going to use it and where it was going to be, yeah, and, yeah, basically what kind of tools they needed.

Brock: Right. I would imagine-- it's my impression that they were certainly at this time such a major user of digital electronic computers that-- I just wonder if there was kind of a cadre of people at IBM devoted to kind of serving them as a customer.

Hardy: I'm sure there must've been. We sort of had our own group and our own access in our own area that we worked with at NSA. Of course, NSA is extremely partitioned, <laughs> and so we worked with a group that was going to use Harvest. And the person I shared an office with when I was doing some of this work had worked at NSA and then she was up here in Poughkeepsie and came to IBM and made sure we did everything right. <laughs> But that was very narrow. And, you know, I don't know what it's like now, but back in those days you walk into NSA. There were people who checked everything. They looked at every piece of paper you took in, every piece of paper you took out, everything in your briefcase, your purse, whatever. Everything was checked coming and going.

Brock: You would go to Fort Meade to have these meetings.

Hardy: Yes.

Brock: Interesting. And were there-- in terms of the-- well, you described another woman who came, who was in I guess programming and mathematics and stuff who came to join IBM. In the kind of NSA/Harvest people you were talking to was it a mix of men and women or was it similar to what was on the IBM side?

Hardy: It certainly wasn't exclusively men.

Brock: Okay, I guess that's really the test at the time, right?

<laughter>

Hardy: Are there any women?

Brock: Some or none?

<laughter>

Hardy: Right. You could walk around NSA and there were women there.

Brock: Let's see. Sorry, I'm just reviewing the question list here.

Hardy: That's okay.

Weber: David?

Brock: Yes.

Weber: Did you know Charlie Bourne?

Brock: Charlie Bourne, Marc is asking if you knew Charlie Bourne?

Hardy: No, not that I remember. That doesn't mean I didn't know him. <laughs>

Weber: He did information retrieval systems for the CIA and the NSA. I interviewed him.

Hardy: Oh, for the CIA. Yes, they don't talk to each other.

<laughter>

Weber: But he also did some work for the NSA.

Hardy: Okay. <laughs>

Brock: As we've come to learn. Well, for how long were you working on that project?

Hardy: I only stayed there a couple of years. It was another one of those unfortunate situations because when I joined the project-- I mean Fran Allen had some problems with this also, but I'm sure that's in her interview. But when I joined the project, I was one of the more experienced programmers and I definitely knew how to manipulate a 704 to do what I wanted. And so after about a year, there was a group of us, maybe half a dozen, 8 or 10 people working on some of the Stretch systems. As I say, Fran was more oriented toward working on some of the tools that would be supportive of Harvest, but you still needed tools to work the Stretch so you could, you know, assemble code and run your Fortran compilers and stuff, so my group was focused on that. After about a year, IBM sent Fran and me together to management training school. We were the first two women ever to go through management training in IBM engineering.

Brock: Wow.

Hardy: So turns out they tell you a few things in there they should never have told us. One was that managers, we expect, you know, just in IBM's hierarchy, managers make a salary a few percentage more than the highest paid person working for them, which is what you would sort of expect, right, a little bit more?

Brock: Uh-huh.

Hardy: And there were exceptions to this in research but basically nowhere else in the company because sometimes there were research scientists that were really good--

Brock: Right, right.

Hardy: --but they didn't want to make them into managers, so there were exceptions in research, but in all the rest of IBM the managers were expected to make a little more than any of the people working for them. And another thing they told us was that, "You guys, because you've come into management training, which is special, you're the people that we hope will become senior executives, and the background we look for is MBAs, and in particular Harvard MBAs. And we will pay for your education if you'll go to Harvard and get an MBA." Great. So I come back. It turns out that-- and of course, I get the salaries of all the guys who are working for me. They're all men. I get their salaries. Turns out I am making-- if I had gotten a 50 percent raise I would be making as much as the lowest paid man working for me.

Brock: So you were off the bottom of the chart.

Hardy: Yeah, exactly, and I'm supposed to be making, according to the management training, I'm supposed to be making more? Instead of that I'm making a fraction of what the lowest paid man working for me is making.

Brock: They didn't realize this when they disclosed those salaries to you?

Hardy: Apparently not. So I asked my manager, who was Sully Campbell--who was a great guy; he was really good--if he could adjust this, so he managed to get me a 35 percent raise, which was beyond belief at IBM, but I'm still making 15 percent less than <laughs> the lowest paid man working for me. So this doesn't look to me like there's-- you know, just staying here and going up-- I'm never going to make it. So then the next thing I decide to do, which is why I wasn't there very lon; I decided, well, I'll go back to school. I'll get this MBA. Turns out Harvard wouldn't take women.

Brock: Oh, for the love of God.

Hardy: So here's where they tell us--

Brock: They just wouldn't admit-- what year was this?

Hardy: Fifty-nine.

Brock: Nineteen fifty-nine.

Hardy: Yeah. And so here they are, they tell us, "Here's what you need to do. Here's what you should be making. Here's what you need to do to get ahead," and then you go try it and none of it works because you're a woman.

Brock: Clearly we're in a situation like your training course, you know? They'd never--you're the first ones there.

Hardy: That's right.

Brock: They probably, they obviously must've thought you could go to Harvard.

Hardy: Obviously must have. It just--

Brock: Unbelievable.

Hardy: --you know, if you're a man you never think about it. Why would you think about it? If all the people before you have been men, why would you think about it that Harvard doesn't let women in?

Brock: Oh, my gosh.

Hardy: Yeah, so, anyway, it seemed like, what do you do when everything they recommend is impossible because you're a woman, so I just said, "I'm leaving. I'm gonna go to school. I'm gonna go to Berkeley. I'm gonna do something else and try to get my head together and figure out what on earth do you do in this kind of situation?"

Brock: What was Fran Allen's reaction?

Hardy: She stuck it out. She wasn't--I can't say that she was any happier, but she stuck it out. And, you know, Fran was the first woman to become an IBM Fellow, but years after she should have been, and she was very unhappy about that. It was just the same thing. It never occurred to them that a woman would do the kind of work that was appropriate for Fellows. They expect it, and she does this and she does more and more, and they don't know what to do about it because they thought Fellow meant men.

Brock: <sighs> Wow.

Hardy: <laughs>

Brock: It's hard to even hear you talk about it, man.

<laughter>

Brock: It's making me feel frustrated just listening to you--

<laughter>

Brock: --describe it. I can't imagine what it was like for you. Well, that answers my question about your decision to leave IBM and go to UC Berkeley.

Hardy: That's right.

<laughter>

Brock: On the technical side of things I was just curious if there was things that you learned while you were programming for Stretch, programming for Harvest, I was wondering about if there were things you learned, lessons you learned, techniques that were important later on.

Hardy: Oh, yes, yeah, and I would say also about the matter from training class, the fact that it <laughs> ended up being upsetting, it was extremely useful to have had a management training class and to know what they ought to be like because Tymshare never-- you know, Tymshare was a startup. They didn't do management training classes until much later, and so it was very helpful to have been through a management training class. Same at Livermore. I managed a small group at Livermore, and it's helpful to have management training, to have some idea of what people expect of a manager, so that was great. And, of course, I did the Fortran compiler there, and it was-- well, when I went over to Livermore they didn't have a Fortran compiler. They were writing a new one. It was very helpful to have already written one for them.

<laughter>

Hardy: So it's not that I wrote the one on Stretch by myself. You know, there was a group, but you know what everybody's doing. It's a team project. And the same when we got to Livermore. "Oh, yeah, this is where you want me to add the next thing? Okay." <laughs> You know, I don't have to wonder what that means, so it was very, very helpful, right.

Brock: Interesting.

Hardy: And I also did an editor for the 6600 at Livermore, and, again, we worked on that same kind of-- how do you build editors, how do you build tools like that for the Stretch, and, so, yeah, it was very helpful.

Brock: So you thought through many of these similar kind of tools?

Hardy: Many of these similar questions and problems and, yeah, how do you even think about that kind of a problem?

Brock: At this time and in these contexts, I'm not sure that I properly understand what an editor is.

Hardy: Well that's a good question because it's nothing like today's editor. <laughs>

Brock: Right, that was my suspicion.

Hardy: <laughs> What you're really doing in a lot of these contexts is keeping the printout of the code and what you're doing is helping identify-- as we talked about earlier, there's the code sheets, you get punched cards, you print them, and then you have a listing. And the editor helps you look at this listing and mark it up and things like that.

Brock: On a teleprinter or--

Hardy: Not actually. You're really doing all of this by hand, but it does give you some other look at this code, because we didn't have teletypes--

Brock: Right.

<laughter>

Hardy: --until I got to Livermore.

Brock: So it was in a way, a way to modify this code listing. You know, you would kind of put the card deck with the program into the machine and then you could load this editor and whatever content of the editor and it would change that listing.

Hardy: Change that, right.

Brock: And then could it produce a new--

Hardy: New cards.

Brock: --card deck for you.

Hardy: New cards.

Brock: Interesting. So much more efficient than re-punching--

Hardy: Right, re-punching all the cards.

Brock: --a few number of cards. I get it. Or you could do some global change, I guess, across the--

Hardy: Yeah, and, well, one of the handy things it did is, of course, when you re-punched it re-ordered. Those last eight columns are very helpful.

Brock: Interesting. Well, so you decided I think it was in 1961 to leave IBM, go back to school. You chose UC Berkeley. Why did you choose Berkeley and what did you choose at Berkeley?

Hardy: I had a random assortment of classes--

<laughter>

Hardy: --because I didn't know what I was doing. But I chose Berkeley because at least it was northern California. And I hadn't been permitted to go to Stanford, so--

<laughter>

Brock: You permitted yourself.

Hardy: Right, so now that I was paying I could go to Berkeley. So I just took a random assortment of classes, took some math, took some French, took some psychology, you know, as I say, a random assortment of classes.

Brock: Were you enrolled as a graduate student?

Hardy: Probably.

<laughter>

Hardy: One of those random graduate students, right.

Brock: Okay. It seems like it must've been a fascinating time to be in Berkeley, going to school in Berkeley, '61, '62.

Hardy: Well, it was, let's see, '60, '59, '60, '60, '60, '61. I guess you might be right. It might be '61. Let's see, '61, right?

Brock: Yeah, that's on the cusp of it, right?

Hardy: Yes, everything was-- it was another-- you know, LUCK! I managed to land in Manhattan at the right time, managed to land at Berkeley at the right time, <laughs> right. It was a great time to be there and had a great time with the friends I made at Berkeley, but for me personally it was more of a sorting out. What do I do? And then it turned out, as you probably know, they delivered the Stretch that year to Livermore, so since I hadn't figured out I was going to actually pursue a career in anything else, I went to Livermore, was practically the only person in California who knew how to program a Stretch, so it wasn't too hard to get the job.

Brock: Did they call you or did you--

Hardy: No, I went out there. I knew about this and I went out there, and wasn't too hard to get the job. And the first thing they needed was a-- as I said earlier, they needed a Fortran compiler. Oh, I'm the person. I wrote the other one. <laughs> Now I can write this one. Yeah, and the one at Livermore was much more efficient.

Brock: The compiler.

Hardy: The compiler, for a lot of reasons, a lot of reasons.

Brock: Reasons for--

Hardy: A lot of reasons why--

Brock: --the machine is different?

Hardy: --it was more efficient. They didn't have to solve all of the world's problems. It didn't have to be readable by a lot of people who didn't know how to read code and a lot of these other problems that you had to deal with.

Brock: Right, because--

Hardy: Didn't have to deal with every possible reconfiguration of Stretch. They had a Stretch.

Brock: For this machine, and I would imagine they would never want anything to leave Livermore, so you don't have to worry about sharing it.

Hardy: Right, nothing ever leaves, <laughs> right.

Brock: So you became--

Hardy: Actually, one thing did leave but not that.

Brock: Oh, I think-- yes, because you developed something that-- well, what did leave?

Hardy: It was something I used. One of the things they did at Livermore, well, they got the 6600. While I was working on the Stretch they got the 6600, and there were a few timesharing systems people had tried at that point, so Bob Abbott was one of the guys out there, and a few programmers got together and wrote a timesharing system. Norm helped them a lot because he had been familiar with CTSS, I think it was, so he helped them with the design a lot and they wrote a timesharing system for the 6600. And so we all got teletypes on our desks <laughs> and got to use the timesharing system. And it turned out that is the one thing, the timesharing system, that they actually exported to Los Alamos. That was it-- Los Alamos didn't take anything else from Livermore, but they did take the timesharing system.

Brock: Interesting. So you became a Livermore employee, then, rather than IBM.

Hardy: Yes.

Brock: Okay. And you already had the necessary security clearance, I guess.

Hardy: No, they had to do it again.

Brock: Oh, because you needed the Q thing--

Hardy: Yes, something, something.

Brock: --for the nuclear secrets, I imagine.

Hardy: Something, yes. <laughs> There was something weird about it, so I had to go through it all again. And atIBM, I guess they had started earlier. Well, they knew we were going to need NSA clearance, so they started us through the clearance process while we were still writing the Fortran compiler, but [at] Livermore I just showed up so they couldn't really have me do anything until I had the clearance 'cause I couldn't get inside the gate. <laughs> And it turned out there were three other guys, me and three guys who were getting our clearance at the same time, and so it took about six months. We spent six months playing Bridge <laughs> outside the gate. Every time my friends asked me, "Why don't you join our Bridge club?" I'd say, "I spent eight hours a day for six months playing Bridge with these guys, <laughs> and I'm never going to play Bridge again."

<laughter>

Brock: You had to actually go up to Livermore and sit in an office building outside of the--

Hardy: Outside the gate.

Brock: Like in the visitor area or something?

Hardy: Uh-huh.

Brock: Oh, my gosh.

<laughter>

Hardy: So it wasn't quite that bad. They let us-- I guess by the last month they let me-- they really wanted this Fortran compiler, <laughs> and so they let me in. But I had a guard with me every minute I was inside the gate. And the really funny thing about this is that of course I would compile, I would get a listing, you know, compile the Stretch, get a listing, and all the listings that come off the computers inside the fence had this trim on the edge that said classified information, and you're not supposed to look at anything that says classified information until you haveyour clearance.

Brock: Which you just--

Hardy: So the guard would have to come along and tear off the edge so I could look at the—

Brock: Like the perforated edge or whatever?

Hardy: Yeah.

Brock: Oh, that's funny.

<laughter>

Brock: They must've really wanted that compiler, yeah.

<laughter>

Hardy: So it was really crazy, yeah. <laughs>

Brock: But I mean you can--

Hardy: But there was nothing else on the computer. It isn't that I could have taken anything because they clean the computer in between users. It's all yours. There's nothing-- nobody else is--

Brock: So it's essentially--

Hardy: It's a bare machine.

Brock: --wiped clean.

Hardy: It's clean. There's a bare machine.

Brock: There's nothing there.

Hardy: There's nothing there.

Brock: Isn't that interesting?

Hardy: Yeah, but they still had the guard tear out-- <laughs>

Brock: Was that done through software or hardware?

Hardy: What?

Brock: That reinitializing of the machine, or was that its nature?

Hardy: Oh, you load in your-- you know, you just walk up to the machine, you put your cards in the card reader, it reads them in, does the processing, you get your printout, and basically the machines-- I mean I guess if you were really clever you could write a program that would read what the previous user had put there, but--

Brock: Yeah, okay.

Hardy: --but it would've been complicated.

<laughter>

Brock: Well, had you played Bridge before that?

Hardy: Oh, yeah.

Brock: Okay, yeah. So you weren't-- and then were you playing Contract Bridge?

Hardy: It was just-- no, I was just playing regular friendly Bridge.

Brock: Okay. <laughs>

Hardy: This was just friendly Bridge, and the other guys, we all stayed friends in spite of the fact that we all played Bridge.

Brock: And did you continue to play Bridge afterward--

Hardy: No.

Brock: --or did it cure you of that?

Hardy: That cured me.

Brock: Yeah, yeah. <laughs>

Hardy: Programming is more fun, you know?

<laughter>

Brock: Well, could you describe, once everything was all set and you could just be a regular employee, could you talk about the software group there around Stretch and just what it was like to do your work?

Hardy: Computation at that time was a very good group, a division at the lab, and Sid Fernbach was the manager and well known, and Sid sort of made it his job to get the first of every computer that ever came out.

Hardy: So it was a great place to be because you had every-- everybody around you was working on a brand new computer <laughs> and they were fun and interesting, and computation was a really good place to work. It was back when it was a government operation-- so there were many fewer gender issues.

Brock: In government.

Hardy: In government. Government, yeah, the law didn't come in until '64, the nondiscrimination law, but the government was trying out some of these laws earlier than that. They really did try to have a better gender balance and there were just-- if you were managing a group, which I did for a while, then I really was making more than the people working for me, unlike IBM, which was just totally out in nowhere. So there were many fewer gender issues in Livermore. I shared an office with a woman named Barbara Shell with whom I'm still friends. And, actually, she came to work for me over at Tymshare later, years later. So,

yeah, and we got teletypes on our desk and got to use this timesharing system. I wrote the editor for the 6600, which they used for many years, and I wrote the LISP compiler for the 6600 and part of the PL-1 compiler. I don't think we ever quite finished it, but it was fun, you know? We got to try all these different things. And, of course, once you've used a timesharing system you never want to go back. This business of carrying your cards down to the computer, <laughs> risking dropping cards, which everybody does once in a while, carrying them back up, and then waiting 24 hours before you get another shot-- it's like, once you use a timesharing system you never want to go back.

Brock: I had written down, I was wondering if it was something of like an epiphany or a conversion experience, you know, that timesharing is so superior in all aspects.

Hardy: It is.

<laughter>

Hardy: And we had never had a choice before. This was a very early try at timesharing and it had some limitations, but it was so much better than anything else any of us had ever worked on that once you try that going back is not likely.

<laughter>

Brock: I mean correct me if I'm wrong. This seems to me a very early timesharing system.

Hardy: Very.

Brock: Was there kind of a buzz in your computation group about it--

Hardy: Oh, yeah.

Brock: --you know, that this is the future of computing?

Hardy: Well, I don't know that-- well, there was in the group that wrote it, and among those of us who did system programming, yes. But a lot of the people, computation was mostly system programming and was interested in timesharing, but not everybody. And most of the programmers in Livermore are doing scientificprogramming. You know, they're modeling, and so of course timesharing is better for them, too, but their focus is on scientific programming and modeling what happens when you blow up the world.

Brock: Right. So it may have been-- right, their focus is-- they may have enjoyed using timesharing to build their models and simulations, but their intent is on the model.

Hardy: Their intent is the model, right, and that's okay, yeah.

Brock: Did the computation group, and with all their new machines, <laughs> did you have your own building on the Livermore campus, or how did that work?

Hardy: I suspect computation. Of course, I can't remember exactly, but I suspect computation was, I suspect our building was entirely computational.

Brock: Okay.

Hardy: And the other buildings were, yeah. We didn't, I didn't, run into the nuclear folks very often.

Brock: Teller wasn't around your offices a lot.

Hardy: Yeah. Right.

<laughter>

Brock: Was he-- you were there from, in the first half of the '60s, basically.

Hardy: I stayed there from, like, '62 to '66. And then in '66 I went over to Tymshare.

Brock: Right. Was Teller the director of the laboratory then?

Hardy: Mm-hm. [No. Director was Harold Brown.]

Brock: Okay. Did you have, did he cast a long shadow of the laboratory? He's such a kind of interesting, big historical figure.

Hardy: Fascinating guy. But, of course, I'm on the bottom.

Brock: Right.

Hardy: <laughs> I mean, he didn't know me from anybody, so… But yeah. He's a fascinating guy, and yes, we all knew he was the guy on top and we're all fascinated by his work, but that didn't have, didn't affect me personally.

Brock: Right. I just wondered what his kind of presence was in the laboratory as, you know…

Hardy: I think he had a lot more presence out in the rest of the lab.

Brock: <laughs> Yeah.

Hardy: Computation was-- Sid really ran computation totally.

Brock: Right.

Hardy: And we were interested in what the rest of the lab was doing and, of course, interested and very respectful of Teller and fascinated by his work. But well aware of the contribution he'd made to the work we were doing. <laughs> But didn't have any day-to-day impact on computation, which Sid had a lot of day-to-day.

Brock: How did you feel personally about the nuclear weapons, well, raison d'etre, of Livermore? You know, I just wondered how you felt about that.

Hardy: I don't know how much I actually thought about it. I wished there weren't nuclear weapons and… But this was the '60s. <laughs> And Cold War, but it was hard to know what was the right thing to do, other than having nuclear weapons, and there was no way to know enough to know whether or not that was the right thing to do and that…

Brock: It was the dealt hand, if you will.

Hardy: Yeah.

Brock: To go back to _____, yeah.

Hardy: Yeah. It wasn't-- yeah.

Brock: It also seems that a lot of the work that you did at Livermore was making compilers.

Hardy: Yeah.

Brock: And I wondered about, you know, what--

Hardy: Yeah. And the editor. Yeah.

Brock: And the editor. But about making compilers in particular. I was wondering about, like, compiler making as a kind of programming versus application programming or making these models and simulations like the other people were doing. You know, is there something distinctive about building compilers, and if so, what is it?

Hardy: Well, doing system programming versus application programming is very different.

Brock: Maybe that's the better division.

Hardy: It's very, very different. Right.

Brock: Could you speak to those differences?

Hardy: Well, you have to have a very different background. Because to do application programming, you've got to know what your application. You have to be-- if what you're going to do is decide how much of an explosion you're going to have with this size nuclear weapon, you really got to understand the physics in a lot of depth, a lot more depth, than assistant programmer ever has to do.

Brock: Right.

Hardy: System programming though has other interesting challenges. How do you write these compilers for all the different kinds of people and questions and what do you optimize? How much time do you spend on that? And… Because you have a lot of choices. What choices do you make? And so it's a different, it's just a, it's a whole different world. And I don't know… And just different background completely and different way of looking at things. If you're writing one of these explosion analysis programs, you're the one who's going to write it, you're going to run it, and you're going to read the results. It's all your story. You write a compiler and everybody else in the lab is going to use it. And so you have to look at the whole thing as serving a whole lot of people, none of whom you'll ever meet, and making them think that this works well for them. So it's a different way of looking at what you're doing.

Brock: The general needs of the user community. And then you must have to have such a strong knowledge of the computer.

Hardy: Mm-hm.

Brock: You know, the hardware.

Hardy: The hardware.

Brock: Yeah.

Hardy: You have to know the hardware. And you mentioned all those different compilers. Probably, because I probably mentioned them.

Brock: Yes.

<laughter>

Hardy: One of the things that was fun about writing so many different compilers is we got to write-- I can't remember what they were for, but a few apps for-- at that time. And one of the things that I learned really the hard way was that you have to choose the right language for your app. That I could write something and, you know, what it would take to write something in one of these languages, you could write it in a few lines. And you could write it, choose another language, and it's several pages. And it's just huge difference if you choose the right language. Depending on the app. And so… And it depends totally on the app. So I would get, "Oh, LISP. I wrote this program in LISP and it's only five lines and <laughs> would've taken me three days to write it in FORTRAN. So I'll start writing my programs in LISP." No. It'll only work for that application.

Brock: Oh. <laughs>

Hardy: All the rest of them <laughs> were three lines in FORTRAN, <laughs> pages in LISP. So you had to, really, choosing your language is really important. And it's made it clear to me why there are so many languages today. As you get different apps and use your computer in so many different ways, you have different languages because one is so much more efficient than another for the different apps.

Brock: And how do you, if you're working on a variety of apps, how do you know which one to-- it doesn't seem like it's obvious which one to choose ahead of time.

Hardy: Well, becomes obvious pretty fast. As it turns out.

Brock: Once you begin.

Hardy: Once you begin.

Brock: <laughs>

Hardy: And once you've done a few, you pretty much, you pretty much know where to go for the app you're working on.

Brock: Experience and…

Hardy: Experience. Mm-hm.

Brock: But it's a kind of empirical--

Hardy: I suspect if you did that for several years, you would have better rules.

<laughter>

Brock: You could--

Hardy: You would figure it out. But for me it was just-- I'm not going to complain again about all these languages I have to write compilers for. I now understand why <laughs> I am writing compilers for so many different languages.

Brock: I see.

Hardy: And at Tymshare they had all these different compilers and they kept wanting to-- and people would complain. "Ah, why-- we already have Super BASIC, why do we need FORTRAN?" And it's like, "Oh." Ah, different languages work for different programs. And…

Brock: And the customers are going to have the widest possible assortment of applications, so…

Hardy: Mm-hm. That's right.

Brock: Was it at Livermore that you met Norman Hardy who--

Hardy: Norm. He was on Stretch. He came from Livermore to Stretch on loan to IBM to make sure that Stretch was designed in a way that would be useful to Livermore.

Brock: Oh. So you'd met him back--

Hardy: Back East.

Brock: Back East.

Hardy: Yeah.

Brock: Okay.

Hardy: So I'd already know him when I came out here.

Brock: Well, you and he married when you were working at Livermore; is that--

Hardy: Actually, while I was going to school.

Brock: Okay. And were you in the same group at Livermore?

Hardy: He was in computation mostly. Norm. Norm's expertise is wandering all over the place and finding… And listening to people's problems. And showing them how to solve those problems with half a dozen lines of code instead of 10 pages. He's, that's just what he does. He figures out how to look at a problem from a completely different perspective than everybody else in the room and make it simple. And so he would, he would work on all the different kinds of programs that they had in Livermore. The scientific programs, the system programs, everywhere. Because that's what he's really good at.

Brock: What was his background coming into it? Was he coming from mathematics or…

Hardy: Math.

Brock: Okay.

Hardy: Physics. I think he was a physics major actually.

Brock: And were you living near to Livermore? Were you still living in Berkeley and commuting there or…

Hardy: No. No. I lived in Livermore. I moved to Livermore. Once I was through with Berkeley I moved to Livermore.

Brock: Okay. And okay. We talked about-- and that time-sharing system that was developed at Livermore was called OCTOPUS; is that--

Hardy: Mm-hm. That's what--

Brock: --correct?

Hardy: That's what we called it. I think it had a more formal name, but I don't know what that is.

Brock: That was your ace [ph?].

Hardy: Norm knows. And if you ever do an interview with Norm, which would be fascinating, because he remembers everything. Well, he's stayed involved. You know, he still works with startup companies and designing, you know, on hardware design, software design. So he's stayed involved much more than I have, and so he remembers much more, so… And whatever the official name is, I think Norm remembers that, but I don't.

Brock: Okay.

<laughter>

Brock: OCTOPUS was the one I think maybe that I cribbed from your notes.

Hardy: Right. That's my-- that's what we called it. But I think it got a better name some… <laughs>

Brock: Well, I was curious in terms of systems programming, a time-sharing operating system. You know, were there-- I was just wondering what the kind of the crux was of a time-sharing operating system versus other sorts of system software. What was distinctive about it to allow, you know, this multiple user operation? Was there a crux or were there many? I'm just curious.

Hardy: Well, I have a lot of-- I can give you a lot more detail about the one I wrote than the one at Livermore. And I wrote the one at Tymshare.

Brock: Right. Which was what you did almost immediately. That was your next project when you left Livermore.

Hardy: We left Livermore. Norm had gotten a job offer from IBM over here in Menlo Park. And fortunately, Tymshare had had a little blurb in Datamation about how they were going to start a time-sharing company. As I say, once you've used time-sharing you're addicted. Never want to go back to carrying card decks again. So I called them up and came over and talked to them. I called them up and asked them if I could have a teletype, [Model 33,] at home. I mean, they were advertising that they were going to put teletypes in your office so you could connect to their big computer. So I said, "I want one in my house." And that is not something they had ever thought of. So I-- but we had a nice chat, you know, Dave Schmidt is very friendly. He was the VP at Tymshare, and I talked to him. And he was in charge of all the technology at Tymshare at the time. And so I talked to him for quite a long time and, you know, about what they were going to do and he told me all their plans and stuff. So I went home and called him up the next week and said, "What you need to do is hire me to write your operating system," which they called the monitor. "Because you don't have anybody who knows anything about it." And so I went back and interviewed to do that, and they hired me because they didn't know what, they didn't have any idea

what the operating system was. He had worked at GE and they had a very simple time-sharing system. But they delivered the operating system. That was the whole thing. And he had expected SDS when they delivered the machine, which they hadn't yet at that time. He expected SDS to deliver working operating systems. It hadn't really occurred to him that this wasn't going to be quite the way it worked out. So they hired me to write the operating system, and kind of figure out what was going on. And that's-- so it was very casual to start out with, until they figured out that the whole, you know, if the operating system doesn't work it doesn't matter how good your exec—your shell is, it doesn't matter how good your spreadsheets are. If your operating system doesn't work, nothing works.

Brock: And now, did you have a suspicion that the SDS machine would not come with the proper time-sharing operating system?

Hardy: It couldn't.

Brock: It couldn't. Why couldn't it have?

Hardy: They were delivering it with peripherals. So just for starters. And this was the operating system that came from Berkeley. Originally. And they had modified the 930 to be a 940. And SDS then produced 940s pretty much on Berkeley's design. And Berkeley had done the operating system. But when Berkeley did the operating system, there were no peripherals. Except for mag tape. So they did all the swapping to mag tape. You had to load all your information from mag tape. Now, if you've ever tried to have multiple users on a computer that swaps users to mag tape, you will notice that it is extremely slow.

Brock: This means it would have to, it would store one user's state on a tape and then load in another user's state and work on it and then constantly-- okay.

Hardy: Yeah.

Brock: And is this the Berkeley Genie project? Is that?

Hardy: Yeah.

Brock: Okay.

Hardy: Yeah.

Brock: Okay.

Hardy: And Berkeley did a great job.

Brock: <laughs>

Hardy: I, you know, as-- if you ever interview Norm, I basically replaced every instruction in their operating system for one reason or another. Just because everything was different when you're-- I would be happy to go into details until you're bored to death. <laughs> But the architecture, the basic architecture, stayed Berkeley. All the instructions changed.

Brock: Hm. And this was to rewrite it for an environment where you wouldn't do any of this tape swapping and…

Hardy: Well, and we wanted to run-- the truth is, if you-- you can run one user doing more than one job on a mag tape. If you try to get two users, it's 5 or 10 minutes is what it feels like between jobs. Because of all the reading and writing you have to do. And it's fascinating to watch the tapes but it's…

<laughter>

Hardy: But that's not very good for the user.

Brock: Right.

Hardy: So we had to get disks for storage. We got data products disks, big disks, to store the files for people so that you could leave your files out there and come back the next day and they'd still be there. And then we got a Vermont drum to do the swapping. And there were some issue with both of these peripherals. These were peripherals that were not programmed by Berkeley and therefore not programmed by SDS.

Brock: I see.

Hardy: <laughs>

Brock: So therefore you knew that they didn't have what they needed.

Hardy: And if you've never been able to run more than two people on your operating systems, things like the queues are all screwed up because-- all the buffers are the wrong size. You know, all kinds of things in the operating system are just totally out of line. And you had no, and they had no way of knowing what would happen if you put 30 users on instead of two. One or two. And they had no way of knowing. They did a good job. They left space. But it was not, it turned out not to be the right amount of space at almost any of these places where you had to keep track of the various users.

Brock: So if they didn't yet have their SDS, they being Tymshare when you called them, if they had not received their computer yet, were they just really in a kind of a-- you were Employee Five, was it, or something?

Hardy: Yeah. Right.

Brock: So it's a very formative stage?

Hardy: Very formative stage.

Brock: Mean, did--

Hardy: Yes. Very formative stage. I think they'd only been-- I'm not sure they had. Whether they'd become incorporated the month before or the month after, but it was like… <laughs>

Brock: Okay.

Hardy: Was that close.

Brock: Right at the start.

Hardy: Right at the start.

Brock: And well, when they were talking to you about their idea for the firm, their aspirations, their basic, the basic point, how did they describe it to you? You know, what was their vision?

Hardy: Well, you know the back story of why they started it at all.

Brock: I don't.

Hardy: Tom and Dave had both worked for GE. And that's where they knew each other. And GE was-- Tom had worked for GE for years. And they had transferred him around here and there. He was really a good sales manager. I mean, a really good sales manager. And so they liked to move him to where they needed a really good sales manager.

<laughter>

Hardy: So they were about to move him to Phoenix, and his wife Marge said, "I've moved enough."

<laughter>

Hardy: At which point Dave came along and said, "We could start a company here. And do time-sharing." And so they had planned to license the GE system and just sell it.

Brock: Right.

Hardy: It got right down to the wire and GE decided that they didn't want that competition. So that's when they found the SDS system, the 940 at Berkeley, the Berkeley system, and so their original goal was just to provide time-sharing for the-- right then this whole area was aerospace companies. Their goal was to provide time-sharing for the engineers in the aerospace company so that they could all get on and do their testing and not have to wait 24 hours for the big machine. Because there's lots of, you know, lots of these little algorithms that you can test out, make sure your code really works before you do the big machine.

Brock: Right.

Hardy: And that was their vision. And the trouble was they did that and then everybody, then they had all kinds of other people who wanted…

<laughter>

Brock: Yeah.

Hardy: Then, you know, then they sold to a company up here and then the branch in Los Angeles wanted the same service. And… <laughs> So yeah. So that's basically what happened at Tymshare. It just--

Brock: Oh. So that explains why there's this kind of Los Angeles-looking dimension to the Tymshare story, you know, in just--

Hardy: Mm-hm.

Brock: --a few steps from where we are now. <laughs>

Hardy: Mm-hm. Exactly.

Brock: Well, hm. So let's see. I thought it was interesting too that I hadn't realized that the, what prompted you to call Tymshare, Norm Hardy's move to this IBM advanced computer system effort, which I guess was in Sunnyvale or…

Hardy: It was in Menlo Park.

Brock: Oh, Menlo Park.

Hardy: And Gene Amdahl was key in that project. Probably the leader of that project.

Brock: And this was to be kind of the successor to Stretch.

Hardy: Yeah. And it was-- well, whether-- turned out to be Stretch or some follow-on to Stretch, yeah. Is the next, it was the next, you know, big leap in computers. And he had, Gene, had done the 360, so…

Brock: Yeah.

Hardy: What's the next super computer is more than what's the next standard line in computers.

Brock: Right. I hadn't realized that that development was, you know, in this area as well and that lasted for--

Hardy: Couple years.

Brock: Yeah. Very interesting. Well, let's see. When you had kind of, you'd seen time-sharing at Livermore. You knew time-sharing at Livermore. When you spoke to--

Hardy: Dave?

Brock: Dave. Was there this discussion of the computer, like, computing as a utility? Was that--

Hardy: Mm-hm.

Brock: Was that something you had been following? Was that part of this context?

Hardy: Well, what I wanted was access to the computer from my home. And since they wouldn't give it to me if I wasn't, you know. They had never thought about giving you, anybody, a computer at home, access at home. But I was pretty clear that if I went and worked for them and did the monitor, they would give me a computer. Eventually figure out that I could have a teletype at home. So that's what I did.

Brock: But there was this kind of discussion, I think, more broadly, in the computer and computing circles--

Hardy: Oh, yeah.

Brock: --in the computer industry about it as sort of like a metered utility that, you know.

Hardy: Yeah. Absolutely.

Brock: So that was later or…

Hardy: They, well, as I say, their goal was to service the local aerospace companies. And we charged $10.00 an hour once we got the machine up. And we can talk about what that meant, but…

Brock: <laughs>

Hardy: But that's what it was. It was just for people to do these testing of their little algorithms. And so we had various compilers. We wrote a Super BASIC interpreter. So it was really easy to run a little code and find out exactly if it wasn't-- if your code wasn't right, exactly where the bug was, you could fix it as it was stepping through. And so we had-- it was just very, very convenient for people in, like, the aerospace industry who needed lots of these little engineering programs. Was perfect.

Brock: Well, let's talk then about coming to work for Tymshare, what your position was when you first started, and your effort to, I guess, your building of a time-sharing operating system. Did that coincide with the arrival of the computer or how did it all work?

Hardy: [I started with Tymshare in February 1966. The first computer arrived in September.] Well, there wasn't much you could do. I mean, I read the listings until I knew the, you know, the listings that Berkeley had provided of the operating, of the monitor. They call the op-- well, what we call the operating system, they called the monitor. Okay. So… And what we call the shell, they call the exec. So just to… <laughs> So as we switch back and forth in languages you know what I'm talking about.

Brock: Okay.

<laughter>

Hardy: And so they provided a listing for the monitor. And so, of course, I was extremely familiar with that. The machine didn't arrive until probably September. And so there were lots of, I had lots of time to read the listing.

Brock: Where were you doing that? Were you at the--

Hardy: Distal Drive.

Brock: Okay.

Hardy: They had an office, a very small office, on Distal Drive. And that's where I did that. And when the machine came, the machine went into a machine room, [which was the entire building,] down on East Meadow. And then, of course, I worked down there with Verne. Tom and Dave and Rick Crandall, Comshare, had, I think, the two-- Rick started Comshare. Also with the intent of using SDS 940s. And I think they had negotiated with SDS to make this machine, "Oh, here's two companies that are going to buy your machine if you'll just make one."

<laughter>

Hardy: Yeah. Make a few. And as it turned out, they, you know, there were more than just two companies that used it, but I think Rick and, Rick Crandall and Tom and Dave, made the original agreements with SDS. To do this. So that summer, when SDS was within a month or two of actually delivering the machine, Rick and Louise, his wife, came out to do some testing, because they made the machine at Berkeley available, but it was still swapping to tape so that while you could get on and look at some things, it was very slow. Didn't really, didn't really help very much. It was more useful for me to read the listings than it was to try to… <laughs> Get on the machine.

Brock: Right.

Hardy: And so they were here. Anyway, they were here for a couple months, and so we all got quite friendly. And at that point in time, , it had never occurred to Tom or Dave that they would be anyplace except Silicon Valley, and it never occurred to Rick Crandall that he would be anyplace except back, you know, he was back in Michigan. And so there was no conflict. And up until this time, I mean, you either had to be near a computer or you didn't get to use one. And so…

Brock: Right. <laughs>

Hardy: Who would've thought it was going to be different in the future?

<laughter>

Hardy: And so that's what… They went home before our machine was actually delivered. The machine came and probably came with a card reader. Printer, maybe paper type. But no disk, no drums. So I think, I guess, startup was paper tape. And then it would read in your cards from… That was the loader was on the paper type and you could read the cards and it would do something from there. But you couldn't…

Brock: <laughs>

Hardy: And we did store the monitor on mag tape, so I could -- start up the machine, load in the monitor from the mag tape, and get it to run a little bit.

Brock: Right.

Hardy: Disks came shortly thereafter. So I had to write the drivers.

Brock: Purchased separately.

Hardy: Purchased separately. Disks were Data Products disks. And SDS may have intended Data Products disks, but they didn't do anything about it.

Brock: <laughs>

Hardy: And I don't really know whether they had intended Data Products disks or… I don't remember. I'm sure I knew at the time, but I don't remember now. And first thing we had to learn about Data Products disks is that in spite of the fact that they give you an address inside a page, they won't let you start writing except at the beginning of a page. And so if you're going to swap somebody out, you can write continuous pages, but you can't, if the first person only uses half a page, you can't start saving the next person's files until the next page starts on the disk.

Brock: I see.

Hardy: So that was one of the first challenges of using a disk. That in spite of the fact that you have the address, you can't use it.

Brock: Ah.

<laughter>

Hardy: You can read, but you can't write. Anyway, the disk helped a lot. It's much better to be on a disk than on a mag tape. And so we got a little bit more, you know, Verne and I, Verne did the exec. And… Verne Van Vlear. And so we could actually both be on the computer at the same time, which was handy. Then they delivered the drum. And of course what you want to do is swap out pages, right? The users that aren't running at the moment, you want to put them on the drum. It's much faster than the disk.

Brock: Right.

Hardy: And so you want to put them on the-- you want to swap out half a dozen pages or so, three or four pages, whatever. So you go to write, I go to write these pages out on the drum. It turns out, as delivered,

the drum can write a page and it does [an] entire revolution before it will write the next page. And then it does another entire revolution before it will write the following page.

Brock: Is that just to get to whatever mechanism is writing?

Hardy: Yes

Brock: Okay.

Hardy: So that wasn't adequate. So they sent out an engineer from Vermont Drum. And we spent about a week. He was changing the engineering and I was running the code and adjusting the code to see what kind of code we could write that would get the drum to actually write continuous pages.

Brock: Wow.

Hardy: And while he was changing the engineering, we tried a number of things. We finally got it. And so we invented a new instruction and the drum eventually wrote, if you wrote out four pages, it wrote four pages. It didn't have to keep going around and around. And so, you know, these are the early things that happen with a new computer. Now, by that time then we could actually run multiple users. And, of course, then you get into all the different challenges of buffering and queuing and who goes next, and keeping track of whose, you know, whose interrupts are you waiting for at the moment and… And in those very first days, all the echo was in the 940. [Berkeley had designed a full duplex system and we kept that design.] That means if you typed something on your teletype it had to go to the 940 and come all the way back to your teletype before you would see the print. And this was-- well, that's the way it started. So you had interrupts for every single character that was typed. This is fine if there's half a dozen users. No problem. But as you increase the number of users, you want to move the echo closer to the user.

Brock: Right.

Hardy: So we'll get into that. <laughs>

Brock: So that would be so that I'm sitting at a teleprinter, I'm connected to my Tymshare server. <laughs> I'm connected to your computer, and what you're trying to prevent there is just a big lag between when I hit a key and when that Teletype prints that character on the piece of paper.

Hardy: Right.

Brock: And so that for the user experience is--

Hardy: Is very important.

Brock: --a priority job, if you will, the typing.

Hardy: And as long as you had a very few users, no one could tell.

Brock: Right.

Hardy: You had to get up to a fair number of users before you could tell that it wasn't the teletype that was doing the printing before you could tell that the printing was actually being driven by the computer.

Brock: And that, was that kind of the highest priority? Like, if someone was typing--

Hardy: Yes.

Brock: --it was to give the user a decent typing experience.

Hardy: Yes. Those interrupts took first priority. Yeah. You always echo.

Brock: Interesting.

Hardy: Now, it doesn't take, you know, more than a couple of instructions to do an echo.

Brock: Right.

Hardy: Carriage returns were a little different, because you had to make sure what they meant. Carriage returns had different meanings. But characters, any other character, was just "chw, ww-ww."

Brock: Yeah. Just spit it back.

Hardy: Very, very quick. Just send it back.

Brock: With the--

Hardy: This is because we operated in full duplex. Not everybody initially operated in full duplex. You could operate in half duplex, in which case it would send the character to the computer, but the half duplex meant that the teletype did the printing, not the machine.

Brock: And that was determined by?

Hardy: That was just [a] decision by the company.

Brock: By Tymshare?

Hardy: Well, that was Tymshare's. We did full duplex because that was our decision. [Berkeley had made the same decision.]

Brock: Okay.

Hardy: Our technical decision.

Brock: Okay. And in the half duplex, I would be sitting with my teleprinter, I would be typing, and it would…

Hardy: Was just like a typewriter.

Brock: Right. Oh, okay. So, you know, something switched on <laughs> in the teleprinter, so I'm typing. And then it sends as a batch of characters later or…

Hardy: It sends out the characters as you type, but your typewriter just keeps working like a typewriter.

Brock: I see.

Hardy: Your teletype is just like a typewriter at that point.

Brock: I see. I see.

Hardy: Except that it sends something.

Brock: Oh, I think Marc wants to ask something.

Weber: So why did you decide to go full duplex?

Brock: Why full duplex is Marc's question.

Hardy: Oh. Lots of reasons. [It provides visual checking on the most error prone part of the link between the user and the system, It allows echoing to be shut off for password entry and programs like DDT that chose not to print all of the input characters.]

<laughter>

Hardy: Because you get a great deal more. I wish I could remember all the good reasons. But there are, you have a lot more control, over the user and how you interpret a carriage return, when you interpret a carriage return, what that means. Do you want to end the session? Do you want to swap? You know, all these things are tied up with your echo. And it's-- and as time went on, it became, and we distributed, it became much, much better to be doing full duplex. Much better user experience. The user couldn't tell but we had so much more information we could be working with right away.

Brock: You understood the context of that kind of character stream better.

Hardy: Right, mm-hm.

Brock: Okay. So you could-- okay.

Hardy: So we could do things.

Brock: With-- to just take one little half-step back, talking about the hard disks coming and the drum coming, the drum, I assume, had, is faster to read and write to, but had less capacity.

Hardy: Way less.

Brock: So this, the drum, is used to very quickly store kind of the state of the user's session at a particular moment or what's--

Hardy: Well, only one person can run at a time, right?

Brock: Right.

Hardy: And the 940 isn't very, the 940 memory isn't very large.

Brock: Right.

Hardy: So if you had, well, you had queues for people who were running very short sessions.   You could, depending on how much they used, but usually people who were running short sessions were also, very frequently, also had few pages. I mean, they were just doing something quick and testing something right there and then… So the memory on the 940 would hold enough pages for one or two users. But if you had half a dozen people who, you know, hit carriage return [Enter], then most people wait{;stop processing for a while]. They're looking at something. They want to figure something out or whatever they, or… And carriage return is just sort of my example of a lot of things that could happen, but so you want to run another user. Well, there's one user in memory, and then there's two or three more users on the drum. And so you can swap them in or out quickly, whilethe next user [is running], and so you don't waste any of the CPU time. Clearly if you get users that have large, require larger memories, you couldn't get much memory actually on the 940 mapped into your space. They were very restricted. But then sometimes you had to move some of these folks off to the drum. If you hadn't run for a while, your pages got moved to the disk. Automatically. By the monitor.

Hardy: In the background. So that if you're really studying something, you're not taking up expensive space. And other people who are trying to run actively get the extra memory in the computer and the memory on the drum.

Brock: And you are essentially writing kind of rules of thumb into your system to identify these situations so that you can put, you know, put certain users one place and certain users in another place? This is…

Hardy: You know how fast they're interacting all the time. You know how, you know, you watch every carriage return and you know whether or not they're going on or whether they're holding their breath or reading their code. And so yeah. The monitor's aware of how fast users are coming back, whether they're typing immediately, they hit carriage return and then they take the next character, or whether they're holding their breath or reading what they wrote. And so the monitor's aware of all that. It's also, we only charge $10.00 an hour. Our only charge in the beginning was $10.00 an hour for connect time.

So some people would take advantage of this and do big compute jobs. Now, it was supposed to be for these little test, you know, engineering, you know, [is] my algorithm right tests. Not for the big test when it was all put together. Not for the running of the actual final result, which would be several hours of compute time.

Brock: Right.

Hardy: Well, when you only charge $10.00 an hour, you can… And nothing for compute time, it turns out the compute time is pretty cheap. So then the monitor had to figure out which of these guys were using up all the compute time, and how do you get them, how do you slow them down enough, that it's not worth doing this?

Brock: <laughs>

Hardy: That you force them to use the computer they're supposed to be us[ing], because the price goes up because--

Brock: They're paying per hour.

Hardy: They're paying per hour, but you make their hours much longer than you would have made--

Brock: You give them more hours essentially.

Hardy: You give them more hours. They don't run as often, so they--

Brock: Right.

Hardy: Yes.

Brock: So a lot of what I would imagine would be the advantage of a time-sharing company are all of these decisions that you just talked about. You know, to give the user a good experience. It seems like I'm just typing. It seems I'm the only user. I don't have to wait a long time. I run my little program or I run a program from your library and I get my result and I sign off and I've used a half hour.

Hardy: Yeah.

Brock: And so, so much of it is about, just listening to you, these timings of interpreting these keys, these character streams. I guess how did you know even where to begin with making these rules about how to interpret these character streams, to know what to tell the… How did you tell the monitor what to do?

Hardy: Well, I guess, you know, I'd worked on a time-sharing system. I knew how they were supposed to react. And that I could figure out for-- and, you know, and the big guys who were trying to use up lots of compute time without paying as much as they would've had to pay on a regular machine, you would only run a user for so many milliseconds. I mean, usually people got interrupted because they hit carriage return and they didn't do anything. But the big compute programs, they ran for their two milliseconds or whatever it was, and then the monitor stopped them. They didn't stop themselves. The monitor stopped them and put them back in the queue. And that's how you know that they are the people that are using up your computer, you know, your CPU time. And so you put them in a queue that makes them wait.

Hardy: And people who end their session hit carriage return and then don't come back, those people, as fast as they want, when they do come back, they get run right away.

Brock: I see. So there's a maximum time that anybody can have the machine.

Hardy: Right.

Brock: Or else it's just going to make everything laggy and horrible.

Hardy: Right.

Brock: So you set a maximum time. It's the people who are constantly using up the maximum.

Hardy: Right. They go in the slow queue.

Brock: <laughs> That's really-- wow.

Hardy: <laughs>

Brock: That's very clever.

Hardy: <laughs>

Brock: Well, was it these sorts of issues that we've just been talking about that are the crux of making a time-sharing operating system?

Hardy: Mm-hm. Yeah.

Brock: Yeah. What I guess--

Hardy: How do you decide who's going to run next and how much time they get?

Brock: I guess it's really in the name, isn't it? It's about time management. How are you managing--

Hardy: Yeah, it's about time management.

Brock: --the resources of this one CPU? It's all about the time management.

Hardy: Yeah.

Brock: That's fascinating. Oh, I had another question just on the tip of my tongue. It just went out of my mind. Were these some of the first computers that SDS was delivering to anyone or had they had an earlier line of machines?

Hardy: No. No. They had, you know, the 930 was a big line of computers. Yeah. And no. They were in the--

Brock: Well established.

Hardy: Well established company, right.

Brock: Okay.

Hsu: <Inaudible>.

Brock: Oh, yes, please, Hansen.

Hsu: Was there any, from the business end, would Tymshare change the policy later to charge more?

Hardy: Yes.

<laughter>

Hardy: Yes. They-- yeah, yeah. They figured out that you needed to charge-- they ended up charging for not just connect time but also CPU time. Later on.

Brock: Oh.

Hardy: But until they figured that out, I had to slow them down.

<laughter>

Hardy: And so I, you know, I'm not sure how much management ever figured out what all these little things we're talking about, like how long the guys had to wait who I had, who had to be interrupted by the monitor instead of by their use. And I'm not sure how much the management of Tymshare knew what I was doing, but anyway, that's what I was doing and it worked.

Brock: Because that was fundamental to the whole economics of what the business was.

Hardy: Right.

Brock: That if someone was trying to, I guess, game the price to get--

Hardy: Yeah. That's what they were doing and, yeah, and so, yeah.

Brock: So it's kind of a game theory.

<laughter>

Brock: With the users.

Hsu: Did you have to change it back later? After they started charging? Did you give them more time? Or did you just--

Hardy: I don't remember actually giving them much more later.

<laughter>

Hardy: I think they still paid.

Hsu: <laughs>

Hardy: Because we never did charge, in my opinion, enough for compute time. It's just that we weren't losing money on them eventually. They were not our profitable business. They were not the profitable side of the business.

Brock: These, well, the idea had been, for the Tymshare co-founders to get the system and have local aerospace concerns as the customers.

Hardy: Mm-hm. And they delivered teletypes, which used the phone system.

Brock: That's what I was just writing-- did Tymshare, like, have a stable of teleprinters that they--

Hardy: Mm-hm. Teletypes.

Brock: Teletypes.

Hardy: TTY. Model 33. Ten characters a second.

Brock: Okay. Yeah. Yeah. And this was the kind of ubiquitous teletype. Yeah.

Hardy: Yes. Yes. If you have ever seen a teletype, that's what it looks like. <laughs>

Brock: Right. And did it have some sort of acoustic coupler for the telephone line?

Hardy: Yes.

Brock: Okay.

Hardy: For most-- yeah.

Brock: And so the customer's paying for the phone call. And they're kind of renting the teletype from--

Hardy: Yes. From Tymshare.

Brock: From Tymshare. Okay.

Hardy: Have you ever looked at the software industry's SIG page on the website? There is, there's a picture on that website of a little girl sitting at a teletype with acoustic coupler. And so you can see what the whole arrangement is.

Brock: Set up. Yeah.

Hardy: That was my daughter.

Brock: Oh.

<laughter>

Hardy: My daughters have never lived in a house without access to a computer.

Brock: Wow.

Hardy: And-- yeah. It's, they're almost unique in their age group.

Brock: For their-- yeah. For their age cohort.

Hardy: For their age. Mm-hm.

Brock: Interesting.

Hsu: Wow.

Brock: As, you know, the system is delivered, it's in place, how long-- had you been-- so I guess I'm still a little bit hazy about how you developed the operating system. Did it really come together once the computer was at hand?

Hardy: Yeah.

Brock: Okay.

Hardy: And all, you know, as I say, the first, Berkeley, we got a first draft from SDS, which was simply the Berkeley system.

Brock: <laughs> Oh.

Hardy: And we-- yeah. And everything else I had to change. I mean, I had to add in all the drivers. Had worry about the queues. And lots of other issues, buffers here and there. How much you keep in memory, how much you put on the drum. None of this was there, so all of that was-- yeah.

Brock: We talked about before earlier, at IBM, how it was flowcharts and then coding sheets and cards and listings.

Hardy: Yeah. Well, they were more organized than I was.

Brock: Yeah.

Hardy: <laughs>

Brock: Well, that's my question. How did you, you know, when you were developing this operating system, how'd it go?

Hardy: Well, they had the design. There was code there. And so they had enough code there and they'd run enough users that you knew that there weren't major holes in the design. We added system

calls, which we called BRS's, which I don't know what that stood for anymore, , [BRanch to System] but… And we had a lot of those. So that users could do specific things. Ask the operating system to do specific things, which they had a few, but we had to add a lot more. Because we had, we were giving users a lot more to work with. And so that was another part of the addition to the operating system. And once this was done, of course, moving on, in '68, LaRoy Tymes came. And we had known him over at Livermore. And this is very interesting, because when I went to Tymshare in '66, early on, LaRoy came over and proposed to Dave that he come in and build a network so that they wouldn't be limited to local phone calls. And this was another thing that had never crossed their mind, neither Tom nor Dave. I mean, it's just like this was even more strange than asking for a teletype at home. It's like a network where-- but we're, you know, we're here!

<laughter>

Brock: Yeah.

Hardy: Yeah. What do you mean? What are you talking about? All our customers are local. Well, two years later, all our customers weren't local. And so they hired LaRoy, and that was the beginning of Tymnet.

Brock: Because within two years you had people phoning in from--

Hardy: From other places and--

Brock: --toll call sort of.

Hardy: Yeah. And they were, they had installed, the computer in Los Angeles, and it suddenly became clear that they had a whole country worth of customers. <laughs> Not just a Silicon Valley worth of customers, but an entire country worth of customers. And that people were going to call in from long distance and it was extremely expensive to install a 940 in every city around the country and build up the staff to manage the machine room and all of that, so…

Brock: And so it did come to pass that these aerospace companies locally were the customers and then their colleagues at the other laboratories or facilities in Los Angeles said, "This sounds fantastic."

Hardy: Yep.

Brock: And did they-- so how did it come to be? Were they phoning up or then were they asking for what, the local number?

Hardy: They phoned long distance, and then we installed a computer down there. We had a big computer center in Los Angeles.

Brock: Because you could see the demand coming.

Hardy: Because the demand was there.

Brock: You thought it would expand it even more if they wouldn't have to make a long-distance call.

Hardy: Right.

Brock: Which must be, almost cost, as much as the computer.

Hardy: Yeah. I mean, Texas also had big, I mean, big engineering problems, issues, and opportunities. I mean, the petroleum, oil industry, as there's a lot of engineering. <laughs> And so there's huge, I mean, so there's another installation inEnglewood Cliffs, NJ, and, I mean, where does it stop? Help. <laughs>

Brock: How many? So there was--

Hardy: We got to about three and quit.

Brock: Okay.

Hardy: <laughs>

Brock: Los Angeles and thenNJ.

Hardy: Yeah. [Later Houston became a large center.]

Brock: Okay.

Hardy: And at that, and by that time, the first stage of the network was ready to go.

Brock: Hm.

Hardy: Yeah.

Brock: So that was very quick that you did those.

Hardy: Yeah.

Brock: Within two, three years or something?

Hardy: Yeah. Yeah.

Brock: Okay.

Hardy: We had, as I say, the machine came at about September of '66. In June of '67, SDS wanted to sell more machines. But they needed an operating system--that worked.

Hardy: And so Harvard was going to be one of the places to sell another SDS machine, but Harvard being Harvard, had a very complicated, extensive acceptance test.

Brock: Ah.

Hardy: And they had an SDS back there. With all the same configuration that we had with the--

Brock: The drum, the disk.

Hardy: The drum, the disk. Yeah. The paper tape reader and all that stuff. So they had-- so SDS asked-- there were five companies at that point that were running 940s with the Berkeley operating system. So they had everybody go try to see if they could pass the Harvard acceptance test. And because, of course, SDS was selling a multi-million dollar machine. It sounded--they could afford to send

people back there. You got two weeks to try this out. They got around to Tymshare after the other four had failed to ever pass the test. And so they finally got around to us and we went back, I went back. We had one thing that didn't pass on the first day, fixed that that night. The next day, so in two days instead of two weeks, we passed their acceptance test. And I think it's interesting why Tymshare, the values of Tymshare and sort of the whole spirit of the company put something together where our priorities were to make something useful to the customer first and foremost. Not to make the code fancy or, you know, other interesting things that programmers like to do. But the first and foremost priority was to make it good for the customer. And I think that was very, very fundamental to Tymshare's priorities. And I think it's why we managed to sell our operating system to SDS when everybody else failed. And I think it's because Tymshare focused on customers.

Brock: Hm. Who were those other four. Were they other time-sharing companies?

Hardy: We acquired most of them.

<laughter>

Brock: But at the time, before you absorbed them, they were--

Hardy: Yeah. They were just time-sharing companies, just like-- yeah.

Brock: Okay. Okay. Well, please--

Weber: Do you remember the name?

Brock: Marc's asking if you remember any of the names of the--

Hardy: Well, there was Dial Data and Comshare were two of them. And I'd have to think about it to remember the others.

Hsu: Was there any thought about acquiring the Berkeley Computer Company that the folks had started?

Hardy: Oh.

Hsu: Or was there any relationship with them?

Hardy: No. They were-- no. They-- no. They were-- that wasn't one of the… I think they were more academic. And I think this difference, you know, we acquired Dial Data. We knew Comshare. They were not as focused on the general, making it generally available to the marketplace. They might have a specific marketplace or they might have something else, but general usefulness, was not as much of a focus other places as it was at Tymshare. And…

Brock: Were some of these people, other programmers like yourself, like other people at Tymshare who had kind of, you know, early on been exposed to time-sharing and were more focused to time-sharing as a technology than time-sharing as a consumer-facing business?

Hardy: Well, I suspect.

Brock: <laughs>

Hardy: All the rest of them were men. I knew that. And I think they were more academic. By that time their schools were teaching some, you know, at least you'd heard of computers in college, which…

Brock: Yeah.

Hardy: And I got all my training at IBM, which is customer-oriented.

Brock: Oh, hmmm.

Hardy: And they're, you know, they weren't for how fancy, you know, can you take this, can you make this, can you write this in two lines instead of three? But academics are not like that. They're more like, it's more important to be able to get it all crammed into two lines or whatever the academic thing is at the moment. <laughs>

Brock: Right.

Hardy: And so IBM was really focused on making it work for the customer. And so I think that's where all my background came from. And I think that made a difference.

Brock: When-- oh, I'm sorry.

Hardy: And, of course, it wasn't in a vacuum. Tom and Dave were also very customer-focused.

Brock: Hm. Right. As I guess a consummate salesperson--

Hardy: Yes. Tom was--

Brock: --is by definition--

Hardy: Yes. Customer.

Brock: --The customers' ally. <laughs>

Hardy: Right.

Brock: When your operating system passed that Harvard acceptance test, can you talk about, you know, when SDS wanted to offer your operating system, you know, as their offering is, how did that go? Did you give them a license or…

Hardy: I wasn't involved.

Brock: Oh.

Hardy: That was above my grade.

Hardy: Dave licensed it to them. And-- yeah. And they delivered it from there on.

Brock: Was that a profitable decision for Tymshare, that license, or was it giving kind of the crown jewels to anybody who could now just buy one of these systems?

Hardy: I don't think it hurt our, I don't think we got competition from people.

Brock: Okay.

Hardy: I think we could've-- Dave and I disagreed on how much we could charge for that. Because I'd been with a salesman back there at Harvard. The guy who was going to make all the money if only

somebody could write an operating system that would pass this test. So I had a better insight into how much they were willing to pay for an operating system.

Brock: To make that sale?

Hardy: To make that sale. And he knew-- and of course, the salesman knew how many other sales were hanging, if we could only do this.

Brock: Right. Probably especially if you sell it to a high prestige place like Harvard, then--

Hardy: Right, right. You get a lot of--

Brock: --you're not going to get fired for buying what--

Hardy: Get a lot of coverage.

Brock: Yeah, yeah.

Hardy: So we didn't always agree, but it went out and it certainly didn't impact the, our-- Tymshare grew as fast as it could grow.

Brock: <laughs> Yeah.

Hardy: It didn't have any problem with that.

Brock: Initially you were offering people, you know, time for $10.00 an hour and kind of run what you will. <laughs>

Hardy: Yeah.

Brock: At what point does the company start offering like a library of application software?

Hardy: Very soon. Let's see. What was I going to say? I was going to say one interest-- couple of interesting things. When we first started, we let people program in assembler. We cut assembler out

very early, because as I say, we got, we really got our first customers up in October. Before the end of the year, we had people trying to hack the system.

Brock: Within how long from that?

Hardy: Three months.

Brock: From three months of having that first machine.

Hardy: Mm-hm. We had people trying to get, crash the system.

Brock: <laughs> Dialing in from a teleprinter. Putting in a false account number or something or…

Hardy: Well, they had to be from one of our customers in the beginning. They had to be. But if you licensed this to a corporation with a bunch of engineers and the machine's there at night, what do these engineers like to do? They like to play. I understand that. So the first thing they did was play with this computer and see if they could figure out how it works, you know, see if they could crash it.

Brock: <laugh> Is there something about crashing it means that you know how it works?

Hardy: Mm-hm. Right. Exactly.

Brock: Is there a way to play around and know how it works and not crash the machine?

Hardy: Probably not.

Brock: <laughs> So it's--

Hardy: You probably do get some insights from crashing the machine.

Brock: Okay.

Hardy: And…

Brock: So there's a rationale behind it. It's not just purely destructive.

Hardy: It's not purely destructive. Yeah, I'm sure it is sometimes. But most of the time, in those days, it's just curiosity.

Brock: It's a kind of a test to failure sort of thing.

Hardy: Yeah. It's curiosity. How did they do this? How did they do this? And you just keep pushing on the timing and the characters and-- yeah.

Brock: And so how did you respond to that?

Hardy: Well, besides taking out--

Brock: Oh.

Hardy: Besides taking out the assembler, we, well, so I added a lot of, you know, so I had to make a lot of the original Berkeley code more secure. There were places where you could end up in sort of an in-between state, you know, and so I had to clean those out.

Brock: Hm. I guess when they crash it, they're revealing to you a new place to work on.

Hardy: Yeah.

Hardy: They were job security.

<laughter>

Brock: Yeah.

Hardy: But people who think that this hacking is new or recent or something, no. Three months. Before the end of 1966, they were crashing the machine. So this is not new.

Brock: And it's the customers.

Hardy: The customers.

Brock: <laughs>

Hardy: The customers were crashing the machine. The customers, because the customers, we were selling to engineers. Engineers who can program like to do this stuff. What can you say?

Brock: Did you ever do any of that?

Hardy: I'm not telling.

<laughter>

Brock: I'll take that as a "Yes."

Hardy: <laughs>

Brock: And so I can't remember LaRoy's last name.

Hardy: Tymes.

Brock: It's Tymes. Yes.

Hardy: T-Y-M-E-S.

Brock: I should have been able to remember that.

Hardy: And he is no relation to Tymshare. That just, that was the strangest coincidence.

Brock: But he had, it was in '66 that he originally made the suggestion about the network.

Hardy: Right.

Brock: And…

Hardy: And, of course, this was from Livermore. He knew about time-sharing. He could see how useful the time-sharing system was at Livermore to the various divisions.

Brock: Oh, yeah.

Hardy: He could-- you know, he had the whole image. He had the image they had. They came from General Electric, Tom and Dave, and GE just didn't have nearly as developed, sophisticated a system. So there wasn't nearly as much you could do with the GE system. So the customer base just couldn't expand the way it did at Tymshare. At Tymshare we had, by the late '60s, we had primitive spreadsheets, [Basic interpreter,] you know, software, editor, Word-- no. Nothing remotely like Word, but… <laughs>

Brock: A text editor.

Hardy: If you can imagine the first level, first design, first editor, kind of program, yeah. We had all of that very early. So you could do a lot of work. You could write reports, you could, you know, keep spreadsheets and accounting and all kinds of things. So the general usage, I mean, the number of things you could do with our computers were just enormous.

Brock: Who was building these entries in your applications library? Like, the accounting programs and the text programs?

Hardy: Okay. In the beginning it was two guys, Richard Moore and Arden Scott.

Brock: Did they work for you or did they work in a separate pla--

Hardy: No. They didn't work for me.

Brock: Okay.

Hardy: It took a while before Dave could convince himself that a woman could be a manager.

Brock: How long?

Hardy: It never happened.

<laughter>

Brock: Well, how long did he--

Hardy: He left in '69.

Brock: Ah.

Hardy: And so after that things changed enough that there was just nobody else to make the manager of some of this software, system software stuff. They tried, you know, when I got pregnant in '67, right after the Harvard acceptance test. The first thing they did was run out and hire Norm, my husband. He never interviewed. You know, they knew Norm because there were company parties and things.

Brock: Sure, sure.

Hardy: And they knew he was in computers. So they ran out and hired Norm. They never interviewed him, never <laughs> asked any questions. They assumed that since he was my husband, he knew everything. He had basically written the operating system and I was just faking it. <laughs> And all kinds of other fairly interesting <laughs> thing--

Brock: Did they ask you before they--

Hardy: No. They never even told me they were going to hire him. They just went out and hired him. <laughs> And so it's a funny story. <laughs> This had a funny ending. So they make him the manager. I've told you about Norm. What he likes to do is go around to every project and make a little bit of code, solve a really hard problem in code. Managing is not what he likes to do. But, you know. But I was not managing officially, because women can't do that, but I was sort of organizing things. And so they just assumed he was better at everything than anything I did. And so then everything-- okay. So this is the end of the year. My daughter-- I'm still doing all the coding on the monitor. So I'm working one night. We have a lot of things I want to tie up before my daughter's birth. It's actually due the next day. So I'm

working until midnight and I got all, everybody's requests settled. Monitor was tested. The operators agreed. Everything's working fine. So that was midnight. My daughter's born at nine o'clock the next morning. And--

Brock: Did you go home before going to the hospital or <laughs> did you--

Hardy: Oh, I was at home. Because we had a teletype.

Brock: Oh, oh. Oh, oh, oh.

Hardy: Terminal at home by that time. I was at home. I, you know, it wasn't that bad.

Brock: Okay. <laughs>

Hardy: And by three o'clock the next afternoon, I'm still lying in the hospital. Dave calls. Dave Schmidt calls. He said, "Our best customer has one more feature they want in the operating system. Could I bring a terminal over?"

<laughter>

Brock: To the hospital?

Hardy: To the hospital.

<laughter>

Brock: That's… Wow.

Hardy: I said, "No, thank you. I'll be home in two days. Why don't I fix it when I get home?"

<laughter>

Hardy: And so, you know, so that worked out okay. The irony of all this is that when they handed out stock options the year before, they decided they couldn't give me-- they gave me a few, but very few.

Less than half of what they gave any of the men, even though some of the men were essentially working for me. But they gave me very few stock options. And the reason Dave Schmidt gave me was because, "We can't give you, a woman, stock options, because stock options are, the intent of stock options, is to keep you interested and active in the company. And it would be immoral to tempt a woman to continue to work instead of stay home and have children." And then Dave Schmidt, who won't give me stock options because I'm supposed to be home having children, is the one who calls me while I'm still in the hospital <laughs> and wants to bring me a teletype. <laughs>

Brock: As you say, people are mutually or internally inconsistent, I guess is-- ay-ay-ay.

Hardy: <laughs> Yeah.

Brock: But was he, would you say, he was typical of people in his position?

Hardy: Yeah. Let me just say, I really like Dave. He was a good manager. We're still friends. It was just the time, the culture. And he and Tom had both come from GE. Now, let me tell you my GE story. <laughs> I hope I don't keep you all afternoon.

Brock: Please.

Hardy: <laughs>

Brock: Please keep us all afternoon Ann, please.

Hardy: So one time I finally got annoyed that I wasn't getting any stock options and all the men who were working for me were getting stock options. So GE happened to be advertising for somebody, a programmer, with my experience. And so I sent them my resume. And I called them up the next week and I talked to the woman in personnel and said, "I sent you my resume. Can I interview for a job?" And she said, "Well, it is true that your resume fulfills our requirements better than any others we have received, but we do not hire women in technical positions. And besides that, you have management experience and we can't possibly ask a GE man to ever work for a woman." <laughs> And so you can understand Tom and Dave coming from that context, that environment, why the thought of having a woman doing any of this was just not--

Brock: Right. Foreign.

Hardy: Not within their-- yeah. Not in their program. Just wasn't there. And…

Brock: And that, that GE operation, is, or was, located in the Bay Area.

Hardy: Yeah.

Brock: Correct? That was where their time-sharing, computing--

Hardy: That's right.

Brock: --was. Was that--

Hardy: This is basically where Tom and Dave had come from.

Brock: Was it on the peninsula or the East Bay?

Hardy: No.

Brock: Yeah, it was--

Hardy: Right over here.

Brock: Okay.

Hardy: And…

Hsu: Was that based on the MIT project?

Hardy: No.

Hsu: No.

Hardy: No. It was a very… I forget what they called it now, but it was a very limited system, GE system. [GEISCO]. And it's what I think I said, it's what Tim and Dave thought they were going to sell, until GE pulled the rug out from under them and then they got into SDS, for which they were very grateful because it was a much better system.

Hardy: And… But GE at that time was just not-- this was, you know, late '60-- 1970 maybe. I don't know, '69, '70, right in that time frame. There was a non-discriminate [non-discrimination] nation[al] law passed in '64. Which one would think they couldn't just announce to you over the phone that, "We don't hire women," but…

Brock: Well, I guess they and many other people were just ignoring it or…

Hardy: Yeah. Yeah. It meant-- actually, it's good thing they passed the laws, because 20 years later they made a difference. But they didn't make a difference for 10 to 20 years.

Brock: Hm. Why is that? Because it relied on actually people bringing lawsuits based upon the law, I guess.

Hardy: Actually, the people who brought the lawsuits in the beginning all lost. I think what it took was a generation of new managers.

Brock: Huh. Yeah. I was thinking about, you were talking about the people from Comshare who in 1966, you know, there was this thought, "Oh. There would never be a competition between--"

Hardy: Right.

Brock: "--us because we're in these different regions." I guess when, I guess at the point around '68 or maybe it's even '67 when, you know, the Los Angeles installation is there, the Houston one is maybe being built, and you're deciding, Tymshare is deciding, "Oh, well, perhaps we do need to build this network." <laughs>

Hardy: Network.

Brock: Then I guess once you make the decision to build the network, then there is no regionalization.

Hardy: There's international.

Brock: Everybody's, you know, it's all competition now.

Hardy: Mm-hm. It's all competition now. And I think Comshare, I don't know, but I think Comshare had a more direct-- they were in Michigan. They were probably-- although we had huge customers from the automobile industry. So I'm not sure why there wasn't more problem with Comshare, but they seemed to have been more limited and more focused on what they were doing. And we didn't have to just kill Comshare, because at that point we were worldwide. We had nodes in Paris and Japan and everywhere, so we were not very limited in where our customer base was.

Brock: Wow. Well, maybe-- hopefully Marc is beaming back in, because I--

Weber: Hi. Yeah.

Brock: Yeah.

Hardy: Hi there. <laughs>

Brock: Hey, Marc.

Weber: I don't know what happened. Just wouldn't let me back for like five minutes.

Brock: Yeah. I was worried that the battery ran out. <laughs> We were just talking a few moments ago about kind of getting into the Tymnet story. So I'm glad to have you back on. Maybe we could-- I don't know what everybody's--

Hardy: <Inaudible>.

Brock: --time is like. Are you good, Eric? Okay. Maybe we could at least get into the beginnings of the Tymnet story.

Hardy: Beginning of Tymnet?

Brock: Yeah. Yeah. And--

Hardy: Well, it was very gradual. And one of the first things we did, build these-- well, we bought. Our first nodes were purchased. And they were the ones who-- the first thing we did was move the echo out into the nodes and then had the nodes communicate back to the SDS. So that was the first step in--

Brock: Of the network.

Hardy: Of the network. It wasn't anywhere-- it was just a matter of having local phone calls for people everywhere and then the nodes connect, otherwise there was no change to anybody.

Hsu: What were the nodes? Were they minicomputers?

Hardy: They were minicomputers. And we migrated from one to another fast enough that I can't remember them all. <laughs> And… But they are written, it is written down someplace. I'd be happy to <laughs> send you if you're actually interested, if you remind me. <laughs>

Brock: So that was, a customer would have a local phone number. It would reach this minicomputer, and it was essentially-- was its primary purpose to provide the echo for the typing or was it also doing some sort of scheduling?

Hardy: It did nothing except the echo and forwarding information.

Brock: Pass it on.

Hardy: Its primary purpose was a local phone call.

Brock: Okay. And then you leased maybe an open line between that--

Hardy: Yeah. Then we got leased lines from there back to the, whatever the local computer center was and…

Brock: Did you expand the number of computer centers?

Hardy: We had, we ended up, with three computer centers.

Brock: Okay. Was--

Hardy: Here, Houston and in New Jersey.

Brock: Oh. And you closed down the Los Angeles.

Brock: We closed down Los Angeles.

Brock: And took that machine…

Hardy: And moved it to one of the computer centers. All the computer centers had multiple machines. I'm not sure where that one went when… But…

Brock: Okay. When did you open the New Jersey center?

Hardy: Jeez, I don't remember.

Brock: Was it--

Hardy: Early.

Brock: Early-ish. Yeah.

Hardy: Yeah.

Brock: Okay.

Hardy: Yeah.

Brock: And that was for financial customers primarily? Or I guess there's all sorts.

Hardy: Just everything.

Brock: <laughs> Yeah. Well-- yes, Marc?

Weber: And each of the centers was running the same operating system, same basis <inaudible>?

Hardy: Yes.

Brock: Each place was a kind of a copy.

Hardy: Each place ran exactly the same thing. And one of my biggest disappointments in life is that we put one in Paris. And I had brought up so many remote computers by that time I didn't even have to go to Paris to get the machine running.

<laughter>

Brock: Well, maybe could we-- so that seems like a very straightforward network initially.

Hardy: Yeah.

Brock: Was there--

Hardy: It got very sophisticated.

Brock: Right. Well, I'm interested at this point, at the very beginning of Tymnet, at the very beginning of Tymshare's network, what was the--

Hardy: Wasn't even Tymnet at that point. It was-- yeah.

Brock: Okay.

Hardy: It was just a network.

Brock: The company's network.

Hardy: Mm-hm. And basically it wasn't obvious to anybody. It wasn't even a network, because all they were many computers with lines back into the host. They weren't networked together. It was just a line back to the host.

Brock: A kind of a hub in a spoke.

Hsu: So the hosts didn't talk to each other?

Brock: In nodes, yeah.

Hardy: The minicomputers didn't talk to each other. And the hosts didn't talk to each other. Right.

Weber: So where did the idea, I mean, it was LaRoy that came out, wanted to apply a true network to it?

Brock: When did the idea come to make it a true network where all the elements--

Hardy: Oh. We always knew we were going to do that.

Brock: <laughs> Okay.

Hardy: You know, it's a-- you start at the basics. You get the most important thing done so that customers have a local phone call, and then you move out. I mean, everybody… Norm, LaRoy and I, always knew what it was going to be. You can't start-- again, it's [a] customer-oriented company. We didn't have to do the most sophisticated network in the world before we could announce it. We could start with the simplest network, which helped the customers, because they had local phone calls. And grow from there.

Brock: And the--

Weber: What were the--

Brock: Oh, sorry, Marc. Go ahead.

Weber: So what were the models you were looking to, SABRE, SAGE, or…

Brock: The models for a network that you were-- what models for networks were you thinking of for computer networks, SAGE, SABRE?

Hardy: No. No. This was quite original.

Brock: Mm, okay. And was it--

Hardy: In terms of the architecture of Tymnet, it was original.

Brock: Okay. I was just wondering why, was the idea that, you know, you would maybe start off with these nodes, this hub and spoke sort of arrangement on your way to building out maybe a more interconnected network, was the idea then that you would be shifting customers from one computer center to another? And in essence doing kind of like a meta-time-sharing across the network or what--

Hardy: You couldn't shift them because they all had their information on the host that they were accustomed to.

Brock: Ah.

Hardy: So you had to forward them to the host that they were--

Brock: To their host.

Hardy: To their host.

Brock: Oh. Then by having more interconnection, what was the, kind of the theory of that? What would be the advantage?

Hardy: This is a very long answer.

<laughter>

Brock: I will…

Hardy: Well, first of all, [it] meant you could call in from anywhere to the host you wanted, because you were now on a network. You weren't on a minicomputer to a host. You were on a network, and you could connect to any of the hosts from any of these little minicomputers in the field.

Brock: Okay.

Hardy: So that was one big advantage. That people could travel around. And if we wanted to move a customer from one host to another, you know, we had their data for one reason or another. We wanted to take that host and dedicate it to some other big customer and get this little guy over to another host, not a problem. Because you were on a network and you could go wherever you wanted. After we got it up and-- Tymnet basically up and running, and I'm not, I can't remember right now all those steps. If you really want to know all those steps, you need to talk to Norm and LaRoy. But once we got Tymnet up and running, these little minicomputers that were all over the world, and they were all over the world, we could put in a lot of interesting code on these minicomputers. So we could do a lot of, we did a lot of, network communications. If you wanted to talk to a network over here that, or a computer that wasn't necessarily ours, we could do translations in these minicomputers. So one of the things we did was, as he just mentioned, Marc just mentioned, connecting to airline hosts. Doing airline reservations. Well, every airline, we put a teletype in the-- we were getting a little, we had managed to get a little better than a teletype by this time, but... <laughs> A terminal in a office. Travel agent office. And they would need to talk to different airlines to make reservations. Every airline had their own protocol. So what we could do is you could, the travel agent, could type in what they wanted, you know, a reservation on such-and-such an airline. And we could translate that request into that airline's protocol.

Brock: Protocol.

Hardy: Right there in the minicomputer. We never had to go through our computer. So that was one example of the kinds of things that we ended up doing. We would then, we would benefit, Tymshare would benefit, because sometimes some of these transactions, they also needed to use the SDS or one of our other computers for more of the reservation system. So we had, we sort of benefited both ways around.

Brock: I see. As a way to drive increased business, increased use of your computers, you allow this interconnection.

Hardy: Yeah. And sometimes we just, and we just charged for it. And if you weren't going to our computer, you were just going to an airline, then we would just charge for that service.

Brock: Right. Huh. With this, with the network then, as Tymshare was building this network, was it then that each of the nodes, each of these minicomputers, were then connected to, not necessarily to each other, but to each of the big computer facilities of Tymshare?

Hardy: Each minicomputer was connected... Some were connected to the host. Many were connected just to each other. Just like the--

Brock: Oh, I see.

Hardy: Just exactly like the demo downstairs. Or, I guess…

<laughter>

Brock: Mm-hm. Yeah.

Hardy: I guess back there. Just like that demo. It shows you how packet switching works. It's all packet switched, and so by connecting, interconnecting these little minicomputers, if one line got crowded, you sent it on another one.

Brock: And were they leased telephone lines between--

Hardy: Mm-hm.

Brock: Okay. So you're using the leased AT&T phone lines to connect all of these minicomputers together. And including some direct connections to hosts.

Hardy: Mm-hm.

Brock: But not all of the minicomputers then necessarily would have a host connection.

Hardy: Most of the minicomputers did not have a host connection.

Brock: Okay. Right. Because you have these--

Hardy: Just like in the picture. <laughs>

Brock: These cheaper local leased lines and then by doing the packet switching you can get it to the host.

Hardy: Yeah. And--

Brock: Cheaper than having an open long-distance line across the country.

Hardy: Much, much cheaper. And, of course, then we could put minicomputers in front of American Airlines and/or… And there were a lot of examples. That was just one. You could put minicomputer, and then you could have travel agents talk to American Airlines. It didn't matter where they were. They could get to the American Airlines host.

Brock: As long as you-- it's an interesting blend of, like, there's this kind of co-location, if you will, of having your minicomputer, you know, some of your minicomputers, close, physically close, geographically close.

Hardy: They had to be close to the host. There had to be one close to the host. But all the rest of them were all over the world.

Brock: That's fascinating. So it was a mixture of just distributing enough around, of the minicomputers, but having a least a few close to these important hosts.

Hardy: Yes. Right.

Brock: Yours and other people's

Hardy: And other people's. And the rest are distributed-- I mean, I told you what our three computer centers were, and we had-- but you could stick a minicomputer anywhere. They're very inexpensive. You can stick them anywhere. That means some company can have local dial-up and it doesn't matter where in the world their computer is.

Brock: Mm. Marc, did you have a question here?

Weber: Yeah. Sorry <inaudible>.

Brock: No.

Weber: I read that Tymnet was circuit switched <inaudible>.

Brock: Circuit switched Tymnet?

Hardy: Yes.

Brock: And then changed to packet switched?

Hardy: Mm-hm. Yes.

Brock: Okay.

Weber: When did it switch to packet?

Hardy: I believe that was in the early '70s.

Brock: Okay.

Hardy: It wasn't later than that.

Brock: Huh.

Hardy: Whether it was '70 or '72 is what I can't remember. It's one or the other.

Hsu: So it's the original architecture where it was the hub and spoke, were communicating directly to the host, was circuit switched.

Hardy: Circuit switched.

Hsu: And then once you had this network where the minicomputers were networked to each other, that was packet switched.

Hardy: Packet switched. Right.

Hsu: That makes a lot more sense.

Brock: And--

Hardy: Sorry. <laughs>

Brock: No.

Hardy: Thank you very much.

Brock: Thanks.

Hardy: That's exactly right. Good question. <laughs>

Brock: I would imagine that the idea of-- well, correct me if I'm wrong, that a packet switched network of this kind at that time was extraordinarily rare. I mean, I guess there's ARPANET.

Hardy: It was--

Brock: Are there others that--

Hardy: Well, I don't know.

Brock: --you were following?

Hardy: I don't know. But it was, it was certainly the only one that anybody could buy onto. There were no others that you could buy into and just use, however. It was, as far as I could tell, it was the only one that was just open to the public to buy into.

Brock: Hm.

Hsu: I think BBN had one that they were selling?

Hardy: Yeah.

Hsu: Telenet?

Hardy: And yeah. I haven't looked at it for a while. So I don't remember all the details. But Tymnet was all over the world, and… But they really are <laughs> little minicomputers.

Brock: How fast did that occur?

Hardy: Well, LaRoy came in '68, and it was no later than '71, '72, and it was worldwide.

Brock: Wow.

Hardy: Packet switched. LaRoy's good. <laughs>

Brock: Wow.

Hardy: LaRoy is really good.

Brock: That is astounding. What kind of places did you put the minicomputers, just in terms of like a physical--

Hardy: In office closets.

Brock: You would rent an office and stick it in a closet or…

Hardy: No. Yes. We could rent an office, or we might have a sales office there and stick it in the closet. Yeah. Or, you know, if somebody out in the boonies wants a connection, they give us a shelf in their office and we'd stick our minicomputer in there and <laughs> that was it.

Brock: And give them maybe a reduced…

Hardy: Yeah.

Brock: Or give them a payment of some kind for that.

Hardy: Yeah.

Brock: That's fascinating.

Hardy: <laughs> They went anywhere. They went in very strange places.

Brock: And was it difficult, was Tymshare paying for this big buildout out of its earnings or was it taking on debt or was it difficult to finance?

Hardy: No. It wasn't… It was really… Tymshare was so lean, you know, they had one person doing the monitor, they had one person writing all the Tymnet.

Hsu: Wow.

Hardy: You know, LaRoy, for years, LaRoy was the only person who knew what was in that network code. For years I was the only person who knew what was in the monitor. So they weren't spending money on any extra employees. <laughs> Because two of their most critical software pieces were held up by two people.

Brock: Wow.

Hardy: Yeah. And so no. They could really do an awful lot of expansion under earnings, for the earnings. They did get some more money, but they really, they were very profitable.

Brock: And it did go public in the early '70s?

Hardy: In the early '70s.

Brock: Okay. And what was the experience of that like for you and the other people in the company?

Hardy: We hardly noticed.

Brock: Really?

Hardy: Right.

Brock: Hm.

Hardy: It was all up a--

Brock: Hm.

Hardy: So the act of going public wasn't-- I think they, we, had a party or something.

<laughter>

Hardy: But beyond having a party, it didn't impact any of the worker. The employees. It did make us more visible. And it did give us money to do some acquisitions that we probably couldn't have done. The combination of the investment and the visibility gave us, probably gave us, the resources to do some of the acquisitions that happened in the '70s. And so that changed things a lot.

Brock: Were you, was LaRoy, in the programming he was doing for the network, how did that, how was that related to the sort of programming work that you were doing? Was there any need to coordinate those two things?

Hardy: Oh, yeah.

Brock: There was.

Hardy: Because as the-- <laughs> Well, SDS, the 940, came with-- can't remember what they call them. But some communications interface. . [SDS sold CTE communications units for the 940. You had to set them to some fixed baud rate. They cost about $1000 each. They handled one dial-up teletype or other ASCII terminal.] And then, of course, we had to change-- first thing we had to do was change the echo. Then we had to change out the hardware, because we used a minicomputer instead of the whatever SDS delivered. And, you know, as the network developed, yes. We had-- there were after that, minor changes, but those were the two big changes.

Brock: And LaRoy was writing the software that would go on the mini--

Hardy: LaRoy wrote the software that went-- yes. LaRoy wrote the minicomputer and I wrote the monitor.

Brock: Okay.

Hardy: Yeah.

Brock: <laughs>

Hardy: And, you know, we both knew what needed to get done, so it wasn't…

Brock: Right. You knew what was happening where they had to--

Hardy: Yeah, we knew what the interface was, so it wasn't a big deal.

Brock: Let's see.

Hardy: Just replace some of that interrupt code.

<laughter>

Brock: And was it, well, I guess as you were building out Tymnet, were you, was the company, aware of these other I guess governmental and military packet switched computer networks that were being built?

Hardy: Oh, yes.

Brock: Okay.

Hardy: LaRoy and Norm were very involved, very much aware of. And I think, yeah. You'd probably have to talk to them, but I think they had conversations with some of the ARPANET folks.

Brock: I would imagine it would be a pretty small community of people.

Hardy: It was a very small community.

<laughter>

Brock: And much of it right here.

Hardy: Yes.

Brock: On the peninsula.

Hardy: And it's local. Yeah.

Brock: Yeah.

Hardy: And I don't… And they were in different worlds. They were delivering to different worlds. And so comparing the technology was not a problem. It was never an issue that we talked about, the technology. And they can give you a lot of details about that that I find fascinating but… <laughs> They're not, they weren't my area of expertise. You should talk to the experts about that.

Brock: Okay.

<laughter>

Brock: I'm sorry, Marc?

Weber: Did you see Telenet and CompuServe?

Hardy: Yeah. Yeah.

Brock: What was your…

Hardy: They were competition.

<laughter>

Weber: Anyone else that was providing networking for business?

Hardy: Well, those are the only two I remember. But that doesn't mean there weren't others. I was so buried inside the monitor that what was going on out there… And early in the '70s we did, you know, at the time we went public, we did a lot of acquisitions. I was involved in a lot of the acquisitions and then once we got them in, one of the things that Tymshare, on their shoestring, did not do very well, was their accounting system. And so we acquired Graphic Controls, up in Buffalo, New York. Graphic Controls had a much better accounting system than we had. So in the early '70s, one of the things I managed was the conversion of Tymshare's accounting system to sort of an expanded, enhanced Buffalo, Graphic Controls accounting system. And that's a lot of, lot of work. And then we kept acquiring companies, and

so we had to keep adjusting our accounting system to account for all <laughs> these other companies that were coming in.

Brock: What were all these other companies? Surely some were other time-sharing companies that you're acquiring. But were others kind of like companies providing a service, if you will?

Hardy: Some of them were. Yeah. Some of them were just computers, so people could bring their, you know, their programs in and run them because there was a computer here. And take them home the next morning or whatever. . [By 1970 Tymshare had a PDP-10 and later a 360/67. Some of the acquistions were strategic because they expanded those markets.]   The big, the big one, was United Data Centers. UDC.   That came with Bernie Goldstein and Al Eisenstat Since I can't remember names, you better write those down quick, before I forget them.

<laughter>

Brock: And was that a time-sharing firm?

Hardy: No. They did-- they were more a batch processing firm. And they did a lot of-- I guess taxes may have been part of their work, one of their customers. [Dynatax and later Unitax],   But they were batch processing. They understood the value of getting their work on a network, but they had no interactive capability in any of their machines. Was all batch. Now, we can, there's nothing against running batch. You know, you can ship over your mag tape and we'll mount it and run your programs and you can do what you want with them. So it wasn't that we had anything against running batch processing. We just, it's just that our basic service was interactive.

Brock: And so that was just to expand your offerings to people who wanted to do batch processing.

Hardy: Exactly.

Brock: Now you could offer anything, right?

Hardy: Yeah. Mm-hm.

Hsu: <Inaudible>.

Brock: I'm sorry, Hansen, I think--

Hsu: Oh. I was just wondering if there was any thought to converting those programs to the timesharing?

Hardy: We did.

Brock: <laughs>

Hardy: Some of them we did. And particularly tax processing became very interactive.

Brock: Hm. Well, it just strikes me from listening to you that the company must have been, it seems like it was enjoying just a tremendous amount of growth and financial success.

Hardy: Right.

Brock: And was it-- but not so much growing in terms of head count; is that true?

Hardy: Well, certainly it grew in terms of the sales force.

Brock: Oh.

Hardy: <laughs> You have to be in place and you have to talk to customers, and so sales force grew. But the-- ah, I wouldn't say that the developer group didn't grow, but it grew more slowly, relative to the size of the company.

Brock: And the company established sales offices around…

Hardy: Everywhere.

Brock: Everywhere. <laughs>

Hardy: Here, there and everywhere. Right.

Brock: Earlier we were talking about, you remarked, that I guess it was by the end of the '70s you became a VP for the company and that, you know, we were talking earlier, you were VP of a Fortune 500 company. When did Tymshare make it onto that? <laughs>

Hardy: It was in the early '80s.

Brock: That was in the early '80s.

Hardy: Yeah.

Brock: Okay.

Hardy: Right.

Brock: So it was a--

Hardy: It just--

Brock: Was it just kind of like a, you know, exponential thing? <laughs>

Hardy: It was just continuous. Yes. Now, one of the things about, we talked about UDC and that acquisition. That changed the company a lot. Not because of the business but because of Bernie Goldstein. And he had, you know, I've told you where Tom and Dave were coming from. David quit, had left, in '69, but Tom was still there. And his interest hadn't, you know, he was happy to have the company grow. But developing a monster company or something was never in, never something he was anxious to do.

Brock: Okay.

Hardy: He enjoyed what he was doing. He didn't expand it very much. You know, I mean, here we are, a Fortune 500 company, so it expanded quite a bit but… <laughs> But in terms of developing it out and doing new kinds of products. And that wasn't so much his interest. My Division was doing a lot of airline reservation systems in the late '70s and early '80s. We were doing a lot of online banking for, you know, working with banks to figure out, "How do you do some of these financial transactions online?" So we had a lot of very interesting early, very early applications, very early activity, in what now we never think twice about.

Brock: Yeah.

Hardy: <laughs> But we actually probably did the first from home online airline reservation. And we were, one time we were in, I remember being in Italy on a-- business. And we didn't know when we're going to come home, you know, when the meetings were going to be over. We made our reservations online in Italy.

Brock: <laughs>

Hardy: To-- because, by that time, we could, we were no longer using teletypes. So we were using terminals that you could actually carry around. And so we could make our airline reservations from Italy to come home.

Brock: Wow. <laughs> And the--

Hardy: This is '70s.

Brock: This is a portable terminal.

Hardy: It's a little portable terminal. Right.

Hsu: CRTs?

Brock: No.

Hsu: No. <laughs>

Hardy: No. It was--

Weber: Silent seven hundred?

Hardy: Hm?

Brock: He says--

Weber: Like a silent seven hundred.

Hardy: Yeah. It's a--

Brock: So it was akin to a teletype.

Hardy: It looked like a typewriter, only it connected to the phone line.

Brock: And it would automatically, you know, it would get information in and print it?

Hardy: Mm-hm. Yeah.

Brock: Wow. Wow. And an acoustic coupler, just like the other things.

Hardy: Yeah, that's right.

Brock: Wow. And that's… Hm.

Hardy: So way, way early compared to what people think about. I mean, I told somebody I was in the computer industry for my career and they said, "What did you do? Computers didn't come until 1990s."

Brock: <laughs>

Hardy: So no… I mean, but that's just when people think about it.

Brock: Yeah.

Hardy: And they don't realize how much preceded what happened in the '90s. <laughs> To make that possible. You can't just make everything out of, you know, start from the whole-- you have to start gently, quietly, slowly. <laughs> That was fun.

Brock: So with the banking and the airlines, you were both helping banks and airlines to figure out how to do kind of online transactions?

Hardy: Right.

Brock: Okay. And the idea would be you would, Tymshare would be… Or they would use Tymnet to make these offerings to their customers and you would collect a fee or how would it--

Hardy: Well, it varied all over the place.

Brock: Yeah.

Hardy: So a lot of times somewhere along the way Tymshare had kept the accounting, for example. Or of some of these, for some of these transactions. So we knew what was going on and they would take the reservation. We'd keep some of the accounting information for the--

Brock: I see.

Hardy: Online banking. Was really the same. There's a lot. If somebody's going to pay a bill online, write a check or something, there's a lot of information that you want to keep for them.

Brock: Right.

Hardy: So and…

Brock: And that would be where Tymnet or--

Hardy: Tymshare.

Brock: --Tymshare would--

Hardy: Would do that. And yeah. And Tymnet would get it delivered to the right office and the right customer and…

Brock: Hm. At a certain point, video terminals, you know, in the '70s I guess are becoming more commonplace. So is Tymshare continuing in this business of renting or leasing teletypes and then video terminals to customers or…

Hardy: They were much more sophisticated by the '70s. They were little portable terminal-- yeah. Like Marc was mentioning. But yes. We could still rent them or you could buy them.

Brock: Was it becoming more common for customers to buy their own equipment?

Hardy: Well, by-- let me try to think about the timing here. Late '70s or early '80s. PCs were coming in, and we could connect to them. And so there was a wide range of what we were doing <laughs> at that point.

Brock: Yeah. That's what I was wondering about.

Hardy: Yeah.

Brock: You know, because the video terminal is just a kind of baby step to these personal computers that I guess could very easily connect to…

Hardy: Yes. We had, we did a lot of work with TWA. We got early, the early Apple, Lisa and Apple II. And at home. And so we could do a lot of this from home. We could make airline reservations. We could store information. Kids could write up stuff and store it on the mainframe and get it back or send it to the-- and of course, there were, there was, an early version of e-mail. Wasn't called e-mail, but it was an early version of. So we could send, they could send it around. And yeah. It was all there.

Brock: That e-mail was for, was that a service offered by Tymshare that companies could use or…

Hardy: You could use it in-- we certainly used it internally. And you could, there certainly was messaging for-- people who had accounts could send messages.

Brock: To other people?

Hardy: To other people.

Brock: Who had accounts.

Hardy: Who had accounts. But it was very limited.

Brock: Was that kind of like putting a message on a server somewhere and then somebody would go and look at…

Hardy: Yeah.

Brock: Yeah.

Hardy: Yeah. It wasn't as-- it wasn't as sophisticated as e-mail, but on the other hand, when I was traveling around the world here and there, I would send e-mail and my kids and I would communicate through e-mail, so… Because we could get on free, you know, with a local phone call. I could send them messages about what was going on and, yeah, so…

Brock: Was it acquisitions that was--

Hardy: It's in the '70s. That's in the late '70s, so… That you're talking about.

Brock: Yeah.

Hardy: Messaging from Italy to Cupertino.

Brock: And you're on one of these portable teletypes?

Hardy: On one of those-- and they're on a-- yeah.

Brock: On the Apple II at home.

Hardy: Mm-hm.

Brock: <laughs> Well, was it for these acquisitions that you were traveling so much internationally or what was…

Hardy: Well, it depended. We did a big contract with Italcable, which is why I was in Rome so often. And Italy turned out to be, their communications, wasn't as up-to-date as ours. They were entirely teletypes. And Italcable was in charge of all of Italy's international communications. And for things like e-mail or messages or anything everybody did, used to do on teletypes, they still did on teletypes and we did on e-mail or something equivalent over here. So we worked with Italcable and completely converted them off of the teletypes onto using a Tymnet communication system so they could send messages from Italcable to various offices around.

Brock: Wow.

Hardy: Yeah. It was very, it was fascinating.

Brock: So that was almost like a national infrastructure project.

Hardy: Mm-hm.

Brock: And they were building their national, part of their national telecommunications infrastructure on top of Tymnet?

Hardy: Tymnet.

Brock: Did they have any concerns about lack of control or ownership of it, do you know?

Hardy: Well, certainly not in the beginning.

Brock: <laughs>

Hardy: I'm sure that as time went on. But then they came over. They sent a couple of their people over here and they were here for a couple years, so they really understood networks before they went back. And we didn't, we were here to tell them everything, about networks, so we were getting a lot of payment in this transition period. They went back and built their own. That was fine with us.

Brock: Okay. So in essence they were developing expertise in modern networking--

Hardy: Modern networking--

Brock: --by the collaboration with--

Hardy: Right.

Brock: --Tymshare, Tymnet.

Hardy: Right.

Brock: And then built their own infrastructure.

Hardy: Yeah.

Brock: Wow. And that, was that a state-owned firm?

Hardy: Italcable was kind of like AT&T.

Brock: Okay. A state owned firm in everything but the name.

<laughter>

Hardy: State controlled. <laughs>

Brock: Yeah, regulated monopoly or something like that. Wow. And how did that connection come about?

Hardy: We just realized they needed some help. What can you do? And…

Brock: Were there other kind of national infrastructure projects or regional infrastructure projects like that before, you know, like, Georgia or <laughs> another country or another region?

Hardy: I don't know that they were like that. We were everywhere, so so many things changed. So many countries came to use Tymnet in one way or another. I don't know that, I'm not sure, there was anything exactly equivalent to Italcable, but…

Brock: Did you have-- okay. Sorry. Did you have kind of governments as customers? So for example, yeah. Did you have governments or state agencies as customers for Tymnet or for Tymshare?

Hardy: National Institute of Health. Right here. Was one of the first big Tymnet customers.

Brock: Because they put their library or their bibliographical database or something on here?

Hardy: Yes. Made it-- yeah. Available everywhere. Yes. And it just, and it pretty much, once that was up, it pretty much expanded quite rapidly. People realized that, "Wow. We can share this information instantaneously, no post office, no nothing." So yeah.

Brock: And that was, they were, they put their bibliographical database onto a Tymshare host?

Hardy: Tymshare host. And yeah. And… Or well, no, they didn't. They put, they kept, their own host. We just provided the network for NIH. And some of these deals were sort of half-and-half. Some of them were just like NIH where it's all theirs. Some of them were, we kept, we held the information. It just, once it got going, it was very flexible. <laughs>

Brock: Oh. I can imagine. You can either kind of provide an infrastructure service, a kind of compute service, or some, any, combination thereof.

Hardy: Any combination and it can evolve as you figure out what you're doing, and right. It was very flexible. And we had very good salesmen and they could, whatever the customer needed, we could come up with.

<laughter>

Brock: And for NIH, for example, for this kind of health information data, would it be that NIH was paying you when people connected to it for free? Is that kind of what would happen? Like, I'm at a medical school and I want to connect to it. You know, they would pay for the traffic?

Hardy: Yeah. We charged NIH, and most-- yeah. And I think most of their clients were theirs. And just used, and we charged, for the service overall, NIH, right. We didn't charge each little--

Brock: Each person trying to--

Hardy: Each little-- yeah.

Brock: --look at it.

Hardy: No.

Brock: I see.

Hardy: But we knew who was--which ones were logging in to NIH. So we could keep track of their time. Ten doll-- no. We didn't charge--

Brock: Yeah.

<laughter>

Hardy: We were past the $10.00 an hour time.

<laughter>

Brock: Well, let's see.

Hsu: How much were you charging?

Brock: I don't remember what we were charging at that point. I was just, I just had to deal with the $10.00 an hour.

Hsu: <laughs>

Hardy: And with the queues and everything, so I really remember that.

Brock: Yeah.

<laughter>

Hsu: Could I ask something else?

Brock: Please do.

Hsu: I was wondering about your trajectory from being just the engineer on the monitor up the management chain up to vice president. How did that go? Like, stages of becoming more and more responsibility?

Hardy: Well, it just, sort of one by one. I, you know, I started out getting the accounting projects, and the monitor kind of on the side, because it was pretty stable. And then there would be another project that they needed a little bit of this. Or some salesman would come in with some opportunity that didn't exactly fit the regular marketplace, so that would… Ron Braniff ran sales. He's really good. And it's a shame that he hasn't been willing yet to do an oral history. And I'm hoping, Mike and I, are still hoping that we can get him to at least participate in a conversation. Because he was really good at the market that Tymshare was in. But as these other little things came along, and particularly after Bernie Goldstein, not entirely, but particularly after Bernie got involved, Bernie was into acquisitions. He wanted to grow the value of the company. He wasn't interested in maintaining the traditional market, the traditional business. He wanted to grow the value of the company. He did a lot of acquisitions. And acquisitions came with unique ideas about how to do things. And so we had to integrate all those companies. They didn't fit in anybody else's division and so they came to my, often, came to mine. The ones that were totally off the wall.

Brock: <laughs>

Hardy: And so like the airline reservation systems and some of the home banking systems and like, crazy. Nobody had ever thought of doing some of these things, and so they came to my division, so… And so eventually, we'd done enough acquisitions that it ended up, you know, a good sized division.

Brock: Mm. And that was the Integrated Systems Division?

Hardy: Yes. Mm-hm.

Brock: So it had essentially evolved. You know--

Hardy: It just evolved.

Brock: --just by process of accretion.

Hardy: Yeah.

Hsu: <laughs>

Hardy: Taking on more and more and then it's…

Hardy: Taking on more and more. All the strange things that nobody else could figure out what to do with. Yeah. I got all those.

<laughter>

Brock: And--

Hardy: Which was really fun, because it was a great background for living in today's world.

<laughter>

Brock: I'm sure. I'm sure.

END OF THE INTERVIEW