Oral History of Kay B. Magleby

Interviewed by:
Gardner Hendrie

Recorded: November 20, 2009
Priest River, Idaho

CHM Reference number: X5611.2010

© 2009 Computer History Museum

Gardner Hendrie: Well, we have here today Kay Magleby who has very graciously agreed to do an oral history for the Computer History Museum [at the Magleby home in Priest River, Idaho on November 20, 2009]. Thank you very much.

Kay Magleby: You're welcome.

Hendrie: I think maybe the first thing I'd like to ask you is if you could just tell us a little bit about your family background about your mother and your father and where you were brought up what siblings you might have had, a little bit of that.

Magleby: Okay. Well, I grew up on-- my father had a series of cattle ranches and farms. And he had a cattle ranch at Henry's Lake in Idaho and a farm in Idaho Falls and another one near Pocatello. And our home was on the farm in Pocatello. He raised purebred Hereford cattle and my mother was a schoolteacher and she taught Tuhee School, for various grades like third, fourth and sixth from one year to the next. So I also attended my high school, Pocatello High School. I was selected as the outstanding athlete of my graduating class. And I went two years to Idaho State College.

Hendrie: Could you tell a little bit more about what sport you played? Was it football?

Magleby: Yes, I played football, right guard.

Hendrie: All right.

Magleby: And then defensive tackle.

Hendrie: Okay, so you played both…

Magleby: Both sides of the line.

Hendrie: Both sides of the line.

Magleby: And right in the middle of it.

Hendrie: Wow, okay. Now, in high school…

Magleby: I also ran the quarter-mile in track.

Hendrie: Oh my goodness. Very few linemen also are on the track team.

 © 2009 Computer History Museum

Magleby: Yes. Maybe that's why I got made outstanding athlete.

Hendrie: Maybe, yes, very good. What subjects were you interested in in school, in your high school-- in your secondary in high school?

Magleby: Well, my favorite subjects were math and various math courses. And the worst one I'd had was English.

Hendrie: All right, you loved math. What do you remember as your earliest memory about what you thought you might like to do when you grew up?

Magleby: Well, I guess the first occupation that I thought I wanted to be was a lawyer. And so when I took my aptitude examinations that came up second to be a lawyer and first to be an engineer. So that was my junior year. And my senior year I took it again and got the same results.

Hendrie: So you decided to believe the test?

Magleby: Well, also, whenever anything went wrong on the farm I'd get blamed for it and I couldn't get out of it. So I decided if I couldn't do that I probably wouldn't make a very good lawyer.

Hendrie: That's good. All right. Very good. So when you graduated did you think about various colleges? Or was it always sort of understood that you'd go to college or was that not clear?

Magleby: No. No. It was always understood that I would go to college. My mother being a teacher and my father had some graduate degrees.

Hendrie: Really?

Magleby: And so he…

Hendrie: So he was college educated too.

Magleby: Yes.

Hendrie: Okay. Now, did you have siblings?

Magleby: Yes, I had a brother and a sister. My sister is the oldest, then my brother and then me.

 © 2009 Computer History Museum

Hendrie: Okay, so you were the youngest.

Magleby: Yes.

Hendrie: All right. What did your sister and brother end up deciding to do in life?

Magleby: Well, my sister had various jobs. I'm trying to think. but she was working in clerical work, in medical clerical work. And my brother is an engineer. He's a mechanical engineer. And he's worked out at that atomic energy site near Idaho Falls for many years and worked on the design of some of the nuclear reactors and that sort of thing.

Hendrie: All right. So clearly, there were engineering genes somewhere in the blood there.

Magleby: Yes.

Hendrie: Okay. When you went to college, where did you think of going? Was it sort of set where you were going to go? Or what were your thoughts?

Magleby: Well, my first two years were at Idaho State College in Pocatello. So I lived at home and attended school. So that was a very convenient thing to do. So that's what I did. And then I got what's called a junior certificate because they only had two years in electrical engineering.

Hendrie: In Pocatello.

Magleby: In Pocatello Idaho State College. And so then I transferred to the University of Utah which was very highly rated in their electrical engineering program and then got my Bachelor's degree there.

Hendrie: Now, why did you decide to go to the University of Utah?

Magleby: Well, there were two other friends of mine, we kind of studied together all along Floyd Siegel and Bliss Law [ph?] and we all got together and decided that's where we'd like to go.

Hendrie: So you all went together.

Magleby: So we all went together, yes.

Hendrie: Okay. You didn't have any trouble getting into the school to transfer in there.

 © 2009 Computer History Museum

Magleby: No.

Hendrie: Now, what did you study? What did you specialize in in your undergraduate? Did you just take a broad range of courses? Or where there any that particularly you enjoyed and you sort of tried to take more off that list?

Magleby: Well, I started out thinking I wanted to be a chemical engineer and so I was very interested in chemistry. But then I enjoyed the math more and the electrical engineering had more dependence on math. And so that's why I chose electrical engineering. And also Bliss and Floyd also were taking electrical engineering so we all went together so to speak.

Hendrie: Very good. Now, did you room with them too?

Magleby: No. No. They were both married and I lived in the dorm.

Hendrie: Okay. All right. Were there any professors or teachers that particularly inspired you or that may have influenced you in college?

Magleby: Well, let's go back to high school. My algebra teacher there, I can't remember her name now but anyhow she was very good. She helped with my interest in math. And then in college I don't remember a particular one. They were all good teachers, I guess.

Hendrie: They were all good. So you specialized in electronics versus power engineering?

Magleby: No. It was electronics.

Hendrie: It was electronics, yes. So it was electrical engineering with electronics. Was the University of Utah a school that did practical work where you had to build things in the lab that sort of thing? Or was it mostly the course work where you studied the textbooks and did the problems and that sort of thing?

Magleby: Well, they had typical labs, but also while I was there I got a job, a part-time job with what was called Upper Air Research Program and I actually built some things there, electronic ones and put them together. I basically sent rockets up and then made measurements.

Hendrie: Oh wow.

Magleby: And so this was airborne electronics if you will.

Hendrie: For a short time it was airborne.

 © 2009 Computer History Museum

Magleby: Yes. And so I did that part-time. And so I learned how to solder and do that sort of thing, you know, like an electrical engineer has to do.

Hendrie: Yes. Eventually has to learn to do. Some schools you get a running start and some you get a big wakeup call when you go to work the first time.

Magleby: Yes, learn on the job.

Hendrie: Yes, learn on the job. Well, so how did you do in school in Utah?

Magleby: I was an honor student.

Hendrie: You were an honor student. Okay. So you did very well.

Magleby: Yes.

Hendrie: And when you go to the point where it was time to graduate, what did you think about what you wanted to do? What were the various options that went through your mind?

Magleby: Well, my first job was at Hughes Aircraft Company. And one of the options was I wanted to live in California. I was tired of being in the cold weather in Idaho. And here I am back again.

Hendrie: Yes. We can discuss what happened in your brain that started that. So was that the only place you applied? I should roll back, did companies come around and sort of recruit at the University of Utah?

Magleby: Yes. Yes.

Hendrie: So you could talk to a bunch of different companies.

Magleby: Yes, I talked to more than one. One place I went and interviewed was at Bartlesville, Oklahoma for an oil company that had a research lab doing electronics work.

Hendrie: Okay.

Magleby: It was very windy and cold the day I was there and I looked out and the only thing between here and Canada is barbed wire fence and that was about it. I liked the mountains around the University of Utah. They have what they call Circle Mountain that goes right around the town. And it was not much

 © 2009 Computer History Museum

more of a ditch bank and they called it a mountain. That's the closest thing they have to a mountain. And also I interviewed at a couple of other places anyhow, I can't think of them right now.

Hendrie: Okay. They didn't stick in your mind. And so Hughes is the one that you went and interviewed at Hughes and you liked it and they made you an offer.

Magleby: Yes.

Hendrie: What department, what area of Hughes? Hughes was still fairly big even then in that day?

Magleby: Yes, it was a fairly large company. And they were involved in making what's called fire control system and that's not controlling fires, it's controlling the armament to fire in jet airplanes.

Hendrie: Yes.

Magleby: And so my first project there was designing test equipment to test the computers on the targets and control firing the armament And that's where I got to learn about Hewlett-Packard instruments because I used those in that work. And while I was working there, I kept in touch with Bliss Law and Floyd Siegel and initially while I was there I was going to get a graduate degree at the University of California and started to do some night school. But that was really too much of a stress for me.

Hendrie: To work all day…

Magleby: And then drive halfway around the town of Los Angeles.

Hendrie: Yes.

Magleby: So I was in touch with Floyd Siegel who was working for Hewlett-Packard at the time and he gave me an invitation to come to interview. And he was just starting to go to Stanford University on what they called an Honors co-op system where you go to school half time and work fulltime. And so your days were long but it wasn't nearly as long as what had been at Utah—- I mean at…

Hendrie: At Hughes.

Magleby: At Hughes, yes. So I went there and interviewed. And it wasn't very long that I got a job offer.

Hendrie: Who did you interview with, do you remember?

 © 2009 Computer History Museum

Magleby: Well, several of the engineers and the engineering manager. There was a section that I would be working in. Norm Schrock was that manager.

Hendrie: Norm Schrock, okay.

Magleby: And I did a typical interview, I guess. And one thing I remember, when I finished the interview, I had to go to see the personnel director, Ann Laudel. And she talked to me for a little while and then she told me what my salary would probably be. And Hewlett-Packard had a very good bonus program. And so she says you'll get a percentage and she said well that's what it typically runs. And then she handed me a slide rule so I could calculate what my salary plus bonus would be.

Hendrie: Oh my goodness.

Magleby: I thought that was kind of interesting.

Hendrie: That was very different. I don't know any personnel person who knows how to use or ever met one that knows how to use a slide rule.

Magleby: I didn't know she did either…

Hendrie: But she had one.

Magleby: …made for that purpose, you know, interviewing engineers.

Hendrie: All right.

Magleby: So then a very important part of my life that we haven't talked about yet and that was when I was at the University of Utah I met Barbara. So we got married in Idaho on Priest Lake. Barbara's parents had built a nice home there on Priest Lake. And so we went to that home and got married and then started our married life down in the Los Angeles area. That's when I was going to school and working for Hughes.

Hendrie: So did you get married just sort of in your senior year, as you were graduating?

Magleby: Yes, after we graduated and we got married.

Hendrie: All right. Wow, very good. Well, that is an important part of your life. So where were you living in Los Angeles when you were working with Hughes?

 © 2009 Computer History Museum

Magleby: Where was the place, Barbara?

Barbara Magleby: Playa del Rey.

Magleby: Playa del Rey.

Hendrie: Yes, okay. But then you, I assume, obviously that Hewlett-Packard did make you an offer and you said yes.

Magleby: Yes. And we moved up there. Palo Alto at that time.

Hendrie: All right, good. What were you assigned to work on when you first got there? You're still a pretty junior engineer.

Magleby: At Hewlett-Packard you mean?

Hendrie: Yes, Hewlett-Packard, yes.

Magleby: Well, I was the first one to work on their sampling oscilloscope project.

Hendrie: Was this in the research department?

Magleby: In the R&D lab.

Hendrie: In the R&D labs.

Magleby: Yes, so I started the sampling oscilloscope program. And then later when it got staffed, well, then they brought in a more senior engineer to manage the program. And what I did, most of the key sampling technology I developed. And together with Vic Van Duzer we had a patent on that work that we did.

Hendrie: Okay. What were the technical breakthroughs that needed to be done to make a working product that HP would be willing to sell?

Magleby: Well, they wanted to have a very fast new wide bandwidth oscilloscope.

Hendrie: Yes.

 © 2009 Computer History Museum

Magleby: And then they were not limited in bandwidth by an amplifier as a conventional type of oscilloscope. So there had been a sampling oscilloscope, an experimental one built in England and we had a paper on that, which it described some of the basic techniques that you used, make the samples and put them together to draw the wave form.

Hendrie: Yes.

Magleby: The difficult part was making the white bandwidth sampler and that was my project. And we had to develop a very fast pulse generator because the bandwidth is determined by how narrow a pulse you can use as to control the sampling.

Hendrie: To do the sample, take that sample.

Magleby: Take the sample. And also we had to develop some high frequency diodes to actually do the sampling. And Hewlett-Packard at that time had an experimental semiconductor activity. And so I worked with Horace Overacker who was managing that and who developed these very fast diodes to be the key elements in the sampler.

Hendrie: Were these gallium arsenide diodes at this point?

Magleby: No.

Hendrie: Okay.

Magleby: The gallium arsenide diodes were just coming up available at that time.

Hendrie: Now, what year is that you go to? Is this 1957 or ’58?

Magleby: 1958 I think when I went to Hewlett-Packard. Another key thing was that the samplers were very-- non-linear. So you couldn’t get a good linear display. It was very difficult to get a good linear display. So Vic Van Duzer and I came up with a scheme to use feedback and take the linearity of the sampler out of the picture all together. And so that was one of the things that was in the patent that we got.

Hendrie: Very good.

Magleby: I guess those are some of the key things that we did. And then, of course, just the design and reliable product and go through the environmental testing temperature and all of that. And so that took some special things to make it work.

 © 2009 Computer History Museum

Hendrie: Right. At this period, was a product like this, would it be developed all the way to being a product in the R&D labs?

Magleby: Yes, at that time…

Hendrie: You would do the research.

Magleby: And there was a section in the R&D labs that focused on oscilloscope technology. And then we would develop the product and it would go to manufacturing.

Hendrie: All right.

Magleby: And it was manufactured in Palo Alto also. This was in the Palo Alto facility.

Hendrie: Very good. How successful a product did that turn out to be for Hewlett-Packard?

Magleby: Very successful, yes. That was one of the things that we beat Tektronix to because we had a good sampling oscilloscope and as you pointed out in your discussion, Tektronix came out with a plugin for theirs but it wasn't really as good an integrated product as ours was.

Hendrie: Well, Tektronix was a very good competitor in oscilloscopes. So it was really good for Hewlett-Packard to come out with something that's better than Tektronix.

Magleby: Yes. One interesting thing was when we introduced the product and took it to the IEEE [actually the IRE show] show we had our sampling scope there and Norm Winningstad from Tektronix was there and he's the one that designed the plugin. And so he came over and he had built a little very small pulse generator that he could carry around with him using tunnel diode technology.

Hendrie: Yes, okay that would do a very sharp pulse.

Magleby: Very sharp pulse. It was fast enough you could test the rise time of the oscilloscope. And we were advertising it as a 500 megahertz oscilloscope. But by tweaking it and all that one we took had a gigahertz of bandwidth. So he came over and he thought he was going to show us off and he set it up so we could look at the rise time of the oscilloscope and it turned out to be a fraction of a nanosecond. And so he was very impressed.

Hendrie: Because it really worked.

Magleby: Yes and it was twice the bandwidth that we were advertising.

 © 2009 Computer History Museum

Hendrie: Yes, which isn't what he was used to.

Magleby: People usually exaggerate.

Hendrie: Yes, it's the other way around.

Magleby: That's what he thought he was going to find.

Hendrie: Yes.

Magleby: So he was amazed and walked away.

Hendrie: Okay. Did he understand-- well you had patented the techniques for generating this very narrow pulse.

Magleby: I've got another story to tell about that. I gave a paper at an instrumentation conference and we described how we did that. And so he got very interested and then they bought one of our first oscilloscopes and we sent it to him, sold it to him. But about the time that we made the change in production, we went from using what was called an avalanche transistor to generate these sampling pulses to a step recovery diode which was faster and less jittery so it was a very clean. We had a very clean good display. So we sold him-- when they placed their order we sold them the last one of them was the one that had the avalanche transistor. And then when we gave the paper we talked about how we generated this and Norm was in the audience. So they asked about how we got that transistor and the step recovery diodes and they were developed by HP's small semiconductor research lab. And so he got up and says, "For the sake of one diode I can't do that." Because they didn't have…

Hendrie: They didn't have a step recovery diode. They didn't have these diodes.

Magleby: Yes, in fact, to understand how to make a fast pulse from the diode was a interesting story too. In the counter division of Hewlett-Packard there was an engineer who was making a high frequency counter and we wanted to have a very abrupt change in the wave form and that would generate a lot of harmonics. And they would use those to mix with the input signal to get a wide bandwidth counter.

Hendrie: Okay.

Magleby: And a fellow named Frank Boff who was working on the project and that section in the lab was just adjacent to the oscilloscope section. And we were talking over coffee and he was commenting that this wave format was faster than he could measure it in a conventional scope. And at that time, we had a prototype of the sampling scope but we didn't have a production version or anything.

 © 2009 Computer History Museum

Hendrie: Yes, right, but you had one in the lab.

Magleby: We had one in the lab. So I wheeled that over to where his lab bench was and we connected up to it. And then it was as fast-- so much faster than even our sampling scope was.

Hendrie: Yes, you could just see that you were being limited by the sampling scope. You still couldn't see it.

Magleby: Yes. And so that's how we-- within a matter of hours, I think, I had already made a nine pulse generator for the sampling pulse using that step recovery diode. And so that was kind of an interesting development in the lab there how we worked together to take that invention and put it in production. [This was one of the best examples of the "next-bench syndrome" at HP].

Hendrie: Yes, one group sees it and the other group says, "I could use that characteristic". And so you had a pulse generator and then eventually you integrated the pulse generator into the sampling.

Magleby: Yes, in about two days.

Hendrie: In about two days.

Magleby: Yes, when I saw that I was excited.

Hendrie: I'll bet you were. Wow, all right, that's pretty good. I like the story of shipping the competitor the last one of the old model, rev 1 and then you come up with rev 2 and it goes out to production. That's pretty good. That's very good.

Magleby: I guess we could get in trouble for that.

Hendrie: No. That's the wonderful thing about doing oral histories that are 40 or 50 years after the time. It's a great story but nobody's going to get mad. All right, good. So do you remember what year you announced the sampling oscilloscope and gave the paper out? I'm trying to understand how long a period this was from when you got to Hewlett-Packard. In fact, you didn't tell us, do you remember what month you got in Hewlett-Packard?

B. **Magleby:** November.

Magleby: November. A good thing I got Barbara here.

 © 2009 Computer History Museum

Hendrie: Very good. Thank you for staying, please. And then when would you have had it in production and given the paper?

Magleby: Let's see. It would have been about a year later.

Hendrie: So maybe the next fall?

Magleby: It was the fall joint computer show where we went into the story. Yes, that was back in New York and that was in the spring.

Hendrie: The spring one was-- the spring joint computer conference was in New York.

Magleby: Well, actually, it was the instrumentation…

Hendrie: It was the instrumentation, yes, it wasn't the computer conference.

Magleby: Yes, so we took it back.

B. **Magleby:** Actually we got to Palo Alto earlier than that, Kay. I was mistaken. It was probably about early summer.

Hendrie: Okay. All right.

Magleby: So probably a year from then as well.

Hendrie: Yes, roughly. I just wanted to get some …

Magleby: And that was another thing that it was being developed much faster than the typical instrument because we were so excited about this new technology that we worked long hours and it accelerated the development.

Hendrie: Okay. By just working extra hours and very hard.

Magleby: Yes.

Hendrie: Okay. Now you were not yet going to school.

 © 2009 Computer History Museum

Magleby: Oh, yes.

Hendrie: You were in the program?

Magleby: I got in the honors program.

Hendrie: Was that sort of part of the deal getting hired there that they said they would send you?

Magleby: Yes.

Hendrie: Yes, okay.

Magleby: And they paid half the tuition and I worked fulltime so I got the regular salary.

Hendrie: Okay. So you were working long hours on the oscilloscope and also working on your Masters degree.

Magleby: Yes.

Hendrie: Wow, okay. I wonder whether now is a good time to ask what you were doing for your Masters degree? Does Stanford require a small thesis for a Masters degree? Or is that reserved just for people getting a Ph.D.?

Magleby: That was for the Ph.D.

Hendrie: Okay. So it was basically coursework.

Magleby: Basically coursework, yes.

Hendrie: Now, what was your course work focused in? Did you have particular area that-- you get more flexibility when you go for a Master's degree as to what courses you take?

Magleby: Yes.

Hendrie: So what were you taking?

 © 2009 Computer History Museum

Magleby: Well, I'm not sure it was all just in the Masters Degree program but I took all of the logic design and computer architecture classes that Stanford offered at the time.

Hendrie: Why did you do that?

Magleby: Well, I was interested in…

Hendrie: You just decided you were interested in it.

Magleby: Yes, well, when I was going to school at the University of Utah they brought in an analog computer in my senior year and we got to work with that a little bit. And as you know analog computers basically run operational amplifiers.

Hendrie: Right.

Magleby: So we were supposed to do a little project just whatever, you know, it ended up being like a mini thesis.

Hendrie: Yes.

Magleby: And so Bliss Law and I built an operational amplifier using transistors. And at that point transistors were brand new.

Hendrie: Yes.

Magleby: So that was when, I think, when I displayed my interest in computing at that point in time.

Hendrie: Okay.

Magleby: And then I just followed that interest when I was going to Stanford and took logic design. And Alan Peterson had a course on analog computer architecture, another one on digital computer architecture and that was it.

Hendrie: I was going to say and try to find a course on analog computer architecture now.

Magleby: And that was the only courses they had in computers.

Hendrie: Is that right?

 © 2009 Computer History Museum

Magleby: Yes. And then they had one course on logic design that taught you how to do Boolean algebra and do basic logic design.

Hendrie: Was that an engineering course or a math course?

Magleby: An engineering course.

Hendrie: It was an engineering course, all right. Do you remember who taught you that? That's a long way back.

Magleby: Yes, I don't remember, off hand.

Hendrie: Okay. All right. So you've all ready become-- even though you were working on computers at Hewlett-Packard you became just interested in them and decided that's what you wanted to study on your Masters program.

Magleby: Yes. And also for my Doctor's program too.

Hendrie: Okay. Well, now, let's see, should we talk about your Ph.D. program? Or should we follow up and go back to the sampling oscilloscope and then after that product was done and you had given your paper? What did you do next at Hewlett-Packard?

Magleby: Well, by that time I had finished my Masters degree. And let's see, I've got to think for a minute.

Hendrie: So you did it basically in one year?

Magleby: No. It took two years.

Hendrie: It took two years, okay.

Magleby: Anyhow when I finished up my Doctors degree I had to go one year fulltime to satisfy the residency work.

Hendrie: Okay.

Magleby: And once I finished that and got my Ph.D. degree, then I went back to HP Labs and was working on some sampling products, an effective volt meter and some of the things they used sampling technology. And I was very interested in seeing what I could use for some of the logic design and

architecture that I learned in Stanford. And so I talked to my boss Paul Stoft at that time. And asked him if I could work on making a computer that would be compatible with instruments? And so we started doing that work and we didn't get very far along with it until one day there was a call by Norm Schrock to prepare a presentation to the executive committee of Hewlett-Packard. He had been talking to Mr. Packard and asked him-- Packard was very interested in what the various engineers were doing. And so Norm Schrock told Mr. Packard that I was working on this computer study. And Mr. Packard got very interested in that. And so he had me and Norm Schrock put together a presentation to give to the executive committee of Hewlett-Packard which consisted of the Engineering Vice President, and the Vice President of Marketing and Finance and all of the executives of the company, Mr. Packard, Mr. Hewlett.

Hendrie: Okay.

Magleby: We weren't too sophisticated in preparing the presentation material. It was handwritten on flip charts and I had the diagrams and things to explain how the computer could be used with instruments, automated measurement systems and things like that. And the funny thing about that was, as I mentioned, I wasn't very good in English and I misspelled the word peripheral on one of my charts. And Mr. Hewlett pointed that out to me.

Hendrie: It must have been pretty funny.

Magleby: But anyhow after I finished my presentation usually the questions-and-answers start right away, but they were all silent. I sat down and the whole executive committee were I guess all thinking at that point in time. Mr. Hewlett got up and it was a big conference table and all and he was on one side and Mr. Packard was on the other side. And Mr. Hewlett got up and kind of put his hands in his pockets and walked all the way around the conference table and didn't say a word and he got back to where he started and he said, "I don't understand computers and I don't like them. And I don't think we should mess with them." And I remembered that comment.

Hendrie: Oh my goodness.

Magleby: And Mr. Packard asked Norm Schrock, my boss, he says, "Well, what are you going to have Kay do if he doesn't continue this work?" And he says, "Well, he can go back to doing work in sampling technology." And then he turned to Mr. Hewlett and he said, "Well, I think we ought to think about this. I think Kay's on to something." And they never did argue. I've never seen Mr. Hewlett and Mr. Packard argue.

Hendrie: Yes.

Magleby: And so I went back to doing my work on that. And the next thing I knew I was at home one day and I think on a Saturday or something and I got a call from my boss telling me that Mr. Packard wanted me to go to New York to meet with him there. And so of course…

 © 2009 Computer History Museum

Hendrie: To New York?

Magleby: Yes. And he'd been looking around for different acquisition opportunities to accelerate our getting into this field because there weren't very many of us who could even spell computer, especially peripheral.

Hendrie: Can I just do a pause right now because we need to change the tape. I don't want to have the tape run out.

Magleby: Okay.

END OF TAPE 1 / BEGINNING OF TAPE 2

Hendrie: We were… I think you had been invited to go to New York.

Magleby: Yes and Mr. Packard <inaudible>.

Hendrie: Did you have any idea why you were asked to go New York?

Magleby: Yeah, yeah.

Hendrie: What was that? What did they tell you?

Magleby: Well, he had been to see Digital Equipment Corporation because they had a small computer. And in fact I got one of their small computers, a PDP-5 and seeing how I could use it and interface to our computer, into our instruments, you know.

Hendrie: Oh really? So you had already purchased one of those?

Magleby: Yeah, yeah.

Hendrie: And so you had in the lab?

Magleby: Yeah, I had in the lab. And one of the reasons we decided to do our own was because it was so awkward to try to interface to, you know. They still got a bunch of logic modules and you had to design your own interfaces and their software wasn't good for it and so I said, well…

Hendrie: But it had a built in A to D [ph?] converter, a ladder network in the accumulator.

 © 2009 Computer History Museum

Magleby: Yeah.

Hendrie: Yeah. I mean they were trying to do something for-- instruments tying into instruments.

Magleby: Yeah, trying to, yeah. But they wanted to interface it to our Hewlett-Packard…

Hendrie: To a Hewlett-Packard instrument, yes, that would be very hard.

Magleby: Hewlett-Packard, you know, digital volt meter for example or a counter or, you know, programmable power supply even, you know. So if you wanted to put together an instrument system you had to have-- in fact that was a chart that I made, well one of the charts, my flip chart, was a computer in the middle and it had a whole bunch of different input devices which were volt meters and counters and other things that produced Digital's information.

Hendrie: Yes.

Magleby: On the other side of the chart was output devices, an oscilloscope. HP was actually developing a high speed printer at that time. And, you know, actually HP was in the XY plotting business and so…

Hendrie: Okay.

Magleby: So we had all of those things that were output devices and had input devices and in the middle was the computer. And they said, we have all of this but we don't have the computer. So that was the essence of my presentation.

Hendrie: Okay. Now did HP instruments have digital outputs that would be appropriate to connect out to the computer?

Magleby: Yeah.

Hendrie: I mean they weren't just free standing instruments, they had gotten beyond just making ones that, it's on the display, what's going on and that's it.

Magleby: Well in addition they had an output on the back that would give you that-- like a frequency counter is a digital thing, you know.

Hendrie: Yeah, right.

 © 2009 Computer History Museum

Magleby: A digital representation so they would put a digital representation output in the back of the frequency counter.

Hendrie: For anybody who wanted to connect up to that and build some special piece of equipment to connect there.

Magleby: Yeah.

Hendrie: All right.

Magleby: And so, you know, in order to connect that then to the PDP-5 for example you had to build an interface and DEC, Digital Equipment Corporation, their main business was logic cards and interface modules. In fact…

Hendrie: Right, yes. They wanted to sell you lots of those.

Magleby: Yeah, in fact that's kind of why they were in the computer business, you know, was so they could use their logic modules.

Hendrie: Right.

Magleby: So anyhow, to finish the story, Mr. Packard had been there considering the acquisition of Digital Equipment Corporation and he wanted me to come back there and talk to him about it and, you know. So, you know, when I came back to New York and met with Mr. Packard and we discussed this issue and I told him at that time, Digital Equipment Corporation was of course in this logic module business and they were developing what they called a flip chip technology where you had an integrated circuit, you know, to put upside down and ultrasonically mount it to the printed circuit board.

Hendrie: Right.

Magleby: So they had very simple integrated circuits but they were depending upon this flip chip.

Hendrie: Flip chip, yes.

Magleby: <laughs>

Hendrie: Flip chip, yes that's really hard.

 © 2009 Computer History Museum

Magleby: To be a key part of their design. And so I told Mr. Packard that I didn't think that was going to be a very enduring technology, but it was becoming obsolete, you know, the high density integrated circuits were coming along and I was exploring the ones that we could use and I thought that they would be better than that.

Hendrie: And there were ones that you could use.

Magleby: Yeah, yeah.

Hendrie: Okay.

Magleby: And so I think that was one of the key reasons why he decided not to acquire Digital Equipment Corporation.

Hendrie: Well, somebody should have told Ken Olsen what you told Mr. Packard because they never were ever to make them reliably.

Magleby: Yeah. So, then I came back home and a little while later I got a call saying he wanted me to go to-- I guess it was Michigan wasn't it, where I went?

Hendrie: Yes. I think it was Michigan because I think I know what's going to happen next.

Magleby: Well anyhow this group was working a small computer. It was being done by Union Carbide, a division of Union Carbide. And Union Carbide had decided they weren't going to go forward with their project. And so I don't know how Mr. Packard got in touch with him but anyhow we stopped by and we looked at the technology they had and they were building their computer of high density integrated circuits, which is what I thought the way it should be done. And it was about the right capacity for what we would do. So we recommended that he acquire technology from Union Carbide.

Hendrie: Wasn't it DSI [Data Systems, Inc.]?

Magleby: Yes, DSI.

Hendrie: Yes.

Magleby: That was a division of Carbide at the time.

Hendrie: I think it had started independently and run quickly into financial troubles and then somehow gotten attached to Union Carbide to pay the bills.

 © 2009 Computer History Museum

Magleby: So anyhow we acquired it and then Paul Stoft and I went back and met with the engineers and interviewed them, met with Sam Irwin who was the President of DSI and came back. And then again a presentation to an Executive Committee meeting where Paul and I presented the proposal and we acquired DSI. And I think Mr. Packard continued to negotiate. So, Sam Irwin came out and he and I met with Mr. Packard and so I was very much involved in that acquisition.

Hendrie: Oh, wow. I didn't realize that.

Magleby: And after the acquisition then we had the key engineers come out to work for Hewlett-Packard and under my direction. And then we also added some other local area engineers. Dick Reyna was involved in some systems work.

Hendrie: Dick who?

Magleby: Reyna.

Hendrie: Okay, Dick Reyna? Okay.

Magleby: Yes. And he was the one who helped us with the design of our input/output structure. And one fellow named Arne Bergh was involved in magnetic technology and of course our early computers had magnetic core memories. And Ed Holland was involved in logic design so we had him participate in the design of the central processor. And then we merged them together with some engineers from DSI to form the computer design group that I was managing.

Hendrie: You were in charge of it?

Magleby: Yes, I was in charge of it.

Hendrie: Okay. Now do you remember the names of the people that came from DSI?

Magleby: Yes, yes.

Hendrie: Okay. Who were they?

Magleby: Well, John Koudela came.

Hendrie: Yes.

 © 2009 Computer History Museum

Magleby: And he was more in application engineering. He was the one who that helped DSI decide which applications to go after. But he also had a pretty good understanding of computer architecture. And so he came out and Sam Irwin was hired on as a consultant and he reported to me as consultant.

Hendrie: I'm going to ask you for some Sam Irwin stories because I know he's an amazingly colorful character.

Magleby: Bob Gray was a computer member guy and so we brought him out. I guess, Gene Stinson was also a mid logic designer. We got him. In each of the key elements we had one guy from Hewlett-Packard, one guy from DSI.

Hendrie: In each of the key areas.

Magleby: Yes.

Hendrie: Now who was the project engineer on this computer at DSI? Who came up with the architecture?

Magleby: Oh, Sam Irwin came up with the architecture.

Hendrie: Okay, Sam Irwin conceived the machine. He would be viewed as the architect and the lead designer.

Magleby: No, they had a lead designer too, but Sam was the one that did most of the-- I forgot what his name was, but I don't think he came out with us for some reason.

Hendrie: All right. So the lead designer did not. The principal logic designer did not.

Magleby: Yes yes. Well, and Gene Stinson [ph?] was one of the guys that was involved.

Hendrie: Was one of them, okay.

Magleby: Yeah.

Hendrie: All right. Good. Well that's very interesting.

Magleby: I've got kind of a funny story about Sam Irwin.

 © 2009 Computer History Museum

Hendrie: Oh, good. I'm ready for a Sam Irwin story.

Magleby: He was consulting for me and so he came out from Ann Arbor and gone to get his car and drive down to Palo Alto and we'd have our meetings and then he'd go back. Well this one time when he was going back to the airport, he came out and got in his car and drove to the airport and when he got to there he realized that it wasn't his rented car, the key had apparently worked <laughs>…

Hendrie: In somebody else's car?

Magleby: Yeah, it was a rented car, but it was, you know-- a Hertz Rent-a-Car. But I think there was, you know…

Hendrie: Wasn't his.

Magleby: It wasn't his. So, you know, he was kind of late to get his plane and all and he didn't wanted to mess around. So he just walked into the Hertz counter, threw the keys on the counter and <laughs> <inaudible>.

Hendrie: Got in the plane and never confessed that-- even though he knew he was in the wrong car.

Magleby: Yeah. So I thought that was kind of funny.

Hendrie: Yes, that is pretty funny. Wow. Okay.

Magleby: So anyhow we put this group together and we were very-- Sam actually helped come up with the architecture and John Koudela also contributed to it. But I was responsible for putting it all together and making it, you know, integrating it and overseeing the design.

Hendrie: Now wasn't the DSI machine that they were-- did they ever actually finish the machine at DSI because I have a brochure actually which I've given to the museum for the DSI machine. They were advertising. Whether they were shipping I don't know, but they were advertising.

Magleby: I don't know whether it's the same one or not because they had another one, an earlier model.

Hendrie: An earlier model.

Magleby: Yeah, that they were in production with and, you know, so they actually had a functioning business.

 © 2009 Computer History Museum

Hendrie: Okay. All right. I'm sure it was the earlier model then. I mean it must have been.

Magleby: I would think so because they couldn't announce this thing, they weren't very far along with it. And it was more conceptual at that point.

Hendrie: Okay. And I sort of remember it was a 12-bit machine, not a 16-bit machine.

Magleby: No, this was a 16-bit I think.

Hendrie: The one they were working on that you bought.

Magleby: It might have been a 12-bit machine.

Hendrie: I'm thinking the machine that I have the brochures on I believe was a 12-bit machine.

Magleby: And the more I think about it, I think it was a 16 bit-- I mean a 13, a 12-bit machine.

Hendrie: Okay.

Magleby: Yes, I think it was. You know, if you can get me a copy of the brochure I can tell you. <laughs>

Hendrie: I'll bet I can figure it out too, if I get a copy. I just don't remember now. I should have brought it with me.

Magleby: One of the things that was wrong with their prototype was that they used the Motorola integrated circuits and they have a tendency to be unstable.

Hendrie: Oh really? The early Motorola ones were unstable?

Magleby: Yes.

Hendrie: Now this is in an era of simple integration. I mean, you know, maybe two flip flops in a package or in four gates or something like that, yes.

Magleby: Yeah. And they had what they call Motorola emitter-coupled logic.

 © 2009 Computer History Museum

Hendrie: Oh, I remember that.

Magleby: MECL they called it.

Hendrie: Yes.

Magleby: And if you didn't get your printed circuit boards laid out just right and, you know, impedance just right they would oscillate. And that wasn't very good for a computer.

Hendrie: That isn't very good at all.

Magleby: And then of course we wanted to have a computer that could work over a wide temperature range because it could work in the same environment the instruments could.

Hendrie: Yes, you needed to match the environment specs of the instrument product.

Magleby: Yes. And so that's very difficult over a wide temperature range to keep it from oscillating. So then we decided to use the Fairchild integrated circuits.

Hendrie: The Fairchild diode transistor logic?

Magleby: No, complimentary transistor logic.

Hendrie: Oh.

Magleby: CTL.

Hendrie: Oh, CTL? Okay. All right. Very interesting. Well the MECL was very fast though wasn't it?

Magleby: It was fast.

Hendrie: Isn't that what I remember?

Magleby: Yes, it was…

Hendrie: That was the thing about them -- it was one of the fasted logic families.

 © 2009 Computer History Museum

Magleby: I think it was the fastest logic family, yeah.

Hendrie: Yes. Okay. All right.

Magleby: When I met Les Hogan was I went down and talked to him about it, when we were trying to select our integrated circuit that we were going to use. And they had me come down to Motorola and talk to their engineers and they introduced me to Les Hogan at that time.

Hendrie: Oh, that's nice.

Magleby: Yes. So then also another story about the selection of the Fairchild product was that one of our component engineers didn't really like Fairchild because they had some problem with some products, not their integrated circuit, it was something else. And so he was trying to talk me out of using Fairchild.

Hendrie: Okay.

Magleby: And the Motorola product you know, I thought it wasn't the right one to use and so anyhow I guess he must have talked to Mr. Packard about it and Mr. Packard came and talked to me about it. And I told him, well I think they might have to adopt their purchasing agreements because I think this is the right technology to use, you know. And so I went to the component engineer and told him, "Well, do as Kay says." <laughs>

Hendrie: Oh that's great. That's good. That's a good story. How did you make the decision to make the machine that you were building? I assume the machine that this group was heading up would turn out eventually to be the 2116.

Magleby: No, it didn't have the right. The architecture was totally different.

Hendrie: Oh, really? Okay. So this is a completely different machine.

Magleby: Yes.

Hendrie: Okay. All right. Well then keep going with the story. I'm not going to ask you how you decided to make it 16-bits because that isn't appropriate yet. I'll ask you later.

Magleby: Well I can go over that a little bit because we had this team we put together, you know.

Hendrie: Yes.

 © 2009 Computer History Museum

Magleby: And we had some of the guys from DSI and some guys from Hewlett-Packard and so we started to figure out what it was we were going to do, you know. Because I had some ideas and they had some things. So we had regular meetings and every day we'd come back and talk about it and then the next day, John Koudela would summarize what we had for that day. And he was kind of the note taker, you know. And he was also knowledgeable about computer structure, you know. So this went on for, oh probably several months anyhow. And we would talk about the different applications and what kind of input/output structure we would have to have and what were the requirements basically, you know, going through the various things that were important. And, of course the way it interfaced with instruments was important. And as I mentioned before the amount of computing power that we needed for the applications that we anticipated. So how fast that would have to be. And so then we put together the detail specifications and started to design it.

Hendrie: Okay.

Magleby: We had people in each one of the groups participate in this…

Hendrie: In working out the…

Magleby: …working out the specifications.

Hendrie: Yes, so your group sort of worked through…

Magleby: The structure.

Hendrie: …the structure and the architecture and some of the fundamental questions. Now did you look at any of the competitive machines that are out there? I think there was-- I think 3C had the DDP-116 was out by then.

Magleby: Yes, we looked at them. I think for some reason, you know, we rejected each of them.

Hendrie: Yeah.

Magleby: And we felt that our contribution was easy to interface with hardware and software and environmental specifications.

Hendrie: Okay. I was wondering if you looked and stole any ideas from them. I mean that's a, you know.

Magleby: No, I don't think we got any ideas from them.

 © 2009 Computer History Museum

Hendrie: Yeah. Okay. You had already had your ideas...

Magleby: Yeah.

Hendrie: The group had all the basic ideas about mini computers.

Magleby: Yeah. Collectively we…

Hendrie: Collectively, yes. Now was there a software person on this group?

Magleby: Not on the initial one.

Hendrie: Not on the initial one.

Magleby: We had gotten into the design and then we decided well, we better get our key software guy. And John Koudela had some software background, like I mentioned before.

Hendrie: Okay. Yes.

Magleby: And so he I guess gave us some software requirements that we put into…

Hendrie: He represented the software point of view.

Magleby: Yes, yes.

Hendrie: Okay. During these discussions.

Magleby: Yes. But anyhow we had hired Roy Clay who was a manager of our software group at that time. And, you know, Roy helped hire the people to form the group and…

Hendrie: Okay.

Magleby: And it was kind of interesting, one of the things we had in our original architecture was a variable length instruction. Because often you have an instruction that didn't have to have it very far removed from where it was to…

Hendrie: Yeah, you didn't need to use very many bits for the address.

 © 2009 Computer History Museum

Magleby: Yeah, yeah.

Hendrie: You could do relative addressing or something like that, yes.

Magleby: Well anyhow, it was a variable instruction. It was one that we had sort of had come up with, you know.

Hendrie: Yeah.

Magleby: And actually were starting to do the logic design of it when I hired Roy. I think we had our first bread board running.

Hendrie: Oh wow. Okay.

Magleby: And Roy said, "Well, that's interesting and it is a little bit more efficient, but it would be terrible to develop the software for it because you're optimizing instructions to use for what?" you know. And so we had a long go around about that. I guess we all discussed it and it was one of the most controversial things that he had to do at that point in time. And so I decided well we have to look at the overall problem…

Hendrie: Yes, right.

Magleby: …and consider the software as well. So that's when we changed addressing structure.

Hendrie: Well that's a good story.

Magleby: And the guy that had the biggest job was Gene Stinson who was our principal logic designer, you know. And when he…

Hendrie: Yes. He had to go and redesign all the…

Magleby: Yes.

Hendrie: …at least all the instruction decode and some of the control.

Magleby: Yeah, exactly.

Hendrie: Wow.

 © 2009 Computer History Museum

Magleby: So that was a very major change at that point.

Hendrie: Yeah, that would be.

Magleby: And he did it, you know, very, very adeptly, so he did a good job on that.

Hendrie: Excellent.

Magleby: We were able to make that change and not lose too much time.

Hendrie: Okay. All right. So…

Magleby: Well then I guess, you know, carrying forward well we completed the design of the first computer, the 2116 and we got it into production. And…

Hendrie: Well now, excuse me. Can I roll back for just a second?

Magleby: Sure.

Hendrie: Now you said that you had done this work and eventually it was this machine that the team was working on that you got to a prototype, but that you had said something a little while ago that this wasn't the machine that actually became the 2116.

Magleby: No.

Hendrie: Oh I must have misunderstood you.

Magleby: No it was, you know, because we evolved some but that was the beginning of the 2116.

Hendrie: Okay. So this machine. It evolved as you worked through some of these problems.

Magleby: Yes.

Hendrie: You got Roy on and that would have changed some of the addressing structure and things like that.

Magleby: Yeah. But that was the basic…

 © 2009 Computer History Museum

Hendrie: That was the basic 2116.

Magleby: Yeah. It came out of this committee.

Hendrie: It came out of this committee. Okay. Yes. All right. Well that's good.

Magleby: And we had…

Hendrie: Now so I want to go back to my question about 12-bits versus 16-bits. Do you remember when you decided to make it a 16-bit machine?

Magleby: It was right from the beginning.

Hendrie: Right from the beginning. Okay. All right.

Magleby: Yes, that was part of the discussions that we had.

Hendrie: Yes. Okay. When you started out the discussions, that was one of the things you decided relatively early.

Magleby: Yeah, yeah. Because the PDP-5 which was the Digital Equipment Corporation computer that I had in the lab to work with was a 12-bit machine.

Hendrie: Right.

Magleby: So we decided that one didn't have enough power for the applications.

Hendrie: Yes. For the applications, okay. I think eventually everybody decided that. You know, Digital did very well with 12-bit machines for years and years, but the eventually had to come out with a 16-bit one, with the [PDP-]11.

Magleby: Yeah, yeah.

Hendrie: So I think everybody arrived at that conclusion one way or another sooner or later.

Magleby: Yes. The PDP-8 had the same command structure as the PDP-5 did.

 © 2009 Computer History Museum

Hendrie: Yes. It was fundamentally reimplementation of the PDP-5 architecture.

Magleby: Yes.

Hendrie: With a few changes.

Magleby: Yes.

Hendrie: A couple of things.

Magleby: But also the technology was different, you know.

Hendrie: Yes. All right. Okay. So this was the 2116. I somehow didn't understand exactly. So basically the machine that DSI was going to build out of integrated circuits when you went and looked at them and eventually decided to buy the company and bring the team, you formed this team with a Hewlett-Packard and a DSI person in each of the areas. And then you worked on what was going to be done and essentially abandoned the design that they had started at DSI for their second machine-- their integrated circuit machine.

Magleby: Yes, we had never intended to put that in production.

Hendrie: Okay.

Magleby: Then they had a prototype of it, a bread board and they shipped it out to us and we put it in a corner of the lab and never did anything with it after that.

Hendrie: Okay.

Magleby: Because, you know, they use this MECL technology, so really what we got from the acquisition was the good engineers.

Hendrie: Okay. They got four, yeah, they got the good engineers that came and stayed.

Magleby: Yes.

Hendrie: Except for Sam.

Magleby: Yeah, well.

 © 2009 Computer History Museum

Hendrie: Did Sam make any contributions to the HP…

Magleby: Yeah, yeah, he participated in these discussions we had.

Hendrie: Okay.

Magleby: And, you know, he had some ideas that we put in.

Hendrie: Okay. All right. Good.

Magleby: I wanted to come back to another story…

Hendrie: Good.

Magleby: …that when we got the first computer starting to work it was around Christmas time. And Barbara had mentioned earlier that Mr. Packard had the habit of walking around when we were busy, you know, and just walk around the laboratory to see what's going on. And so he had what they call, management by walking around. And so one day when Gene Stinson was working on the computer just before Christmas…

Hendrie: Prototype? This was a prototype that's up and working?

Magleby: Yeah, it was working. And he had just got it working and he had a little program that you could type something in and it would type it back out, you know. It was the teletype.

Hendrie: Yes.

Magleby: And so that was sort of the first operating thing he was experimenting with and he had a little program written to do that. And he just typed in something, said, "Merry Christmas Bill and Dave. I hope that our new year is as prosperous as yours will be," you know. And he had that typed in and about that time, Mr. Packard walked up behind him and printed that out.

Hendrie: Oh.

Magleby: So Gene was kind of embarrassed about that. And I think Mr. Packard, you know, picked up the paper and looked at it and said, "Well I hope so too." <laughs>

Hendrie: That's good.

 © 2009 Computer History Museum

Magleby: And I think that maybe is a good time to come back to the thing about when Mr. Packard was coming with a first walk we were walking in to see Paul Stoft when we started the whole program, you know.

Hendrie: Yes.

Magleby: And again, that was because he had a habit of walking around the various, you know, parts of the company and to see what's going on. <cell phone ringing>

Hendrie: All right. We're back on. Can we go back just a couple of sentences or just a little bit so it segues nicely?

Magleby: Okay. Well we were talking about Mr. Packard's managing by walking around.

Hendrie: Yes, walking around. Right.

Magleby: Often when I'd be there working on the weekend or something, he would come and I had my desk and then I had on that side it was the conference table, you know. And he'd come down and sit down on the conference table and just visit with me for a while, you know, see how things are going. And usually that wasn't during normal working hours. I'd be in there and he'd be in there for some other reason probably.

Hendrie: Yes.

Magleby: So that, you know, he was very interested in following the design.

Hendrie: Okay.

Magleby: And he also gave it very high priority to the company. And so if I needed something, you know, we had the printed circuit board group to make their circuit boards. We had the group that designed castings for example.

Hendrie: Yes. For the mechanical.

Magleby: Mechanical things. So he had, you know, Ralph Lee who was the Vice President of Manufacturing and been told to, "Whatever Kay wants make sure he gets it," I guess, you know. So I really was able to high speed things through. But without that priority we wouldn't have been able to do it. So I think that's a very important part of the whole program was the commitment of the top management so that you could get things done.

 © 2009 Computer History Museum

Hendrie: Okay. Very good. All right. Yeah, so that obviously helped that he was sold that this was something worth doing?

Magleby: Oh, yes. And he was very helpful and would call me up every once in a while and have me come up to just visit with him.

Hendrie: Okay. Now this is all after he got to know you when he and you had been out to New York and then you'd been to Michigan to look at the…

Magleby: Yes, but I was well known for my work on the sampling technology as well.

Hendrie: Ah, yes.

Magleby: And Mr. Hewlett was the one that signed my Master's degree because he was on, you know, the Chairman of the Board of Directors at Stanford I guess is what they called him.

Hendrie: Really? Well that's pretty nice.

Magleby: And when I got my Master's degree, at that time Mr. Packard was back in Washington, you know, on the Deputy Secretary of Defense. So Mr. Hewlett was the one that handed me my degree when I got my Master's degree. (this is inaccurate; Packard didn't go to Washignton as D Secy until four or five years after Kay's PhD) Well, when Mr. Packard came back and got to be the Chairman of the Board or whatever it was-- it was Board of Trustees I guess it's called.

Hendrie: Yes.

Magleby: And so he's the one that signed my PhD and he's the one that handed it to me.

Hendrie: Oh wow.

Magleby: So I, you know, I was well known by both Mr. Hewlett and Mr. Packard, you know.

Hendrie: Okay.

Magleby: It's due to my successful work on the sampling oscilloscope. In fact, Mr. Hewlett also practiced management by walking around. Not as much as Mr. Packard did. But one day when I had my desk-- and at that time I had a lab bench behind it and I was working on a bread board model for the sampler. You know, it was after hours and I was working sitting there writing on my lab notebook. And

 © 2009 Computer History Museum

Mr. Hewlett came by and when I went to set my soldering iron down I missed the little tray thing, you know, to put it in and it was laying on top of my workbench and it was starting to smoke. <laughs>

Hendrie: Oh. Oh.

Magleby: He came over and he said, "Well I think you better look or turn around and look and see what's going on on your workbench." And then he handed me my soldering iron.

Hendrie: Oh, that's funny. That really is. Wow. Okay.

Magleby: Well anyhow I guess maybe that brings us to some of the applications that we had for the computer and some of the interesting things we had in the actual marketing of it.

Hendrie: Okay. Yes, I'd be very interested.

Magleby: Because we were in the DYMEC division at that time which was in the business of making data acquisition systems.

Hendrie: Okay. Now you were not in R&D? When did you move from R&D, corporate R&D to…

Magleby: Oh that was shortly after we got the people from DSI.

Hendrie: Okay, so when the people came from DSI they put the whole thing in the DYMEC division.

Magleby: Yeah.

Hendrie: Okay. All right.

Magleby: And we had a separate area, it was hardware design.

Hendrie: Okay.

Magleby: And then we got the software designers coming we didn't have enough space. So we got one of these mobile offices, you know?

Hendrie: Oh wow. Yes. Okay.

 © 2009 Computer History Museum

Magleby: We set that up in the parking lot. So that's where Roy Clay was and he had his own-- had his software guys working out there.

Hendrie: Okay.

Magleby: It would have been better I think if we'd been all in one-- you know, at least adjacent to one another. But…

Hendrie: There wasn't enough space.

Magleby: Enough space.

Hendrie: Okay.

Magleby: But they just took a portion of the factory actually and walled, you know, partitioned it off from where were in the DYMEC factory.

Hendrie: Oh. You mean in terms of when it got to the point of making the...?

Magleby: No, when we did the design.

Hendrie: Oh, the designers were just in a portion of the factory. Okay.

Magleby: Yeah, partitioned it off from the factory, yeah.

Hendrie: Okay.

Magleby: Oh and another thing that I should mention was during the design we had to…

Hendrie: Oh, why don't we pause? Remember what you were going to say. I'm going…

END OF TAPE 2 / BEGINNING OF TAPE 3

[audio begins abruptly]

Magleby: …one other aspect I think I should cover at this time and that is putting the product into manufacturing.

 © 2009 Computer History Museum

Hendrie: Yes, that would be very good.

Magleby: There almost always is a conflict between manufacturing and engineering, you know. And engineering wants to-- think they're done and manufacturing says, "Well, the design doesn't work." And we had a very good situation because there was a guy named Frank Wheeler who was a retired Navy Captain and he was the manufacturing manager for the Dymec Division and he wanted to work-- he and I got to be good friends and he wanted to work closely with engineering. So he had a couple of his technicians working with right in-- as part of the design group and also were directly involved in writing up all the test procedures and things like that. And as we were developing our prototypes and all, he was working on how to set up the manufacturing line and everything and staffing it as well so that when we got something ready to go into manufacturing it just "Whoosh".

Hendrie: Okay.

Magleby: So he really contributed to getting the product into manufacturing and reliable.

Hendrie: Good.

Magleby: So then after we introduced the product…

Hendrie: Now what year are we, do you remember?

Magleby: Oh dear. The fall joint computer show that…

Hendrie: But which fall.

Magleby: Let me look at my resume and I can probably figure it out.

Hendrie: Oh, okay. Wait a second. I think I can figure that out from your resume. Yeah, no, it's not clear exactly.

Magleby: I think I can…

Barbara Magleby: <Inaudible> '64 or '65.

Magleby: See I got my PhD degree in '64…

Barbara Magleby: Three. It was probably in '64…

 © 2009 Computer History Museum

Magleby: Sixty-four.

Barbara Magleby: …in June of '64.

Magleby: Yeah, so probably '66 I would guess. [1966 is correct]

Barbara Magleby: Sixty-six?

Hendrie: Okay. All right. Good. All right. Sixty-six, that looks right. I mean that seems…

Magleby: That fits into this _____.

Hendrie: That seems to fit in nicely, yes. Okay.

Magleby: Let's see if I can try to figure out where I was.

Hendrie: Well you were talking about manufacturing and then you had said that you thought maybe it would be good to talk about some of the early applications of the-- some of the first sales of the machine.

Magleby: Yeah.

Hendrie: And I'd be very interested in that.

Magleby: So anyhow they-- we-- I'm trying to figure out how to word this. But anyhow, the Hewlett-Packard-- or the Dymec marketing people were very interested in restricting it to just to use with their instruments, you know. When I wanted it to be a general purpose application, you know. And we designed the computer to be a general purpose computer with features that made it useful for instrumentation, but it would compete on its own with any of the other mini computers that were out. And that was our goal and our strategy. And the Vice President of Marketing for the company, Noel Eldred was very uncomfortable with that because he-- they'd have to develop a whole new marketing team you know, to do that. And so they had it in the Dymec Division and the marketing manager for the Dymec Division was of course following Noel Eldred's advice in trying to restrict the marketing to the very narrow aspect of it. And anyhow Mr. Packard told Noel Eldred and the word came down to the Dymec marketing group that he wanted to have a separate set of marketing sales people, not a whole separate sales force, but to have specialists to go out and sell the computer.

Hendrie: Okay. Not just your average instrument salesman.

 © 2009 Computer History Museum

Magleby: Yeah, yeah. And I remember we were-- I had gone up to the board meeting, board room and had a meeting with Packard about that. And the marketing manager from the Dymec Division was there and Noel Eldred was there and we had a fairly lengthy discussion. And Mr. Packard said the he wanted to have the marketing-- you know, the sales experts or the sales specialists, I guess. And that was kind of a conflict that we had. But Noel Eldred had an interesting, which I think was a useful one, it was called Noel Eldred's trouble graph.

Hendrie: Okay.

Magleby: Have you heard of that?

Hendrie: No, I don't know that. Okay. I'd like to hear about that.

Magleby: He had-- the vertical axis was changes in technology and the horizontal axis was changes in markets.

Hendrie: Okay.

Magleby: And so he said, if you move one over on the change of markets was a trouble of one, you know. And if you build one up in engineering-- or I mean in technology it would be trouble of one. And if you moved…

Hendrie: Both at the same time?

Magleby: Both at the same time. And it was big trouble.

Hendrie: Yes, okay. That makes sense.

Magleby: And so that-- so with his guidance then we said, okay we can have our goal to be in the general purpose mini computer business but let's do it in two steps. We'll start off with serving the instrument market, that's the trouble one. Now we can move our axis over and we can go up in the mini computer market and still have trouble one, you know.

Hendrie: Yes, okay.

Magleby: But if you do 'em both at once…

Hendrie: Yeah, big trouble.

 © 2009 Computer History Museum

Magleby: Big trouble. So that was the basic strategy that was developed. And so if you look at some of the earlier papers and things that were written and they're focused very highly on the instrument market. In fact, the paper that I wrote that I showed you, you know, you'll see that's in there because that was one of the things that was differentiating us from the other people. But we designed the product so that it could be used in other markets as well. And after we introduced it and the first-- next conference when we had some instruments to talk to about it and all. And then the next conference when we were looking around for something new to do so John Koudela and I had an under the table project that was going on…

Hendrie: Yes. Okay. Right.

Magleby: …to make it a basic time sharing system where you could run up to 16 simultaneous terminals.

Hendrie: Okay.

Magleby: And it could be expanded beyond that if you wanted to. So they were looking around for something new to take to the show and I said, "Well, how about this time sharing system?" you know. So, you know, then the marketing people said, "Well, let's do it." And so we had the thing, the prototype working in, you know, in our software lab work. And it had a couple of times where it had failed. And so we thought well, the interface between the disk memory and the computer was having a problem and we found out if we just taped off one of the connectors on the circuit board and we put it-- and the problem went away. And so, you know, it was in the-- some of the timing, you know, was wrong. So anyhow we did that and it ran for two days in our software lab without crashing. And we said, "Okay. It's okay. We can take this one back to the show."

Hendrie: Yeah.

Magleby: And at that time too, all the other people that had time sharing systems, they had their terminals but the computer somewhere else and they had-- they interfaced through the telephone lines.

Hendrie: Yes, over telephone lines.

Magleby: And so they had the modems that they would use.

Hendrie: Right.

Magleby: So just before it got back to the show they had a big strike and they couldn't get telephone service to the floor.

Hendrie: To the floor?

 © 2009 Computer History Museum

Magleby: To the floor. So we had our of course, our computer was there. And so we had 16 terminals and they all worked and everybody else could just talk about theirs but they couldn't demonstrate it, you know.

Hendrie: Oh my goodness.

Magleby: So we had people working, sitting at those terminals all through the show and it worked just perfectly, you know.

Hendrie: Oh, that's wonderful.

Magleby: And then we brought it back to the lab and the second day it was there it crashed. And it didn't have anything to do with the terminal being taped off; we found the problem somewhere else. I forget where it was.

Hendrie: Another problem.

Magleby: That was why it was crashing.

Hendrie: Oh my goodness.

Magleby: We never really fixed the problem.

Hendrie: Oh, you just thought you did.

Magleby: So anyhow.

Hendrie: That's a good story, very good.

Magleby: So then when we first introduced it, for the first year we had, you know, a lot of ideas on how they could put them together to make instruments systems with it. But we didn't have all the software and stuff for the application. We worked with the group in Avondale in their-- oh-- the Microwave Division, we worked with Paul Ely in microwave <inaudible> it would be used-- the computer. And we put the computer in a data acquisition system. And it was a gas chromatograph system that was in Avondale, Pennsylvania and we had them using that computer for that, you know.

Hendrie: Okay.

 © 2009 Computer History Museum

Magleby: But that all takes time. And so by the end of the first year, we hadn't really sold very many. Most of our sales were internally to our own divisions, you know.

Hendrie: Oh, which would then use the-- yes, for the development…

Magleby: No.

Hendrie: …of an application, yeah.

Magleby: Yeah, they would sell-- that would be part of the system they would sell, you know.

Hendrie: Yes.

Magleby: And so Mr. Packard wanted to look into it and see what was going on. So he organized a meeting where he had all of the regional sales managers come and the people from the divisions that were working on the applications come. And we had a whole bunch of people in this meeting anyhow, probably maybe 50 or 60 people. And so we decided that, you know, our engineering decided we would put together a system that would satisfy each of the basic problems that we're talking about and set it up in the conference room. So when they talked about the problems we could just demonstrate that we had a solution to that problem, so they should be able to go out and sell it now, you know.

Hendrie: Right.

Magleby: For example we didn't have our little high speed A to D converter in our voltmeters, you know. So we found a real good one that we could interface and expose some new markets for it, you know.

Hendrie: Yes. Okay.

Magleby: So we were able then to demonstrate for each one of the areas that they had a problem that there was a solution to it. But it didn't-- the night before the meeting that we had we put all the systems around, you know, in the conference room.

Hendrie: In the conference room, yes.

Magleby: And one of the things was-- on one of the systems that was-- had a magnetic tape recorders. Hewlett-Packard by that time was making their own magnetic tape recorders and the tape recorder failed. And I had this one engineer, he wouldn't let anything stop him, you know.

Hendrie: Yes.

 © 2009 Computer History Museum

Magleby: And-- Steve Porter was his name, yeah.

Hendrie: Okay.

Magleby: And we were at home and I got this call from the night watchmen at the Dymec Division and he said, "There's this guy that's climbing over the wall-- or the fence into the stockroom and he said that he works for you." <laughs> I knew it was Steve Porter.

Hendrie: Yes.

Magleby: And he had gotten. He needed to replace the motor in the tape drive to get it to work. So he had gone down there and climbed over the fence to get…

Hendrie: Into the stockroom…

Magleby: Into the stockroom…

Hendrie: …to get the motor out.

Magleby: …to get the motor. <laughs>

Hendrie: Oh my goodness.

Magleby: So I told him, yeah, he worked for me and authorized him to be in the stockroom. <laughs> And he got it fixed and it worked.

Hendrie: Really?

Magleby: Yeah.

Hendrie: Wow. That's good.

Magleby: Oh and another thing when it wasn't selling too well, we had a little game we played with the Dymec marketing group. We took one of our computers and attached it to a teletype and had a little program written that would about 20 minutes or a half hour it would type out a little message, "I'm a 2116. I can do this and that. Where is my customer?" <laughs>

Hendrie: Oh that's bad. You were harassing them.

 © 2009 Computer History Museum

Magleby: Yeah.

Hendrie: So in the first year there were problems in sales Do you remember how many you sold in the first year? Do you remember any of the numbers?

Magleby: I don't remember the numbers but it was probably in the order of 100, you know, maybe less.

Hendrie: Okay.

Magleby: But then after that it just took off, you know, because all these things started coming together.

Hendrie: Yeah, all this work with the various instruments.

Magleby: Yeah. And also the sales people didn't have any more excuses, you know, because we had solved all the problems that they said they were having trouble selling.

Hendrie: Okay. Good.

Magleby: And another-- but maybe I'm coming back to the marketing side. But Hewlett-Packard had a-- they put together a van with some of their instrument systems in it and the computers in it, you know, and drive around to the various major customers and demonstrate it. And one of the customers was the-- at the atomic energy site in-- near Arco, Idaho where they had... And my uncle George Huff was in charge of one of the major areas out there that used the computers. And so we brought the computer there and demonstrated it to him. And he said, "Well, I want you to talk to my computer expert because, you know, I don't know too much about computers." So he went and got the IBM computer salesman. And I had to convince him that my uncle should buy the computer and I did. <laughs>

Hendrie: And I did. Oh that is funny. That's very good.

Magleby: Yeah, then, you know, following that there were a lot of applications that didn't require as much power as our 2116 and in particular didn't require as much computing capacity, for smaller systems. So we developed what was called the 2114, which was the same command structure and everything, so all the software would run on it but it only had eight I/O slots. The way we interfaced things is we have a slot and then the interface card would plug into that slot for a particular device and then it had-- connected on the front of it as well.

Hendrie: Wow, okay, which went to the device, yeah.

Magleby: Yeah, which went out to the device. And then we had-- the software was structured so that instead of having an operating system for each configuration, which was the conventional way at that

 © 2009 Computer History Museum

time, we had a core operating system and then a driver for each one of the different types of devices. So if you wanted it interfaced to a voltmeter, you plugged in the voltmeter interface, load this voltmeter driver and you're off and running. But that wasn't the case at all in any other computers that was available at that time.

Hendrie: Good. So that was the follow on machine. I notice there's a 2115 also.

Magleby: Yeah.

Hendrie: What was that?

Magleby: Well a 2115 was the first smaller one. And then 2114 was the first smaller one and then the 2115-- 15 was the first smaller one and the 14 was…

Hendrie: Was the second one.

Magleby: The second one, yeah.

Hendrie: Okay. The 2115 was literally just-- I mean all of the same boards in the card cage was just _____.

Magleby: Yeah, just change the card cage.

Hendrie: Just change the card cage. And then the 2114 did you redesign some of the boards?

Magleby: No, no.

Hendrie: No? It still used the same boards?

Magleby: A lot of them, yeah, yeah.

Hendrie: Yeah? Okay.

Magleby: So then the next project I was working on was this Omega project I mentioned.

Hendrie: Yes.

 © 2009 Computer History Museum

Magleby: And so we then were looking for a more powerful computer language we concluded it should be a 32-bit machine.

Hendrie: Okay.

Magleby: And it had very efficient stack, architecture so you could very easily change from one application to another and you could have what's called re-entrant software which we couldn't do very well with our 2116 structure. And I got one of the early results of-- proposal of that and I forgot to bring it.

Hendrie: Oh, that would be very interesting.

Magleby: I didn't know whether you would be interested in that or not.

Hendrie: Yes. Yeah, I think we would be.

Magleby: So that's about the time that I left HP. And so they departed quite a bit from what you will see on that early proposal.

Hendrie: _____ Yeah. Yeah. So the Omega project, did it get cancelled and then restarted as the 3000 or how _____?

Magleby: Well I think it evolved into the 3000.

Hendrie: It just evolved into it, yeah.

Magleby: Yeah, of course they had to make some changes when they went to a 32-bit, you know. I guess, they cut it back to a 16-bit machine I think, you know. And that was one of the problems they got because, you know, we were looking at applications that required a 32-bit machine and when you cut it back you lose a lot of performance, you know.

Hendrie: Yeah.

Magleby: And so the early 3000s didn't perform as well as they were supposed to. But I can't take the blame for that because I was gone by then.

Hendrie: You weren't there. Okay. All right. Okay. So what did you do? So you left HP?

Magleby: Yeah.

 © 2009 Computer History Museum

Hendrie: Now, why did you leave?

Magleby: Well, I wanted to go into general management. And when they formed-- when HP formed the computer Division, took it out of the Dymec and made their own separate division, I thought I should manage it. Well, HP didn't think so. So…

Hendrie: Okay. Who did they end up putting there?

Magleby: Tom Perkins was the guy that…

Hendrie: Oh, okay.

Magleby: That's when Tom Perkins-- he was-- he had an MBA and, you know, and had the credentials they were looking for. But so I went up to talk to Ray Wilbur who was the Vice President of Personnel and told him I wasn't very happy about that. And so if they wanted to be, you know, purpose general management skills then I'd like to go to Stanford and they have what they called a Mexican MBA where you-- it's like an advanced management program, you know.

Hendrie: Ah, yes, yes. Yeah, I know, they have one at Harvard too.

Magleby: Yeah. So he said, "No, I think you should stay in engineering. You're a good engineer and you might not make a good manager." He said, "That's a risk we'll take," he said, you know, "We don't know, but we know you're a good engineer." Well I didn't like that.

Hendrie: Didn't like that answer.

Magleby: No.

Hendrie: Okay.

Magleby: And so then I-- I don't know how we wound up with Jack Bishop but they had a company in the Bay Area called Cushman Electronics, was a division of…

Barbara Magleby: Okay, you went to Ann Arbor next. <Inaudible>

Magleby: Oh, yeah, yeah, that's right. Yeah, yeah. Okay. Yeah.

Hendrie: Oh.

 © 2009 Computer History Museum

Magleby: And then I came back to there, yeah.

Hendrie: Oh, yes, I see. <Inaudible>

Magleby: Yeah.

Barbara Magleby: <Inaudible>

Magleby: Yeah, I got myself out of…

Barbara Magleby: <Inaudible>

Magleby: Well anyhow, yeah, Sam Irwin who was the President of Sycor…

Hendrie: Yeah, so Sam Irwin went and started another company of course.

Magleby: Yeah, and he got wind that I wasn't very happy. So he says, "Why don't you come back and be my Vice President of Engineering?" So I did. And managed to get their first products into production. And they hadn't had-- they had very poor luck until then meeting any of their schedules, you know.

Hendrie: Yeah.

Magleby: But, you know, I got that thing organized and working in a more efficient way and after that we made all of our schedules. But I was getting tired and we didn't like Ann Arbor very well. And I got a call from—oh gosh.

Barbara Magleby: Then he went to Fairchild <inaudible>

Magleby: Yeah, and I'm trying to think of-- who's the guy that…

Barbara Magleby: <Inaudible>

Magleby: Oh _____, that was Les Hogan.

Barbara Magleby: Yeah.

Hendrie: Oh Les Hogan had got into Fairchild.

 © 2009 Computer History Museum

Magleby: Yeah, he <inaudible> Fairchild.

Hendrie: Ah, okay.

Magleby: Oh, it was John Atalla, that's who I'm trying to remember. I got a call from John Atalla and he was doing some consulting with Les Hogan and Les Hogan said well they thought they should get in the computer business. And John Atalla told him, "Well, you better get a hold of Kay Magleby. He's the one who got Hewlett-Packard into the computer business." So I was-- I was-- yeah, I was at Sycor and then I went back and met with Les Hogan and they decided that they would form a little group and put me in charge of it. And so I hired some engineers and we were off and running. But we didn't get very far when I got a call to in and see Les Hogan. And he says, "You know, Kay, my forecast for the profits for next year were met, but the problem is that there was the wrong sign."

Hendrie: Okay.

Magleby: "And I'm going to terminate anything that's not going to make profits." And of course I was just getting…

Hendrie: You were just starting.

Magleby: Yeah, we were starting. And so he said, "Well, keep a few people and, you know, kind of keep the program going, but then we get profits going, we'll start it back up again." Well I didn't like that idea. So at that time I ran across Jack Bishop and he…

Barbara Magleby: I was back to the Labs at that time, HP labs. They took you in as a Director of Telecommunications. <Inaudible>

Magleby: No, that was after I left Cushman.

Barbara Magleby: Okay. All right.

Magleby: I think. I'll have to look on here and see.

Barbara Magleby: He left Fairchild and I thought he went back to HP.

Magleby: Then I went…

Hendrie: Yeah. It says you went back to HP after Fairchild and then you went to Cushman after…

 © 2009 Computer History Museum

Magleby: Okay.

Hendrie: …your second stint at HP. Yeah.

Magleby: Okay.

Barbara Magleby: He's been in and out of HP three times.

Magleby: No, just twice.

Hendrie: Okay.

Barbara Magleby: I thought it was three times.

Magleby: Okay. So anyhow…

Hendrie: So it was Director of Communications program responsible for product marketing, strategic planning for HP telecommunication products.

Magleby: Yeah. But Cushman was before that wasn't it?

Barbara Magleby: No, he says Cushman's after.

Magleby: Let me see. I should have looked at this.

Hendrie: Cheat sheet.

Barbara Magleby: I'm amazed you remember so much.

Hendrie: I know.

Barbara Magleby: I am surprised that you can remember all those names.

Hendrie: Oh, the names. I couldn't remember names like that.

Barbara Magleby: Not from that long ago.

 © 2009 Computer History Museum

Magleby: So after I left Sycor I went to Fairchild Corporation and we had a group we put together to-- the foundation for Fairchild line of computers, using their components, you know. So after I had the systems pretty well going and I had people that I hired, I had about 20 people in my group at that time and Les Hogan called me to into his office and told me that his forecast, his profits were going to be the same magnitude but the wrong sign.

Hendrie: Yes.

Magleby: And so he had to terminate any groups that weren't going to make a profit this year. So I had to terminate my group. And he asked me to identify a few of the key people and kind of keep it going, you know, and then step it back up again later. But I told him I didn't think I could do that because, you know, I couldn't hire people and fire them and hire them again. And so at that time John Young at Hewlett-Packard found out that I was unhappy and called me to come see him.

Hendrie: Okay.

Magleby: And discussed me being on his staff and be responsible for Hewlett-Packard's interest in communications technology, in particular instrumentation to perform the measurements that are needed to maintain the telephone systems. And so I would be working with the various instrument divisions and helping them define what products they should make to support the telecommunication testing.

Hendrie: Okay.

Magleby: So I went around in various divisions and saw them and met with their engineers and consulted. I did that for a while. But also he said he wanted me to lay out a plan for Hewlett-Packard to get into the microwave radio business. And so they get in actual communications equipment as well as test equipment.

Hendrie: Okay. As well as test equipment.

Magleby: He said, "Well, you did a good job of laying out a plan for us to get into computers, well how about telecommunication products?" And one of the things I was interested in was-- I can't think of the company right now, but there was a company that made microwave radio products. And I gave a presentation to the board for-- Fairanon [ph?], it was to acquire Fairanon. And Ed van Bronkhorst who was the Vice President of Finance said to the Executive Committee that, "Well, I like Kay's idea but I don't think we should acquire the company. Why don't we just give Kay the money and <laughs> develop it?" But anyhow it didn't work out. And so then I left Hewlett-Packard and-- see now I have to cheat again. Yeah, and that's when I went to Cushman Electronics.

Hendrie: Okay.

 © 2009 Computer History Museum

Magleby: And Sam Irwin, I mean Jack Bishop was the one that met with me and-- and Roy Cushman was the founder and his health was not good. So they needed to have a replacement for the president. So here was my opportunity to go into general management, which is what I wanted to do, you know. So I was then offered the position of the President of Cushman Electronics. And one of the things that he insisted on is that I go back to Harvard's Advanced Management program. So I did and attended that. And I'm not quite sure how to word this, but anyhow, Jack Bishop and I had a disagreement after I had been there for a while. And I had about tripled the size of the company and doubled the percentage profits and we had a whole new line of digital microwave radios <laughs> that we were just bringing to the marketplace. But anyhow, we would be controlling our shipments somewhat to match his sales forecasts and I thought we should try to ship everything we could, you know.

Hendrie: Yes.

Magleby: So we wound up, everybody working to meet our production goals and filling up the back of the place with instruments that weren't shipped, you know. They were just holding back until-- for the next quarter's profits. And so we had a disagreement. And, you know, it was interesting, there was a little article in the paper about when I left there. Jack Bishop says, "Well, Kay, Dr. Magleby and I had a difference in management philosophy." <laughs> That's how he put it. But anyhow I was invited to leave.

Hendrie: Okay. All right.

Magleby: Yeah. Well that's probably as far as we need to go. Do you want to go through the rest of these things? Well, I guess we might as well.

Hendrie: Yeah, you might as well.

Magleby: You can cut it out if you don't want it.

Hendrie: Yeah.

Magleby: Okay. So then-- so after I left Cushman I was invited to be the President of a Bell-Northern Research Incorporated, which by this time I had developed quite a bit of understanding of telecommunication products and all. And so they had a group in Palo Alto. Their headquarters were in Ottawa, but they had this group in Palo Alto. And the person that was managing that was a Canadian and he wanted to go back to Canada.

Hendrie: Okay.

Magleby: So they asked me to become the President of Bell-Northern Research Incorporated. And that's a subsidiary of Bell-Northern Research Limited in Canada, which is the R&D activities for Bell Canada and Northern Telecom. And I had about several hundred engineers working for me there. And

 © 2009 Computer History Museum

to kind of close the loop, Northern Telecom was acquiring companies to improve their United States business and among the companies they acquired was Sycor <laughs>.

Hendrie: Really?

Magleby: And so that was one of my group, I had the responsibility for Sycor engineering.

Hendrie: Oh my goodness. Oh wow.

Magleby: And so some of the same engineers were still there when I left. And then they had a group in…

Barbara Magleby: Minneapolis.

Magleby: Minneapolis, yeah. And so I had group there and then I had a group in Palo Alto. So I had around 600 people in that…

Hendrie: Wow, that's a lot

Magleby: And then I got bit by founders fever…

Barbara Magleby: Founders fever?

Magleby: Founders fever.

Hendrie: Oh, you got bit by founders fever? Oh, yes, that's a great disease, well known disease in these parts.

Magleby: There were some of the things that we were going to do that we were going to do at Bell-Northern Research that they, Northern Telecom didn't want to do. And I thought it would be a good idea to go do 'em, you know. And so I formed a company called Magleby Management and Development.

Barbara Magleby: No, it was ITS, honey.

Magleby: Oh yeah. <laughs>

Barbara Magleby: He's getting tired.

 © 2009 Computer History Museum

Magleby: Yeah, I guess I'm getting tired.

Hendrie: Yes. All right.

Magleby: Okay. That was Integrated Telecomputing Systems.

Barbara Magleby: That's it.

Hendrie: Okay.

Magleby: And some of those things I think could still be marketable today. But they were-- we had one of the first voice mail systems.

Hendrie: Oh my goodness. Wow.

Magleby: And we had-- it integrated with a PBX, because PBX was one of Northern Telecom's main product lines.

Hendrie: Right.

Magleby: And so we had this group, the Advanced Business Systems I guess it was. And they were experimenting with different kinds of ideas for office automation. And so we had an integrated voice mail messaging system. And we developed a special terminal so that you could-- like a short hand terminal that secretaries could learn to use quite easily and so they could type as fast as most people could speak. So they would say, "Well, would you like to leave a text message or a voice message?" And so then, you know, you could say, "Well, I'd like to leave a voice message." And they would type it and put it in there where you could come back and retrieve it on your-- you know, the person in the office then could retrieve it.

Hendrie: Yes, okay.

Magleby: And one of the things we could do-- why it was really more efficient was most people can read about three times as fast as they can speak. And so, you know, if you could have all your messages in text form when you came into your office…

Hendrie: You'd get them a lot faster.

Magleby: …and organized, you know, you could do it a lot faster, you know. So they interfaced between the calling party and the person you're calling. If you're sitting in your office and a call comes in and you

 © 2009 Computer History Museum

don't know who's calling, you know, so you have a choice of offending one of two people. You can let the thing go on the messaging machine, you know, or you can have the secretary take a message or you can tell the guy, you know-- and then you'll have to tell the guy that you're talking to already, "Hey, I've got a call. I've got to take this call," you know.

Hendrie: Yeah.

Magleby: But if you could have a message come in so that a call comes in and you say, "This is Kay Magleby. I'd like to speak to you," and she could then key in just from the few keys that-- your name and who is on the phone. And I could key, "Take a message" or "I'll take the call."

Hendrie: I see. Okay.

Magleby: And so I had this little communication link that was using the telephone line…

Hendrie: To do this. Very good.

Magleby: …to do that.

Hendrie: All right. I have to…

Magleby: Stop?

Hendrie: …do a pause. Yes.

END OF TAPE 3 / BEGINNING OF TAPE 4

Hendrie: I had read something about, that you did some work on something that became the 2116. I read it in some book about HP, while you were doing your PhD. What did you do your thesis on, at Stanford?

Magleby: My thesis was on synthesis of non-linear feedback shift registers. and what that is, is a shift register is where you just shifted the data around. Well, if you take the data out, and combine it with the states of the shift register, that becomes putting the feedback in the other side. And you can get them to make cycles.

Hendrie: Which have various interesting patterns.

Magleby: Yeah.

 © 2009 Computer History Museum

Hendrie: I know of those as Johnson Counters. You ever hear that term? I first heard about those as Johnson Counters.

Magleby: I don't recall, but--

Hendrie: Yeah, in fact--

Magleby: Maybe I did, I just don't recall.

Hendrie: I actually used one, in a microprocessor I designed, to generate the-- act as both a real time counter, and for, you know, for the feature, and to generate refresh addresses for early dynamic RAMs.

Magleby: No, I don't recall.

Hendrie: But I couldn't-- I didn't know anything about any theory. I sat down at work, I only needed 256 bits. I went down and just worked through it, on paper, until I found a feedback pattern that worked.

Magleby: Yeah, well there's a fairly standard way to make a feedback, sort of just using.. anyhow, exclusive or-gates as part of the feedback structure, and by choosing the right ones, you can make a lot of sequences, and so linear feedback.. is what they were, and this was-- so we have linear logic.

Hendrie: Right, yes.

Magleby: And there's a mathematical way of determining what the shift register sequence will be.

Hendrie: Oh wow, I wish I'd known that.

Magleby: In particular, people are interested in long shift register sequences, you know, because they're using them to generate pseudo random noise but they wanted it to be something they could predict, so they could insert it as part of the message, and then remove it at the receiving end. And so if you knew-- if you could have the same feedback circuit, then you could use it to, all of a sudden, remove it, you know.

Hendrie: Yes, you can. Okay.

Magleby: So this was being used to-- for people in secure communication, and, but there's just a restricted-- you know, the coefficients for a polynomial determine which feedback taps to use to make the maximum sequence. But then you're limited to how many you can do, by the fact that it's a linear

 © 2009 Computer History Museum

feedback network. So if you want to use, you know, both ends and or-gates, or whatever you want to do, then you could get many, many more maximal sequences.

Hendrie: Oh, okay, that's what you--

Magleby: You can get, like, I forget the number, but several thousand more-- thousand times as many. And so that people were very interested in this for secure communication. So what I could do, I developed a system where you could use linear logic, I mean, nonlinear logic and combine cycles of just circulating. You had a circulated register and we put a number in, you'll have a given cycle, you put another number in, and have a different cycle, you know, but I could combine those together with this system that I developed, so I could use nonlinear circuits.

Hendrie: That's wonderful. Very good.

Magleby: At the end, just many, many more cycles, so my topic was synthesis of nonlinear feedback registers.

Hendrie: I love it. <laughs> That's pretty funny.

Magleby: But one of the interesting things about that, is when I was working on my dissertation, one of the fellas in the-- we kind of had a little area where we were working, you know, and it was a guy named Phil Fire [ph?] and he had developed what's called fire codes, which are sort of very efficient codes.

Hendrie: Yeah, okay.

Magleby: And so I think he had access to a lot of these different classified work that was being done using these fire codes or maximal sequences. And so I was kind of nervous, because I couldn't know what they were doing, you know. So I asked him, "You don't need to tell me what they're doing, but can you look at what I'm doing and see if they're doing the same thing?" Or working on it, you know. And he did, he looked at it and he said, you know, "Yours, this is interesting and new," and then so I didn't have to worry about that.

Hendrie: You didn't have to worry, exactly. Oh that's good.

Magleby: But I had occasion, not too long ago, to go up to the Stanford Engineering library to do some patent infringement analysis, looking for prior art. And so I went up to where the dissertations are, you know, in the-- and you see all nice and neat and crisp, and you know, in the stacks, and I came to mine, and boy, that was kind of ragged on the edges, and the place where they told how many people have looked at it, and it was overflowed.

Hendrie: Oh really? So that's pretty good. So lots of people found it later, and said, "This is interesting."

 © 2009 Computer History Museum

Magleby: Yeah, well of course, there was-- thesis topics get published and the theses do, and so I got several requests from-- countries-- you know, Russian--

Hendrie: From Iron Curtain countries, yes.

Magleby: Iron Curtain countries, yes.

Hendrie: Oh my goodness.

Magleby: So I never did send them any.

Hendrie: It was pretty good. That was a great thesis.

Magleby: Apparently it was useful, you know.

Hendrie: Good. All right. One question I like to ask, you know, I'm sure I will think of other things, but I can always call you up if I have little questions that, you know, just need to understand something.

Magleby: Sure.

Hendrie: What advice would you give a young person today, who's, you know, interested in math and technology?

Magleby: Well, of course computer technology is always evolving, so that would be an area for, and applications are always, you know, coming along, and math is kind of, almost a logical, you know, development, so your mind is the same kind of thing for logic design, and I think that would be one area that-- and communication, you know, digital telecommunications is another area which is, you know, evolving, and mathematics would be helpful there.

Hendrie: All right.

Magleby: So it's not so much the particular skill, or the particular application, as it is the skill and the logic that goes into your math, and you have these word problems that you have to work out, and figure out how to set it up, and that kind of brings it back to the real world, you know?

Hendrie: Okay.

Magleby: But I think, electronic engineering has been a good field for me, and it's, you know, so that's what I'd recommend.

 © 2009 Computer History Museum

Hendrie: Okay, good. All right, thank you. Oh, I thought of one other thing, again, totally out of sequence. Is there any of the-- it would be good to take one of the early instrument oriented applications. Do you remember one that was particularly, you know, when, during that first year or two when you were working, like everybody was working on instrumentation applications. Do you remember one that particularly stood out, or you thought was novel, or was very successful-- proved to be very successful?

Magleby: Well, one application of the data acquisition system was to go onboard a ship out of Woods Hole, and what they were doing was making very accurate temperature measurements, you know, versus the depth they go around places to do that. And the systems they had were ones that would just take the data and put it on mag tape, and take it off to an IBM computer, and analyze it, you know. That way they'd take a lot of data that they didn't need. And so if you could do the analysis aboard the ship, it would be much more efficient. So Hewlett Packard made a digital thermometer, if you will. It was a crystal controlled oscillator, and the frequency was a function of the temperature it was in. Instead of being stable, it made it so that it was linear, unstable, or non-linear.

Hendrie: Yeah, I understand.

Magleby: As to change the temperature, you got a linear relationship. And so Woods Hole developed a system to take this data from the digital-- they'd have-- towing it behind the ships, and they would have several of these coming in, and they would want to digitize the data, and then stored it on mag tape. Well they put that computer on there, and then they could disregard the type of data they didn't want, and they could go a lot faster, you know, and wouldn't have to store so much data, and if they didn't get the kind of results they wanted, they could go back again, and go over it. If they did the other way, the ship was gone, you know.

Hendrie: Yeah, okay.

Magleby: And so I thought that was kind of interesting, you know.

Hendrie: That is, that's a good one. Good, all right.

Magleby: And of course the other one that we did that was very successful, was this time sharing system. We-- there was a company called BC Timesharing [ph?], got one of our systems and commercialized selling time on it. I guess they had a couple of them. And they were quite successful with that, and they were also used by a lot of universities so they could have their own little time sharing system.

Hendrie: Okay.

Magleby: I think Stanford Business School had one, for example, for the business school people to, you know--

 © 2009 Computer History Museum

Hendrie: Do problems, do problems.

Magleby: Yeah, do problems on the computer. That's a couple of them anyhow.

Hendrie: Yeah, okay, good. All right. Well, I really want to thank you, Kay, for taking the time to go and do this, and record this oral history for the Computer History Museum.

Magleby: Okay.

END OF INTERVIEW

 © 2009 Computer History Museum