Oral History of Robert Beck

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Gardner Hendrie: We have today with us Robert Beck who has graciously agreed to do an oral history interview for the Computer History Museum. Thank you very much, Robert. I think what I'd like to start with is for you to tell us a little bit about your childhood background.

Robert Beck: All right. Well, I was born in the rural part of Nebraska, near Lincoln. And I lived there with my mother and grandparents. My mother was divorced very soon after I was born. So I was really much raised by my grandparents. And I remember much about the farm, you know, until I was ten, helping harvest potatoes and going down, collecting gooseberries, the things of farming, which has sort of shadowed me because, later on, I've gone back to farming because I like that. I had no siblings. I had a couple of cousins in Columbus, Nebraska. And each year we would go to their farm, and I would join the harvesting crew. Usually, my job was to sit on the old thrashing machine and point the device that stacks the straw as it's harvesting. And I was impressed with how hard farmers work. The work was often done collectively by the Guedeken family that all came together with their machines, and there was a big feast at lunch and at dinnertime. It was a very good feeling. I love the harvest. I don't know why. It just brings me back to that.

Hendrie: Tell me a little bit about your early schooling in Nebraska.

Beck: Yes. My grammar school was a few miles away. And believe it or not I walked or ran most of the way each way. Seemed quite comfortable to me. It seemed silly to walk. It was a charming school. I can remember the first incident that struck me. The teacher asked, "Can anybody in the class draw us a map of where we are?" And sure enough some of the kids knew how to draw a map of the county of Lancaster and said here we are. And I said, my goodness, that's quite illuminating. I had no idea such a thing existed as a county or a state. The other thing, I think the first day in school I talked too much and I was put in the corner. And our neighbor, Ruthie Schwindt, came home and told her parents who told my grandparents what I had done that day. Was very embarrassing. I never did that again.

Hendrie: Do you remember when you learned to read? Did you like to read?

Beck: I loved early reading. I don't remember. But dog stories, Dr. Doolittle and that form of book, I found fascinating. I loved that. Our life was simple there. We didn't have a radio, but I managed to set up a crystal set on the farm. So I was able to hear the early nominations of Roosevelt versus Wilkie. It was a great event in my life just sitting there stretched out in bed listening to my crystal set, sneakily hearing what was going on at the convention.

Hendrie: Ah, oh, you were supposed to be asleep.

Beck: Yeah, that's the beauty of the crystal set. It's so quiet you can listen to things and nobody knows.

Hendrie: Do you remember what your earliest thoughts about what you might like to do when you grew up were?

Beck: Not really. Things went very slowly. In a career sense, I had no big plan. I sort of drifted around. Later, when I went to high school, I took up printing and I became a linotype operator. And I thought that would be my career. That, of course, is totally gone now. There are no linotype operators. But it was a very-- I enjoyed machinery. On the farm, I was very proud of some things I would do. Since we had lanterns for the illumination, I found an old car battery and a car headlight bulb and I wired it up and set it on the battery and it illuminated the whole living room. And that created a big impression with my grandparents and my mother.

Hendrie: You lived in Nebraska up until about ten. So you had moved when you went to high school?

Beck: Oh, yes. We moved to Long Beach, California, where I went through, you know, grammar school and junior high and, finally, to Wilson High School in Long Beach. And that's where I took up the printing. And sooner than that, I was the head printer of the school paper. So I felt that was a great career. I guess I love mechanical things. Doing all of that was very satisfying.

Hendrie: When you moved to Long Beach, was it just you and your mother?

Beck: Just she and I. This point in time was the year called the Dust Bowl in the Midwest, and it was very hot. And people were deserting. We came out to California. We were all called Okies, because that's where many people came from. But we're all called Okies, and I had to go through the shock of giving up overalls and wearing trousers. That was a big change for me, the whole social concept of the school and clothes. And modern non-farming life was so different for me. I wasn't really happy about it, but that's what I had to face up to.

Hendrie: You weren't on a farm then when you got to Long Beach.

Beck: No, no, no, she started working in laundry. I worked most of my childhood. I did work in the laundry and, later, with a paper route in Long Beach. And for a while I delivered dry cleaning in a panel truck. That was much more hard work than I would've ever thought. I mean, getting in and out of a truck with all that junk and finding locations was very taxing.

Hendrie: Tell me a little bit about your high school subjects that you really liked and which ones you were not particularly interested in. Do you remember?

Beck: Yes. I loved mathematics and science. It just seemed so clear cut to me that that's a good thing to study. And I did very well in my science classes. Once when I had to be out of school to have the mumps, I studied at home. And I was studying biology at that time. Since there was nobody to correct me, I developed a lot of mispronunciations, like I called the esophagus the <with incorrect pronunciation> esophagus. For a while it was a little bit embarrassing later, because I had developed all this bad vocabulary. You often see it with self-taught people. They're way off. They don't know…

Hendrie: They see the word.

Beck: And they sort of pronounce it, and it comes out weird.

Hendrie: When you were getting close to graduation from high school, did you still have the idea you would be a linotype operator or what did you think and what did you end up doing?

Beck: Well, yes, that was sort of my plan. Actually, I had to rush my final semester in high school because the draft was coming up. And I went into the U.S. Navy at that point. And that was a great experience for me. I enjoyed the Navy. I was a radar operator. And as a result of being in the Navy a fairly short time, I was financed through college. I was a little inspired by my print shop teacher in Long Beach. When I went back to see him, he said, "Why don't you go to college and study what you'd like?" And so I did study. I went to UCLA and became a student of physics.

Hendrie: Do you remember what year you went into the Navy and how long you were there and when you got out?

Beck: I can work backward. I graduated from UCLA in 1950, that was in the late, late part of World War II, and graduated in time to benefit from the G.I. Bill, which I really admire. I mean, not for just me personally but for everybody. That school, UCLA, was jam-packed with returned GIs. And they were all very serious students. It was a very tough, competitive period to make a good grade, in college, at that time, with all those returned GIs.

Hendrie: Why did you decide to study or major in physics?

Beck: Because that was a very easy subject for me. I enjoyed learning about the nature of physics because it's very illuminating. I loved it. Just in passing, I might mention I didn't like the study of electronics very much when I was in school. It turns out, later on, I got into computers. I had to catch up on electronics part.

Hendrie: Did you take some electronics courses at UCLA?

Beck: Yeah, as part of my curriculum, I studied electronics and I hated it. Well, mostly it had to do with strange things which didn't interest me, like how to design superheterodyne radio sets. I'm not sure I know yet what that means. Nobody even talks about it anymore, but that was a concept of the radio communication. And I found it very awkward to think about.

Hendrie: That did not come naturally.

Beck: No, that did not fit me, no.

Hendrie: Were there any particular teachers in college that influenced you or that were pretty inspiring?

Beck: Actually, not too very well that I can identify who helped inspire. I was inspired by the competition with the other GIs. I mean, the professors were not of great interest to me. The people I knew in college, that's where the real struggle was to keep up with the thing. Just as a sidelight, when the graduation came, there was a huge graduating class of physicists. But there were so many, there was nobody looking for people hardly. There was one interviewer for the whole class that came from GE, and they hired one out of the whole class. So the door was sort of closed to my immediate employment in physics. And a chap named Glen Hagen was trying to drum up a little computer enterprise at Northrop Aircraft. And in order to find people who would be suitable, he gave us brief evening classes before graduation in computer designs and how they work. I aced the test. I did it perfectly. So I was employed based on that sort of odd sort of recruiting. Nobody taught anybody how to do computers. You had to work it out on your own.

Hendrie: Nobody knew anybody.

Beck: There were books around, but, you know, these books were quite out of touch with what we would be doing. So we just had to learn from this class whether we were competent or had an ability to take up computers.

Hendrie: So he somehow identified students who were graduating or seniors.

Beck: They were on the verge of graduating.

Hendrie: And his idea was to…

Beck: …go teach to…

Hendrie: …teach it. And that way he also could…

Beck: …recruit.

Hendrie: …figure out who the good ones were and recruit.

Beck: Yes. And it was very successful. It was a very pleasant group of guys. We got together at Northrop, and I started to learn more about computers on the job. I learned a great deal about how to design computers from Eric Weiss who was a jeweler who used to design pinball machines. And that somehow is sort of vaguely related to computers. He and I spent quite a bit of time together studying how computers work.

Hendrie: But he was a jeweler who did pinball machines?

Beck: Yeah, right.

Hendrie: Do you have any idea how he got into it? Was it just a hobby?

Beck: No. He got into pinball machines as a permanent occupation. It was his avocation to have a jewelry business. But his main ability was in designing and building pinball machines.

Hendrie: Did you meet him in college or was he at Northrop?

Beck: At Northrop.

Hendrie: He was part of this group?

Beck: No. Obviously, others were being recruited by Northrop Aviation to work on things other than computers. He was there mostly to work on a missile called Snark, a missile not much known anymore. I don't think it was very successful, but that was in the works when I was there.

Hendrie: When you got to Northrop, what did you do first?

Beck: Well, was sort of a teamwork effort trying to design the computer that was ultimately called the MADDIDA, M-A-D-D-I-D-A, standing for Magnetic Drum Digital Integrating something or other [Magnetic Drum Digital Differential Analyzer]. It was the equivalent of an analog machine designed by Vannevar Bush, which solved calculus relationships by gears and pinw--

Hendrie: It was an electronic Digital Differential Analyzer, right?

Beck: Right, mm-hmm. So I spent quite a bit of time working on that directly. And I also helped install some after we produced them.

Hendrie: Did you work on the circuits or on the logic?

Beck: All parts of it. I started to learn to do circuits. I did logic. We used what's called Boolean Algebra, which all of us learned very quickly, about how to keep track of how the computer makes its mathematical decisions.

Al Kossow: Was the Northrop idea of explaining how computers are put together in lists of Boolean equations, where all the other Southern California people get the idea of doing it that way? The East Coast people all use schematic diagrams and don't really write everything out as Boolean equations. But on the West Coast, you all did it that way.

Beck: That's right. I don't know who originated it, but think it was just a local phenomena in California. Because there were, ultimately it seemed like, dozens of little computer companies starting. And I think we all used it. We would sometimes meet with other engineers from other companies. I can remember one brilliant guy named Floyd Steel who would give us inspiring lectures about the concept of a computer as a *tabula rasa*, a blank tablet, which could do anything. And we were all using Boolean Algebra to design these computers. But it was fun to be inspired by the camaraderie with other competing companies, because it was all being self taught. I mean, you had to figure it out within your own self and with your friends.

Kossow: Floyd Steel is legendary in the real-time control business.

Beck: He was, I think, a genius. I quite admired him.

Hendrie: Was the MADDIDA originally done to be used by Northrop, or had they built Digital Differential Analyzers before to solve the differential equations for aircraft and then decided maybe they could build them and use them themselves and sell them?

Beck: I think it really was an independent part of Northrop's activity. It really did nothing with Snark or any of the other projects that they were really interested in. It was just a separate venture into the computer business. Because somebody there, I think Jack Northrop or others, thought it was a good idea to explore and see if there was something that could be done with computers. So it was started, and it went along for a while. Actually, that operation was later bought up by Bendix Aviation Corporation because they had the similar inspiration to branch out from their automobile stuff and aviation stuff to get into computers.

Hendrie: Do any interesting stories come to mind about things that happened during the development and possible debugging of the prototype MADDIDA when you're designing and building the first one?

Beck: Well, to me, the highlight of that period was as I was making a installation of a computer at Steven's Towing Tank. A chap dropped by. He told me he was Enrico Fermi and he had a problem he wanted to run on this. Because he understood how this computer was meant to work. And it was a nasty little test question involving a near-singular matrix where the MADDIDA just kept circling around the solution it was never getting. As a test question it was very clever, and I enjoyed meeting him. And he never humiliated us by saying, well, you can't do that, what good is it for. I mean, he didn't say anything like that. He just satisfied himself that computers had a long way to go yet. That's certainly my feeling too, because the MADDIDA was a pretty limited concept. Compared to, now, what we have as general-purpose computers, you wouldn't hardly call it a computer anymore.

Hendrie: But it was digital?

Beck: Oh, it was a true computer. It had a magnetic drum memory, and a lot of things were very interesting. But as a concept it wasn't one of the great world-shattering uses that would really matter much to anybody.

Hendrie: The concept of the DDA, how much did it follow the mechanical differential analyzers in terms of having a certain number of integrators? Was it all fundamentally programmed through single integrator unit?

Beck: It sort of took the concept of integrators and created individual integrators spread in sequence around the periphery of the drum. And the computer would come around and service each one to generate what amounted to the turning of shafts and send the signals to other integrators which would work on it. And it would chug along and solve certain questions that were very interesting about how to do a gornu spiral or something. You could have the computer do very interesting things. But compared to, say, a general-purpose machine, it was nowhere in the ballpark of doing what other computers were meant to do.

Hendrie: Do you remember how many MADDIDAs were sold?

Beck: Oh, I think we sold dozens of them, and it gave us a chance to meet a lot of people. Got acquainted with people up near San Francisco who were working on banking computers, you know, the first computers, I think, the B of A [Bank of America] was creating for its banking work. I don't really recall the names of the people, but there were a lot of clever projects going on that were directly related to business.

Hendrie: I wouldn't have thought that the MADDIDA was very applicable to those.

Beck: Oh, not a bit, no.

Hendrie: Not a bit.

Beck: No, it was for scientific research.

Hendrie: You mentioned that Bendix, at some point, acquired Northrop. Do you remember when that was?

<crew talk>

Beck: That would've been in 1952 that it was acquired. It's still pretty early in the computer business.

Hendrie: Did you just stay where you were?

Beck: No. We went to a new facility up near Inglewood. They created a new facility. I started to work on a first real general-purpose computer, which I enjoyed very much, at Bendix. It was called a G-15, and it was a big success. I think we sold hundreds of them at the time. It was inspired, let's say, by the

work of Turing in England. He designed what were called ACE and the DEUCE computers, and the G-15 was somewhat heavily influenced by the DEUCE.

Hendrie: What did Harry Huskey give Bendix besides the idea and sort of the Turing architecture that Turing developed?

Beck: He pretty much gave the concept of the Turing machine. But I don't think he was capable of working out the details, which I enjoy, which is constructing the model of how a computer would actually achieve what he was selling. I don't think he ever told any of us that it was a scheme that had been developed by Turing. He was being a consultant to us, and it was not all a waste. We didn't feel cheated.

Hendrie: Was the sort of block diagram architecture worked out by him?

Beck: No.

Hendrie: You had to take it even from that point and then figure out the logic design of the various units.

Beck: That's right. That was a time when you could really do that as a young person. Because it took, you know, sort of day and night work trying to remember all the details of how it was going to work out and bringing it together. I sort of holed up in my apartment, in Inglewood, and did a lot of work on it just by myself and without much sleep. And finally I got the whole concept put together.

Kossow: Was the internal timing and things of the G-15 influenced by MADDIDA?

Beck: No, no. That had just been a practice thing, which I could learn from, and, I suppose, some concepts of flip-flops and the like that I could use. But it was really a start from scratch with Huskey's concepts. We put together a very striking machine.

Kossow: Did MADDIDA use the same two circles and kind of the infinity sign for flip-flops?

Beck: Yes, mm-hmm. Maybe you've seen the drawings of the G-15.

Kossow: Oh, absolutely.

Beck: Those are ones I probably drew myself.

Kossow: Ultimately, CDC redrew them to sort of spread it out, because it's a very dense drawing.

Beck: Oh, yes. It's not a very-- it was a very primitive approach to computer design.

Hendrie: How did sort of the work on the G-15 get parceled out? I'm inferring that you did a great deal of the detailed logic design. To build a machine like this you obviously have to have standard circuits or you'll get in a great deal of trouble. So there's circuit design for the various circuit modules. There's often things that are a little tough, that are analog problems, like drums, rewrite heads and things like that.

Beck: Well, you've described the process quite well, because some of the crucial things are the drum memory, which was worked on by an engineer who I would not remember now. But he struggled with it. It was very well done. And it had one difficult problem. Because he wanted one register, the arithmetic register, to be a very short track on the tape. So it involved getting a read and write head very close together, and it was very difficult to make that work. And he struggled with it quite a while to get that register to work.

Hendrie: Ah, because of the interference between the high currents and the very low signals from the read head.

Beck: Yeah, that was very difficult. Many other mechanical designers created the physical frame of the computer, and other engineers designed the individual plug-in modules of which we had, you know, many different types which all fit together. And then there was a trick of making a wiring list to wire up the connections for all of those computers. I don't know. You know, must've been ten or a dozen engineers working on different pieces to bring it together. Oh, and there were some tricky parts. One was to make a tape reader, which seemed pretty simple. We used punch tape at that time. And we used little photocells and light coming through the holes in the punch tape to load information into the computer, and that was surprisingly difficult. You wouldn't think it would be, but very often little errors would occur. It was hard to dig it out as to what it was.

Kossow: The tape reader on the G-15 is interesting because of the little cartridges, little reels. And you plug the cartridge on the top of the machine.

Beck: Right. Very good. It's a little deep drawn aluminum box that had the cartridges in it. It was very slick I thought.

Kossow: I have two of them sitting on my desk right now. How long did it take you to design the machine?

Beck: Oh, probably about six months or so. We started the building of it even before I'd completed it, because there were a lot of details that still had to be worked out. As I say, it's an ideal job for a very young person who has a lot of energy. Because I pretty soon started thinking that I ought to get into management and out of this work, because it's just hard to keep up that pace. I'm sure that's true of the modern designers too. They just must go out of their minds getting things done.

Kossow: When does Max start on the DA-1 differential analyzer box for the G-15?

Beck: I'm a little hazy on that. I do know he was working with us there at Bendix. And I think that was a separate project which I didn't pay much attention to actually. And he worked on that. As you probably know, since you've worked on this, Max, after a while, took off. He went to Europe for a while. He just gave up the work and wanted to go to college or something there. And he came back inspired on maybe we ought to have another computer company. Yeah, because I guess he thought about the whole process of how, well, how you deal with the larger parent company in trying to get the computer company to go. I think it occurred to him that he really would like to work on an independent company, not be subordinate to another company's operations.

Kossow: Was there any work on transistorized computers done at Bendix, or did that start at Packard Bell?

Beck: Let me think. I think that really started at Packard Bell. And Bendix was all vacuum tube stuff. And just as a sidelight, transistors came up at that time and, at Bendix, we bought a few. And they came in the mail, and they didn't work. They were just fakes I think. You know, because, you know, they have several leads in them. And you think, well, maybe that ought to work. But it doesn't work. Somebody just stuck some leads in a little epoxy and sold them as transistors, which was a very clever way to begin the transistor business.

Kossow: Do you remember at all who the company was?

Beck: No, no, no, no.

Hendrie: Wouldn't that be a great artifact to have?

Beck: Yeah, we should've saved it, didn't realize what an interesting artifact that would be.

Hendrie: That's really interesting.

Beck: Yeah, so, after that little brief experience at Bendix, we sort of steered clear of transistors for a while to make sure it was not all phony hype.

Hendrie: Did you get involved at all in circuits, at Bendix, on the G-15?

Beck: Yes. I did some circuit design or checked the work of other engineers and tested a number of the circuits to see that they were reliable. And, yeah, I did a certain amount of circuit work too.

Hendrie: When Bendix bought you, what was the transition from you working on the MADDIDA to the G-15 and not on the next generation DDA?

Beck: I think it was really-- we owe that to Dr. Huskey, who inspired us into getting into a general-purpose computer. And it was just dropped, wow, just immediately when he made his presentations to Bendix.

Hendrie: And so management just said, oh, let's go do this and took engineers from where they could get them. And I gather, since you were doing edit, the stories about installations of MADDIDA, it was being manufactured and installed and sort of the design work was fundamentally done on it.

Beck: Yes, it was. That's right.

Hendrie: Any interesting stories that you remember about getting the G-15 going? There are often, in designing a computer, little bumps on the road that you tend to remember and a lot of stress.

Beck: Right. I'm trying to think. I think we were-- that project, I think, went very well. I think it was a very successful design and it worked very well. I didn't have much trouble in doing installations. I did a few. They generally were shipped off and they worked. It was a very reliable computer even though, now, in retrospect, its methods of doing problems are sort of archaic. They aren't so well suited to…

Hendrie: The architecture's not so well suited…

Beck: No.

Hendrie: …to modern computers.

Beck: But it represented the genius of Mr. Alan Turing who was quite an amazing man. I would've loved to have met him.

Hendrie: How many bugs did you find in your logic design when you actually had to go and debug it?

Beck: Really none. My problems were more rather simple-minded problems. Very often the contacts on the plug-in modules didn't work very well for some reason. And it partly had to do with how the girls that did the wiring wired the contacts together. They would leave no flexibility in them. They were meant to be little flexible pitchforks to grab on the contacts of the boards, but they became very rigidly connected to one another with the wiring. So I think one of my breakthroughs was changing the wiring to a flexible, well, you didn't have any tight attachments from wire to wire. The wires would have little loops in them.

Hendrie: Stress-relief loops.

Beck: Yeah, right, so that the sockets started to work. Was very difficult debugging problems, because it all was sort of intermittent. The failures of connections were intermittent. So you weren't sure whether it was a design problem or just a simple mechanical problem.

Hendrie: Intermittents are really fun, aren't they?

Beck: Yeah.

Hendrie: Do you remember what the earliest installations of the G-15 were? I wouldn't have been surprised if you'd gone to the first couple of installations.

Beck: Oh, certainly. I went to Honeywell, they were an early customer, and also to a plumbing company that was trying to get into the computer business called Standard Radiator and Sanitary Company. It's still in business. They make flushing instruments. But I don't think they did too well with the computers.

Hendrie: We were talking about the G-15, and some of its applications, and during the break we had a little discussion about one of its biggest applications. Maybe you could talk about that.

Beck: Yes. We were very fortunate to have programmers who were able to create a program for the cut and fill problem of building highways, and we sold a large number of our computers to people who were in civil engineering programs. And that was, I guess, our killer application. Nobody used that word at the time, but it was.

Hendrie: Okay. Very good. Do you remember any other particular applications that sort of stuck in your memory?

Beck: Well, yes, partly because they were secrets. We sold some to NASA.

Hendrie: You mean NSA?

Beck: NSA, the National Security Administration, but we could never find out what they did with them. But we knew what that was for, but we weren't involved in that. We sold a fair amount of equipment to NSA. And I do recall at least visiting Werner von Braun and his team down in Huntsville. I'm a little hazy on what we sold there. Oh, that must have been later. That was at Packard Bell.

Hendrie: Ah, okay. Okay. Alright. Well, now I'm wondering were there any G-15 things?

Kossow: One of the things about the G-15 was it wasn't particularly easy to interface to. So did anybody ever ask for any special interfaces. You had a card reader and a punch a Flexowriter and paper tape and mag tape, and eventually the DBA.

Beck: Right. So it required a certain amount of effort to satisfy those requirements. But inherently the computer itself was a rather difficult one to use. You had to sort of love it and then said, well, I'll work through it, because much of the programming I'm sure was done in programming, in computer language not programming stuff.

Hendrie: Yeah. Do you remember whether there was a symbolic assembler or anybody tried to do a compiling? There was a thing called intercom that Weizenbaum did on Harry Huskey's machine up in Berkeley. Huskey had a G-15 in his house. There were algebraic interpreters for it.

Beck: I see. I don't think our company got the benefit from that. That was probably his own private venture, far as I know.

Hendrie: Yes. So he'd then go sell that on his own. He seemed to have a little entrepreneurial spirit. Any particular things about the architecture or why it was done? Was there a particular drive to try to minimize the number of tubes so that it would be a low cost machine?

Beck: Oh, yes. Again, relying on Turing's original concept, it was meant to be a minimal machine. For example, it had a curious way of adding numbers together. You could add all the numbers on a memory, any one memory track, or as far as you wanted to go. It didn't just say add. It would add numbers thirty through forty on track number six, and commands of that sort which were meant to efficiently try to gear into the recorded memory because, you know, things weren't always available at the right time. You had these curious things. Also there was a, to me it was a mathematical problem of how to get it to do the divide operation, which I sort of put together. Other people who looked at it said, "That's sort of miraculous that that gives you a division quotient answer." It's partly because you're either adding or subtracting on alternate steps into the numerator to get the answer. I don't think we want to dwell on that one. I think it was cute, and it impressed everybody.

Hendrie: Okay. Was there supposed to always be a divide, a multiplier and a divide?

Beck: Yes. It had all the basic comp mathematical.

Hendrie: All four functions.

Beck: Yeah.

Hendrie: Okay. So you just figured out.

Beck: Each one.

Hendrie: How to go and make it happen. Right? Very interesting. Okay. Let's move on to the G-15. Talk about what did you do next?

Beck: Then I wrote my next song. No. Well, it seems to me as we were winding up our success with the G-15, Max Palevsky came into our lives with the urge to formulate a new company, which is very difficult to do from scratch. You got to find investors. Get the engineers enthusiastic about leaving a secure place and going into the new venture, which we eventually called SDS, or Scientific Data Systems. And Max also especially got the investors to put up the money, particularly Albert Sperry and Leonard Sperry. They were very nice grandfatherly like figures, which we all liked as long as they were with us. The unfortunately passed away and Art Rock stepped in to represent the investors.

Hendrie: Well, now. That's Packard Bell. Is this at Packard Bell or are we moving on to SDS?

Beck: Yes. SDS. I skipped one.

Hendrie: Don't skip Packard Bell.

Beck: No. I don't want to skip that one. That's what I meant. My mind gets muddled up between these several companies. You're right. There was Packard Bell and that was fun. We were an appendage computer company attached to Packard Bell. Packard Bell was all feasting off their work on the Thor Missile Program, making test equipment and other things. And in my opinion, they developed a huge, incompetent staff, but they didn't realize how incompetent they were until they tried to take over another missile program by competing with a system that Collins Radio, Collins had developed, and suddenly it all fell apart on them, and their guys couldn't figure out anything. And so the Packard Bell Computer Company was in a bit of a squeeze because they couldn't afford to finance us as we were going along. But we did manage to produce and design a computer, the PB250, which was a very clever little machine, of which there are none like it. It had instead of recorded memory information, it had signals sent down a wire by torsion, twisting one end of the wire and as the signal got down to the other end, it was received and re-circulated. In that sense it was very similar to a drum memory in that everything had to be re-circulated in these wires.

Hendrie: This was the magnetostrictive delay line?

Beck: Yeah. Right. That is correct.

Hendrie: Now did you buy those from Ferrante? They were an early…

Beck: I believe that's where we got them. It was an interesting process. It seemed to me like magic.

Kossow: Weren't there lots of problems with getting the ones from Ferrante?

Beck: Oh, yes, there were problems, and I know some of our engineers went there to work with them to make sure they were working before they delivered them.

Kossow: How many people came over to Packard Bell from Bendix? Was it the whole G-15 team?

Beck: Just I think most of the G-15 team, because we were all sort of one unit of this company, this Bendix. I don't think we left anybody behind. We all joined Packard Bell and we had a nice little working relationship. We started at Packard Bell, we started to do different projects. One was to do a voltage to digital converter, which I personally spent a lot of time on. Now they're everywhere. When people convert digital signals to volt, audio or anything. We were sort of pioneering in the process of accurately measuring voltage digitally. That was a very interesting process.

Hendrie: Okay. Could you tell us what you remember about the actual formation of Packard Bell? Where did the idea for the computer come from, and was that the original product or the original plan, or did you start by doing some of these other projects and then say, "Alright, now we're ready to design a computer and build one." Do you remember what went on then?

Beck: I think Max played an instrumental role in developing the concept. Much as Huskey had provided me with the concept of the G-15, Max had the concept of this computer. And I don't where he found out about magnetostrictive lines, but we thought that was a great way of getting away from drum memory. And I think once Max outlined the concept, as far as I can remember, I did the detailed design, but it was much more rapid than the G-15 to design.

Hendrie: Really?

Beck: Yeah.

Hendrie: Was it because you knew more about design, or was it a simpler machine that did not have the complex concept that Turning had?

Beck: Well, I think it was just that I'd learned a great deal from working on the G-15, and so it was like child's play to design it. It was an easy machine, and it's a very attractive little machine.

Hendrie: Okay. It was obviously a binary machine.

Beck: Oh, yeah.

Hendrie: What was the word like? Was it a 24-bit machine?

Beck: That's very good. I believe it was 24-bit, and we were guided in that by Stanley. I don't remember his name.

Hendrie: Stanley Frankel?

Beck: Yeah. Stan Frankel spent a lot of time with us guiding our steps in that, because he was quite a bright guy. He had worked on the atomic bombs in Los Alamos and he was our consultant on that computer.

Hendrie: Oh, I didn't realize that. He had also designed the LGP-30.

Beck: I think so.

Hendrie: At Librascope.

Beck: Yeah. He was a very fine and helpful man, and guided our steps towards a good computer.

Hendrie: Okay, good.

Kossow: So were you the person that came up with the transistorized versions of what you had had in the G-15, or were they radically different designs?

Beck: They were new. We were starting at that point to get transistors that we had confidence in, and I spent some time designing just simple circuits, and other people, and went to work on the basic circuitry to work in that computer. And we all, at that time, the early transistors were germanium transistors and a lot of people made them. I don't remember all the companies, Fairchild up near San Francisco, the major company. Intel was beginning to do good transistors, and Westinghouse and others.

Hendrie: Yeah. Fairchild.

Beck: Fairchild is one I'm trying to think of.

Hendrie: Okay. Alright. Now did you use germanium transistors, or I know Max eventually decided he wanted to build a machine with silicon transistors and used them in the SDS machines. But was the Packard Bell built with germanium?

Beck: It was strictly germanium.

Hendrie: That was probably all that was available.

Beck: Readily available. The silicon, early silicon transistors weren't as fast. They hadn't been perfected for practical purposes. It took awhile. It was a bold step to switch to silicon because there weren't that many people who made high speed transistor, high frequency transmission with the transistors.

Hendrie: Okay. We'll get to that in a minute. Do you remember what the other projects that Packard Bell was trying to do? You mentioned the analog to digital converter. Did they do anything in terms with digital differential analyzers. That's certainly what Max said. Max said he worked on it at Bendix.

Beck: Yeah. We worked on a different version of digital differential analyzers called "Trice", the Trice computer. That was actually made with individual physical integrator. Each one was an integrator, and I didn't really do much work on that, but it was an interesting project.

Hendrie: Yeah. But it was going on at the same time.

Beck: Oh, yeah, right.

Hendrie: Do you think the fact that these projects were going on, did Max have any concept of maybe applying the computer to what were eventually called real time applications, such as missile testing or simulation or things like that, where you want to be able to digitize voltages from the outside world, and you might need to do some equations really fast which, of course, probably at that time a digital differential analyzer could solve some equations faster than general purpose computers.

Beck: Yes. Yeah. Max tended to work on concepts like that, because he did the marketing to various people, to Huntsville and to Werner von Braun team and others. I don't mean Werner-Gren. Von Braun.

Hendrie: Werner von Braun, yes.

Beck: I'm thinking of actual Werner-Gren.

Kossow: So that's where the Huntsville motel story comes. Ask if you wanted to talk about that.

Beck: No. I don't want to.

Kossow: Okay.

Hendrie: You don't want to talk about that.

Kossow: Do you know how Huntsville ended up using the machines? Were there different interfaces that they put on them, or were they just used as small desktop computers?

Beck: I don't know. They were the engineers and I'm sure they didn't just whatever the wanted to on their own. They were not. They didn't want to.

Kossow: You sold them basic computers.

Beck: Yeah. Right.

Hendrie: And then they applied the interfaces themselves.

Kossow: The PB250 is still a serial machine.

Beck: Oh, yes, yes.

Hendrie: So they're pretty slow.

Beck: Um hm.

Hendrie: Okay. Now somewhere in here I was always under the impression that dynamic shift registers were used for the accumulators for the program counter and the accumulator and, well not the instruction register. That wouldn't make any sense, but some of the registers in the machine. How did you build the registers in the PB250? Do you remember?

Beck: Frankly I don't.

Hendrie: Okay.

Kossow: The Museum does have schematics of the PB250. We can find out. It was designed to be an inexpensive machine.

Beck: Yeah, very inexpensive.

Hendrie: So it can do anything you can think of that you think will work.

Kossow: And it was very compact and had very unusual package. So there was a small control panel on the bottom with the power supply, and then they used two banks that folded out.

Beck: Which pivot out, and actually was a copy of the G-15, which did that same opening. And it essentially was a desktop computer you could sit on top of a desk anyhow.

Hendrie: Ah, okay.

Beck: But it wasn't for home use yet.

Hendrie: Yes, yes. I understand. But it was small enough.

Beck: Yes.

Hendrie: Okay. So how long did it take you to do the logic design in that? Do you remember? It was definitely faster than.

Beck: I don't know.

Hendrie: It wasn't as big a struggle as the G-15.

Beck: No. I think it was just a few months to do the logic of what was envisioned in that. It was pretty easy.

Kossow: So the other interesting thing that happened between the G-15 and the PB250 is you change your logic symbols. You go from something that wasn't close to standard logic to something that looks a lot like the NOR gates and NAND gates that look like triangles, and then that style followed on through SDS, the same drawing. I look at the drawings for PB250, and I look at the drawings for the SDS 910, I say, "This was designed by the same person."

Beck: Yeah. It could be. You brought up memories I do not have. That's amazing that invention that went on.

Hendrie: Alright. Do you remember any particular stories about either the design or the debugging of when you were working on the PB250? Maybe there's something.

Beck: No, I don't. It seemed to go very well. I mean, there were no midnight sessions that I can think where it seemed very marginal. It went very well once I got those wire memories to work, the torsion memories.

Hendrie: Now you also mentioned that you had worked on the A to D, analog to digital converter. Did you do that after you designed the PB250 or before?

Beck: Before. That was really when we were starting up the operation for Packard Bell. It just seemed like a very quick thing to get into.

Hendrie: And that you could sell and get a little revenue.

Beck: Yeah. Um hm. Because they're not very big boxes. They're rather simple once you get them correctly. They just involved precision resistors and transistors that operate the switches, and you're creating a bridge network by which you measure voltage, and it's a very nice, little product.

Kossow: I guess some of the earliest A to D converters that were transistorized, too.

Beck: Yeah. Probably so, yeah.

Hendrie: Yes. Okay. Now do you remember when Packard Bell was, you all left Bendix to go do that? Remember what year?

Beck: I have no.

Hendrie: Want to use your cheat sheet? Does it help you?

Beck: I got a cheat sheet. That would have been 1961 we went to this new building in Santa Monica. The highlight of the time I seem to recall as we were doing our preliminary work on getting SDS started, a big Bel Air fire broke out, and we had a marvelous view of it from the building. It was quite distracting seeing the big fires.

Hendrie: Alright. Well, that must have been SDS starting.

Beck: Yeah.

Hendrie: Yeah. Not Packard Bell. Okay. So approximately how long were you at Packard Bell? Did you participate in the follow on machines? I know there was a PB440 and some other machines at Packard Bell.

Beck: No.

Hendrie: You were not involved in those.

Beck: No, no. I left Packard Bell in 1961 to become part of SDS.

Hendrie: Okay. When was Packard Bell started? Do you remember that?

Beck: 1957.

Hendrie: 1957. Alright.

Beck: A brief time.

Hendrie: Yeah. Only four years. That was a very brief time. Now, I remember I first knew your name because there was an advertisement for the PB250 that had on it down at the bottom, "Logic design by Robert Martin Beck." Do you remember how that, anything about that happened?

Beck: I have no idea. Some advertising person.

Hendrie: Some advertising person thought that was a good idea.

Beck: Yeah.

Hendrie: Okay.

Beck: It was to give credit to somebody.

Hendrie: Well, that is very nice. I don't know of any logic designer that has ever gotten credit for a machine design except you. In an advertisement. In an advertisement, yes, yes, oh, yes. Many people get credit for something.

Beck: Yeah, usually our newspaper.

Hendrie: Among their peers they get credit. Okay. That's pretty interesting. Well, do you have any other questions about the PB250 you'd like to just look for?

Kossow: At Packard Bell, were you working as salaried employees, or were you under contract? One of the things I was interested in was when you start SDS, there's a mention that people were under five-year contracts, which is kind of unusual. Normally you just go to work for a company rather than being a contractor.

Beck: Well, we didn't do that for Packard Bell, but I think the clever people who are investing in SDS really want to pin the people down with contracts of employment. I even have a copy of my employment contract, which also included an agreement to provide some cash investment. They wanted us to have some of our own money involved, so I put in ten thousand and Max I'm sure put in ten thousand. And I think it was very clever of them to make a huge employment contract. It made it much more serious, because so many computer people just sort of drift here and there, and these investors thought about pinning us down a little bit.

Kossow: Yes. So they could get the fruits of your labor for a certain amount of time. This is really the best year. In the early 1960s when venture funding really starts in those sorts of terms rather than a company forming a subsidiary.

Beck: Oh, yeah. As far as we know. We may have been one of the first to bill out with our own name, no affiliations.

Hendrie: Yes. You mentioned something about the original people that encouraged Max to start and finance him were Sperry?

Beck: The Sperry's, Albert and Leonard.

Hendrie: Talk a little bit more about them. You presumably met them.

Beck: Oh, man, I met them all. I particularly liked Leonard. They were both marvelous older gentlemen and very, very serious about business.

Hendrie: So the Sperry's were Sperry Gyroscope?

Beck: I don't think so. These were from Sears or some. They had been in some other business. No. These are, I don't really know.

Hendrie: Were they from California?

Beck: They seemed to live in California.

Hendrie: They seemed to live in California.

Beck: Because I went to some of their homes and they were…

Hendrie: You don't have Max backup?

Beck: No.

Hendrie: I have to ask Max that?

Beck: Yeah. It was a very happy arrangement. The sad thing is both of them died of cancer before our company really flourished, and I'd say Max and I were quite shaken by their going, because we looked to

them as a stabilizing influence. And Art Rock said, “don’t worry. I can fill the bill.” He stepped in and did it.

Hendrie: But Art Rock was also an investor.

Beck: I think that’s why he did it.

Hendrie: Along with the Sperry’s.

Beck: right. But until the Sperry’s passed away, we didn’t.

Hendrie: You didn’t see too much of him.

Beck: No. But he stepped in after that and helped us a lot.

Hendrie: Okay. So when you decided to leave, I guess there is a story about that some of you in Packard Bell Computer, a sort of subsidiary of the main Packard Bell Electronics, had been promised that if you did a good job and you had a successful business, that you’d get some stock or something, something more than just a salary, and there was some problems with that actually happening. Could you tell what you remember about that?

Beck: Yeah. Well, Packard Bell I think might have liked to have fulfilled those obligations, but they had gotten into so much trouble, some strange troubles, like Bob Bell, who was the head of it had made a long term contract for wood with the Japanese, and after that contract was made, the price of lumber went into the toilet, and he was stuck with a big loosing proposition just on wood for the television sets. And the other thing was the incompetence of their engineers to continue after the end of their work on this other metal [ph?] and try to take up a new project. So they were hurting for money, and I don’t think they wanted to, well, they were distracted. They didn’t want to think about this little computer operation that seemed to be nagging away at them. And that was a great disappointment to us, but I understood their problems.

Hendrie: So was that the catalyst to go and break away and start a completely independent company?

Beck: Oh, yes, because we felt it was so difficult being caught dependent upon a major company that has other, bigger problems. So we were.

Hendrie: So the finance, the cash you needed, you’re growing. You need cash.

Beck: Right.

Hendrie: For inventory and stuff.

Beck: Right.

Hendrie: And they just didn't have it.

Beck: They didn't have it. They were more involved in creating a problem called "win" or something like that, which was a cost reduction program in the company, because they were. We would go to their meetings and we were all being told save on everything from toilet paper on up to everything, because they had problems.

Hendrie: Yes. Okay. So how did you and Max decide what you were going to build when you decided to leave? Do you remember how that all happened?

Beck: Oh, I think several of us sat in bull sessions about that as we were considering leaving, and sort of were able to outline in our own minds what sort of computer or computers we were going to create. And so we were able to do it very quickly. I think actually we started and delivered our first computer in nine months or some incredible period like that, because we were ready to run quickly. Even though we took the risk of switching to silicon transistors, which were better for standing up under heat. That's the main reason for switching to them, and I think that gamble paid off, and we also had to gamble on whether we would be able to make a core memory that fast, which was quite a challenge, because we had to get that from textbooks how core memories are made.

Kossow: That was one of the advantages that Digital Equipment had. Ken Olsen and that whole crew from MIT built core memories, so they had all of that experience. Do you remember anything from the original business plan about what sorts of products you were thinking of building?

Beck: No. I can't say really. Clearly I know from the other people in the company, that we were planning to build three computers at once, and we boiled it down to two because it was too big a bite. And we designed the 910 and 920 quite quickly. We, because I don't remember actually whether I personally did much design on it. I assume I did. It appears I spent a lot of time worrying about the memory, because that again was the crucial element.

Kossow: Apparently you came up with a really fast flip-flop?

Beck: Um hm. Right. Yeah. It was silicon. We were able to get past the electronics and we designed some very clever things. But I think a number of designers got their hands in that.

Hendrie: Okay. Do you remember what the memory cycle time was and what the clock rate was in that machine? Not readily. I would think it would be in.

Beck: It wasn't blindingly fast.

Kossow: No. It would have to be between two and eight microseconds.

Beck: Um hm.

Kossow: Okay. So one of the tricky things was not having the whole 24-bits of data path. I'm trying to remember if we had three or four, and then you'd go through three times or four times, but your logic was fast enough to actually get decent cycle times. Okay. Very clever machine.

Beck: Yeah.

Kossow: Before that machines we used strictly serial or strictly parallel. They had this really unique implementation where it was sort of half way between. Okay.

Hendrie: Well, that's good. So what was it that you had? You mentioned something about that the memory was the most difficult. Could you tell a little bit about the problems. Did you try to hire a memory engineer?

Beck: Oh, yes. We had an experienced engineer who developed the circuits that are required and some of the design of it. And he put it together with my supervision, and later I really stepped in because it wasn't quite working. It was a very difficult early form of the memory for us. I'm trying to think. I just knew it was sort of life of death for the computer, because you're dead without a good memory.

Hendrie: Yes. An unreliable memory, you can't make a machine. Any other interesting things about it? Are you concentrating on real time performance?

Beck: Oh, right.

Kossow: It was one of the first machines that had priority interrupts, or vector interrupts.

Beck: Right. They're called a priority interrupt. And, you know, I don't know where that idea came from. That may have been Max or when you're going that fast, so many things get done at once. But that was a brilliant concept to do that, where you could actually make a direct interconnection between the computer and some other process which could not have to wait for the computer to check on it.

Kossow: And the other thing was that it was really one of the first what we consider minicomputers, because it was relatively easy to interface to, so there were lots and lots of interfaces that were built through the 900 series.

Hendrie: Alright. Robert, I think we'd like to find out, or I'd like to find out a little bit more about the early days at SDS. Now, were you and Max both on the board of the company from its inception?

Beck: Yes, we were, and the Sperry's and Marvin Brody. I think he was on at the beginning.

Hendrie: Okay. So that was the original board.

Beck: Yes.

Hendrie: When you got started. Do you remember anything about how much money you got started with? How much you raised in sort of the first round?

Beck: It was approximately one million dollars of invested money, which is pretty small for starting a company that size.

Hendrie: Okay. And this was in 1960.

Beck: 1961.

Hendrie: One. Okay. You had indicated before, am I correct, you sort of knew what you were going to do by the time you went and raised the money. You had plenty of time to talk about it.

Beck: Right, in coffee sessions and the like. We pretty well had it in mind, but we were careful not to make a design on the other peoples' ticket. We waited 'til we started as a new company.

Hendrie: Okay. Alright. Now where did the idea to build at least, as far as the public would see, two different computer models as your first product? That would appear on the surface to be very ambitious. Talk to me about the pros and cons, or what the sort of decision process was there.

Beck: Well, a number of us liked the idea, came up, I presume from Max, because he would usually take the lead in that sort of thinking. But we, in fact, were planning three computers, which was a little too much. The 930 was not going to fit in the program. The 910 and 920 were easier to design as a pair, because we could sort of see one with features deducted to make the 910.

Hendrie: Ah. So it really was an overall computer architecture and design with the removal of things to make the lower cost interest.

Beck: Yes.

Hendrie: Machine. What sorts of things did you leave out of the big design? I mean, what were your ideas about that?

Beck: Well, first of all, just the scale of the memory was down to a smaller level. The memory could get quite a bit larger for the 920 by inserting extra modules, memory modules. And this was the essential main difference was the memory capacity which, of course, influenced the speed and the performance a great deal.

Hendrie: Okay. Now how big was your basic memory module? Was it 4K or 8K in the beginning?

Beck: In the beginning we made 4K modules, about the size that you could hold easily in your hand.

Hendrie: Okay. And so if somebody ordered an 8K machine, then you would deal with it.

Beck: Get another module, right.

Hendrie: And how big were you? What was the capacity you allowed for in the original machine?

Beck: Well, we could have four memory modules in a machine if we were so inclined, because they were small enough. It was put up in a relay rack, so it could handle larger memory by having extra components, but would not be a very big memory by modern standards.

Hendrie: Yes. Very good. Now did you do anything internal, in the arithmetic section of the machine to reduce, leave things out to reduce the cost of the 910?

Beck: No. I can't say that we could leave out any fundamental functions. We had subtract, multiply and store and retrieve. You really had to have all of those. I'm sure there were certain input, output channels that were reduced, but it wasn't very much of the cost for that.

Hendrie: So the biggest thing was the memory. And I guess I remember looking at the brochures, the standard peripherals you had, you didn't get a high speed paper tape reader or high speed paper tape punch with the 910.

Beck: No.

Hendrie: So sort of obvious configuration things.

Beck: Um hm. That's right.

Hendrie: Now there's a difference in the multiply and divide time, if I remember correctly, between the 910 and the 920. Is that just pure fiction or, you know, one jumper wire that you changed, or do you remember?

Beck: I think its one bit of salesmanship and a very small change. It really wasn't a serious difference.

Hendrie: Okay. Yeah. It wasn't like you had a separate multiply and divide unit.

Beck: Oh, no way.

Hendrie: And you took it out or put it in.

Beck: No.

Hendrie: Alright. It sounds like the printer board where like changed the belt, and the printer was more <inaudible>.

Beck: Yes.

Hendrie: So basically it really was you could do one design.

Beck: Yes. And then strip out parts, and that would become the other design.

Hendrie: Okay. Did you get the money from Arthur Rock sort of a second round after it got started, because you said Arthur was not a board member when got started initially.

Beck: That's right. But frankly I assumed he had made a contribution on the initial startup, because he was already an investor when the Sperry's died.

Hendrie: Okay. Alright. So he may have been an initial investor, too.

Beck: Yeah.

Hendrie: Okay. Tell me anything about the issues or things in designing the machine. How big a crew did it take to build the initial machine?

Beck: They're pretty small. We had a couple of girls to fabricate the memories, and two technicians to wire the computer up, and a number of other engineers who worked on debugging the original startup. It

was a pretty small crew. You know, obviously there was a draftsman and a few others, and the secretarial help, but it was a very limited group.

Hendrie: Okay. Did you have much to do with the detail design of the 910 and 920? Or were other people doing that?

Beck: I think other people did more of it than I did.

Hendrie: So by that time you were head of engineering, so you were trying to do module sales and then component sales, and things besides the computer?

Beck: And just overall management. I had somewhat drifted away from design, because I felt I was getting older for that work, and younger guys were able to put the energy into it.

Hendrie: Okay. Alright. Now you mentioned that you made your own core planes. You actually string your own cores?

Beck: Oh, yes. We got the little fiberglass frames with openings in them, and strung the wire through the cores and attached them to the little terminals all over the frames. You could hold a frame in your hand and then the frames had to be wired together to a connector, and that was it. We did the real nuts and bolts construction of the core memory.

Hendrie: Okay. You did it totally from scratch?

Beck: Yeah.

Hendrie: Oh, wow. One of the architectural things that was a little different than say your competitors. At the time DEC was certainly making machines in the same general price range with PDP-11 and the PDP-4, or at least the PDP-1. I'm not sure if 4 was out. You decided to put parity in your memory. Do you remember was that just Max's idea what the market wanted?

Beck: I think one of our mathematicians, probably Pete England, said we got to have a parity check because we're going to have trouble, because we were concerned also with magnetic tape recorders and things where we'd have to really check. We transferred information that we had some way of reconciling errors.

Hendrie: Okay. So there were some technical, the technical people thought you ought to do something.

Beck: Right.

Hendrie: Okay. Good. You indicated before that the memory was the hardest part to get working, that the circuits seemed to work pretty well and the logic. I didn't hear anything about the logic having a lot of unsettled <inaudible>.

Beck: There were no flaws as far as I remember. But certainly the fragile level of signal you get out of core memories made it very tricky to get the function. The difference between a zero and a one wasn't that great. And that caused some real confusion. I'm sure other people remember better about when we had a random number generator to put numbers in the core memory and see if it made mistakes. And that darn generator would cause a mistake every darn time for awhile.

Hendrie: Oh, my goodness.

Beck: Yeah. And so that was quite unpleasant, because you couldn't. Now that was a hard thing to track down, because that didn't happen very often, but it would be somewhere in the sequence.

Hendrie: Okay, but a long sequence.

Beck: Oh, yeah.

Hendrie: And not always the same place.

Beck: Right, right.

Hendrie: Oh, darn.

Beck: So that's why I spent a lot of midnight hours trying to figure where in the heck we were loosing the information.

Hendrie: Okay. What sort of conclusions? Do you remember what you had to do in the end to go and fix the problem?

Beck: Well, I just saw that we had to refine the circuit drivers and the receiving amplifiers that the engineer had created for us.

Hendrie: You had to work out the circuits.

Beck: Yeah, redesign the circuits to get the right signals, the signal to noise, I guess you'd say.

Hendrie: Okay. But you didn't have any grounding problems or other kinds of?

Beck: No, no. No serious things, because we were not going for a super high speed clock rate, and so it was not a difficult machine to make work.

Hendrie: Okay. Alright. Were you involved in any of the original customers? Do you remember anything about who bought the first machines?

Beck: Not really. That's sort of gone. That wasn't a problem. We seemed to sell more than we could get built. That was my problem was getting them done and working and delivered. So somehow it was pretty easy to sell them, and not to get them made.

Hendrie: So was Max the one that was going out trying to stir up business for it?

Beck: Yeah. He was the sales guy and really made a lot of contacts in the government and elsewhere.

Hendrie: Okay. It seems like you sold a lot of machines to NASA and JPL and in the aerospace industry.

Beck: Right. I might add one thing. We weren't just selling computers normally. That would have been nice. But very often we were selling systems that did other things. We had to build complex systems and check them out and get them to work and deliver them. For example, we sold some through a Japanese trading company to Japan, and that was a very curious experiment, experience for me, because we had negotiated these deals on a computer and the equipment, and they said, "Well, to satisfy the demands of MITI, M-I-T-I, of Japan, we must have a price of every package that you're going to be sending to us, you know, shipping crates, including manuals and everything." And I started responding to those requests sort of pricing out what the manuals would cost and the systems, components and computers, and what I found out is they were really in a sense renegotiating the contract by this technique of asking, because they would say, "Well, we're going to leave that part out", you know, whatever it was. It struck me as an odd peculiarity of the Japanese system that the contract wasn't very binding. It was more the beginning of a negotiation when you made the sale. So I got a little confused by some of that activity with the Japanese companies.

Hendrie: Okay. So SDS really didn't get into the OEM style of building systems until much later.

Beck: Right.

Hendrie: You would come up with a proposal for the computer and then all this extra interfacing, and come up with a price for that.

Beck: Yeah. And that's the way we did a great deal of our work. And a large number of our engineers were involved in building systems using the computers to do certain particular jobs.

Hendrie: So were you able to use much of the engineering that you did from another system on a follow on system?

Beck: Oh, yeah.

Hendrie: Or was it always one off?

Beck: No. We were able to adapt a lot of the designs that we used for one customer for another.

Hendrie: Do you remember any of the particular special systems that went out that you designed, just to sort of give a flavor of the kinds of different things.

Beck: No. I certainly didn't design those. We had…

Hendrie: I understand.

Beck: …different engineers to work to satisfy certain requirements, and mainly I worried about the overall production of that. So Max proposed and I disposed.

Hendrie: Yes. Okay. And the engineers were. Yes, you had the engineer persons to deal with.

Beck: Right.

Hendrie: But then you were responsible for all production, as well.

Beck: Yeah.

Hendrie: So you had all the material managements.

Beck: Right, inspections and quality control and a lot of things going on.

Hendrie: Oh, yeah. Assignment control.

Beck: Yes, yes.

Hendrie: So in some sense as SDS grew that was a completely different kind of job than you'd ever done before.

Beck: Oh, yeah. Yeah. As somebody pointed out, when we started we were more like a bunch of commandoes, and each guy had a job and went to work and did it. But later on, you're not like a bunch of commandos. You're more like an army with logistics and much more complex administrative details to deal with.

Hendrie: Okay. After engineering had finished doing the 910, 920, what did you do next?

Beck: Well, what we did. I didn't do that much. We had a man named Ben Wang who started developing tape recorders for us that could work in conjunction with a computer, for example. And then another engineer started making hard disk drive memories, which was a very new. I didn't really get into much of that because that was a very tricky project, I'll tell you.

Hendrie: Okay. So you started doing your own products?

Beck: Oh, yes. We built all of our things really.

Hendrie: Okay. In doing some research I found out that they had done a DDA at SDS as well.

Beck: Right.

Hendrie: Really. Okay.

Beck: Yeah. There seemed to be no limit to our ambitions, what we could sell. I was sort of running like on the treadmill to get everything done.

Hendrie: Okay. But you clearly had some very talented engineers.

Beck: Oh, yes.

Hendrie: Capable to do all these things.

Beck: Oh, yes, certainly, yes. You're right.

Hendrie: How did the 930 come about? That's the next main system that you did.

Beck: Yeah. That was the third component that we wanted to have, and that was a brand new design, but it was programmed compatible with the other two machines so we wouldn't waste a lot of problems on reprogramming. That was designed somewhat with my help and others. Since it used all the same

components as the 910 and 920, it was not a difficult job to do. It was just big, a much bigger machine, more capacity.

Hendrie: Okay. So you used the same circuit modules that you had done.

Beck: Yes, right.

Hendrie: You didn't have a new generation of circuit modules.

Beck: No.

Hendrie: And it was fundamentally a fully parallel machine?

Beck: No. I don't think so. No.

Hendrie: Oh, okay. It still had the same four or three disks, groups of doing small chunks in parallel. Where did the 9300 fit in?

Beck: My gosh. That was another. I don't think we sold.

Hendrie: That didn't really sell very well.

Beck: No. It was not a real success. It was unneeded and it didn't add anything. It was just an attempt to make a more glorified 930. It was not a great winner.

Hendrie: It was very sensitive.

Beck: Yeah. No. It was not a good choice. And that's it until we got to the Sigma 7, which became. That was our first attempt to go to higher clock rates. And I don't remember what clock rate change was, but it represented some substantial problems because the signals did one thing. You have to terminate the signals. If they come to an end of a wire, they would create echoes and go back and cause a lot of trouble. So we had to terminate the signals and create a ground plane for the wires to go near, so that we would get a healthier transmission of signals, high rate of signals. I spent quite a bit of time personally working on that and the problem of how to create a ground plane and the termination system for the Sigma 7 circuitry.

Hendrie: Was the Sigma 7, were they small cards still?

Beck: Yeah.

Hendrie: Like the. And then you had. Now was it all just point to point wiring.

Beck: Yes.

Hendrie: Or was it twisted pair in the background?

Beck: No. We still did point to point.

Hendrie: It was point to point still, so you never went to semiautomatic or automatic wire wrap on those back ones?

Beck: No, no.

Hendrie: Okay.

Beck: No. And then I'm sure you've heard. I know the Sigma 7, one of them went to UCLA and played a part in setting up the very first concept of the internet, the very first hello, are you there, the answer was yes, type of communication. Yeah.

Hendrie: Neighborhood. Very good. Well, you had a couple, you had at least one more diversion with the earlier circuits. You did try to build a small machine, the 92. It was a short board like machine. I am not sure. It was a 12-bit machine. It was just another thing.

Beck: That was going on.

Hendrie: It was going on that you had to.

Beck: I blank out on that one. I don't think we sold any of those.

Hendrie: I don't know whether yours sold. I always heard that Larry Israel was the fellow that was hired to do that. But I'm not even sure about that. So the Sigma is the next big thing. Now was there any significant discussion at the board level about whether, or was it just sort of obvious that we'll take the next step. Our first generation's been selling well, the last two. Or was this a reaction to the IBM 360 now?

Beck: That was certainly in the back of our mind, and not something that we would have discussed at the board. But we certainly were aware of what IBM was doing and we had to have a more serious level of a computer. And we created it. That was the last one that I was involved in really.

Hendrie: Okay. Yes. So you went to 32-bits, so that you had bites instead of characters.

Beck: Right.

Hendrie: And then the circuit performance. You said you had personally done some work on solving, providing a ground plane for the signals. Did you do something special in the back plane, or was this just on the circuit card?

Beck: Oh, it was on the back plane between the circuit card connectors. And my personal role was just, you know, putting some wires in and sending some high speed signals unterminated and terminated trying to see how fast signals could get along wires, because we were dealing with a transmission speed near the speed of light.

Hendrie: Right. And this was a bigger machine.

Beck: Yeah. So we had to deal with feasibility of this higher clock rate. No profound discoveries were made. We just found out that if you made a good ground plane, and had the leads running a sensible way, they would get the signal there in time and not mess up.

Hendrie: Yeah. That you couldn't put the ground in the channels.

Beck: No, no.

Hendrie: That would not work.

Beck: No. It had to be as direct a wire you could.

Hendrie: Yes. Okay. So maybe you could share what other problems now that you were sort of really at a much higher level worrying about both of engineering and manufacturing that you had to deal with during this period by the time you had started the Sigma computer.

Beck: Right. Well, we get into the not exotic parts of things having to do with budgets and manpower and fighting off a unionizing effort by the IAM organization, which was really quite annoying because, you know, they put out pamphlets showing Max as a Satan and it's a very difficult time when you go to a union organization thing. And we just got lucky at the end. The IAM got into other troubles with other places, and they ran out of the budget. They couldn't keep supporting their organizing effort at our place and they abandoned all the guys who had been making their commitment to get the workers organized. And so they just cut them off. We can't afford you anymore.

Hendrie: Okay. We have to choose our priorities.

Beck: Um hm. That sort of struck me as sort of shocking that the management of the union would lead people down the path of a unionizing effort and just pull out. Because I think they could have won the thing if they just stuck with it.

Hendrie: Okay. Yeah. That's interesting. So had your efforts with developing an integrated circuit started with the Sigma 7, or was that after that?

Beck: It was before that. We started doing some integrated circuits before the Sigma 7.

Hendrie: Was the integrated circuit in the 930 or the 9300?

Beck: No, no.

Hendrie: That was the Sigma.

Beck: Um hm. That was our first branching out to a new level of technology.

Hendrie: So did you just try to integrate the existing, the box that you had designed?

Beck: Yes.

Hendrie: Or was it your design?

Beck: No. I was really trying to get the same circuitry, integrated circuit which, of course, was a very interesting project to do, I must say.

Hendrie: So you were working with Genetics on that?

Beck: Yes.

Hendrie: That must have been one of the earliest projects that Genetics had?

Beck: I think so.

Hendrie: Yeah. This would have been say 1964 or 1965.

Beck: '65, or even later. I'm not sure.

Hendrie: It might have been 1966. But did you use the integrated circuit in the Sigma 7 or not?

Beck: Yes, we did.

Hendrie: You did. You started. You developed them. Got them working.

Beck: Um hm.

Hendrie: So it wasn't just a transistor machine.

Beck: Right.

Hendrie: You broke a lot of previous barriers.

Beck: Oh, yes.

Hendrie: Okay. What kinds of memories. Did you still design your own memory?

Beck: Oh, no, no. Not anymore, no. I'm just trying to remember what the memories were in the Sigma 7. Maybe Al remembers. I don't.

Hendrie: Maybe RCA? Were you considering buying from RCA.

Beck: No.

Hendrie: Or electronic memory from Magnetics, Cambridge [ph?] memories. That was only a memory. They were all? Yes. You're right. Those were all only memory. I supposed I could stick my head in a Sigma 5.

Beck: Yeah. Maybe you should, because I've lost track of what the memory was, because that is a crucial thing.

Hendrie: That's right. The Sigma 5 and the Sigma 7 came out roughly at the same time.

Beck: Yes.

Hendrie: So the 7 was the one that had memory mapping and the 5 was just a stripped down version of the 7.

Beck: That was sort of a replay of the 910, 920 extension.

Hendrie: So they were both basically the same machine.

Beck: Yes.

Hendrie: You left out certain jumper wires. The other interesting thing is coming out with a 16 and a 32-bit machine roughly at the same time, the 2s and 3s, and then the 5 and 7, the small Sigma's that we used in place of the 920 and those machines would have been.

Beck: Right.

Hendrie: So did the software group report to you then, as well?

Beck: Yes. So it was sort of a mixed arrangement. They somewhat really reported to Max, too. He sort of was a leader in the software development, because that was too much for me to tend to. I'll tell you.

Hendrie: Okay. So there was a problem with software always being late in 1967 through 1969 timeframe especially. There was a time sharing system that I saw design specs for going back to 1967 that finally makes it out in like 1970. It was complicated.

Beck: Oh, yeah. It's a horrible amount of work.

Hendrie: Yes. Like I just came from Brookhaven.

Beck: My goodness. Yeah. Those names just make.

Hendrie: I know. Those names kind of. My friend would just think of engineering managers that would have been working for you in that timeframe, trying to get a feeling of what the organization was like. And this was 2,000 people by the time you left?

Beck: Yes. One key programmer, which we don't seem to mention, is Mendelson, Jerry Mendelson, who worked with Pete England quite a bit.

Hendrie: Okay. Tell me a little bit more about him.

Beck: Well, I first met him at UCLA where he taught me certain kinds of algebra. He was a teacher at UCLA, and we hired him as a programmer, and he was a brilliant programmer.

Hendrie: Oh. So he was a teacher when you were.

Beck: A student.

Hendrie: You were a student.

Beck: Yeah.

Hendrie: Okay. Do you remember what he did? What he was responsible for?

Beck: No.

Hendrie: You just remember he was really good.

Beck: Yeah.

Hendrie: Okay. Very good. Now could you maybe talk a little bit about what the discussion were or how SDS ended up being sold as opposed to continuing to grow?

Beck: Well, I had retired from SDS at the time this came up, but I was still on the board.

Hendrie: Yes. But you were on the board, from a board point of view, considering.

Beck: And I'm pretty sure I'm not bragging too much by saying that one factor leading Max and others to accept the sale was that I had left, and he had looked at me as a pillar of strength that he was going to be losing. But their approach to buy SDS struck as a marvelous thing, and we just couldn't believe it.

Hendrie: What made you feel this is really marvelous? What was it about it?

Beck: Well, I realized that we were doing what amounted to scientific computers, and that Xerox somehow thought they were getting a company well adapted to doing commercial business computers. And they weren't even getting what they thought they were getting. And I thought it was a mistake for them, but it was awfully good for our investors and the company, because it went on quite awhile after they came in. So I thought it was just a wonderful sale to make. Later on I'm pretty sure Xerox must have had some doubts about that. I don't have a copy of it. There was a magazine article on computers referring to the million dollar mistake or was it billion dollar mistake, where the decimal point was,

referring to that purchase, because it didn't work out for them. They somehow thought computers are computers, and if we just worked with their paper producing function, and there was nothing in the talents of the company that were suited to business applications. So it was just a windfall for us. And I think actually even though it was a big loss to Xerox, it didn't really dent their income.

Hendrie: Well, they were such a huge and so successful with their copiers. So you decided to retire in 1969?

Beck: 1967.

Hendrie: So why did you decide to retire?

Beck: Exhaustion, I guess, and just wanted to get back to something else. In my case it was to go get a ranch up in Montana and run a cattle business, because of my roots in agriculture I felt much better about that than continuing to work on computers.

Hendrie: Or at least where you were.

Beck: At that level.

Hendrie: At the level.

Beck: Yeah.

Hendrie: Yes, at a management level.

Beck: Right. Matter of fact, after I bought the ranch, we had one board meeting up here at the ranch. It was great fun. Got all the directors up there, including Dan McGurk, others, and they had a great time.

Hendrie: Okay.

Beck: Well, because we had the meeting in July and it snowed.

Hendrie: Alright. A little bit more about the sale of the company. I wanted to ask a question about how much employee ownership there was of SDS. Was that one of the things that you and Max believed in, having engineers at various levels in the company had stock in the company?

Beck: Yes. We had a broad spread of stock ownership amongst the professional people in the computer company, and many of them just were also delighted with the sale, because it was much more than they had expected.

Hendrie: Yeah. Much more they could ever expect to save from the salaries.

Beck: Right.

Hendrie: Do you remember sort of how much of the company was owned by the employees versus owned by outside investors?

Beck: I'd really only be guessing. I don't know. I think it was a pretty high percentage. I would think twenty percent, but I'm not. I have no real knowledge of that.

Hendrie: It would have easily been twenty-five. We neglected to cover when you went public. That's often an event of at least some transitory significance to a company and its employees. Can you tell us a little bit of the story of that?

Beck: Well, that was very exciting. Max Palevsky and I went to the New York Stock Exchange to visit the first purchase of our stock. We could see it flashed across the board, and it was to me a very exotic experience, when you really see all that activity of people running around on the floor doing things and all the commotion. We were well treated by the head of the Stock Exchange. He gave us a nice lunch and welcomed us in as a member of the board, no, a member of the Stock Board. We really-- I think that was a substantial high point of me for my efforts in the computer business to see that. I remember it so well.

Hendrie: Okay. Well, you'd experienced that before.

Beck: No, no.

Hendrie: And I guess Max hadn't either.

Beck: Oh, no. This is new. Well, you know, that's a pretty special event, the ringing of the bell and the whole business of the Stock Exchange was very impressive to us.

Hendrie: Good. So after you retired and bought your ranch and then when Xerox bought SDS, there wasn't a board.

Beck: No. The board ended. Many senior people in the company continued on closely connected with Xerox. One particular employee that I helped Max recruit, Sanford Kaplan, who was our financial whiz

kid, he actually transferred to the headquarters of Xerox and became a very intellectual citizen at Xerox for awhile.

Hendrie: Oh, okay.

Beck: This is a sidelight. When we recruited him, both Max and I gave up some of our personal stock options to go to Mr. Kaplan, because we were so convinced he should become part of our company.

Hendrie: And that he would make an important contribution.

Beck: Yeah, because we had outgrown our abilities to manage our finances. Kaplan had been part of McNamara's group in the original Whiz Kids. That's why we referred to him as a whiz kid. He was a pretty bright man.

Hendrie: Oh. And how did you manage to meet him? What was he doing?

Beck: Oh. Well, I don't know. He was bouncing around doing different things, being friends to Sandy Kovacs and a lot of other things. But through our patent attorney, Ellsworth Roston, we were introduced to him. Ellie Roston said, "This is a good man. You ought to see if you could get him to work with you, because you may need some help", because the company had become rather complex financially. And I'm very pleased for the hiring of him.

Hendrie: Okay. That turned out to be a very good idea.

Beck: Oh, yes, indeed, because when it comes to dealing with getting underwriters to open your stock and all, there's a knack to that and none of us knew how to do that, but he knew how to do those things.

Hendrie: Okay. Alright. That's good. Were there any other sort of key people that come to mind that offered something, that you remember?

Beck: Oh, yeah. Well, I'll just mention that I did admire some of the clerical staff, secretaries. Max's secretary at the time was Joy Morrell, and my own secretary, Arzelia [ph?] Powell, and at least for me, I gave her a special parting bonus as I left, because you don't just say goodbye to somebody who's taken care of you that much. And I don't know what Max did for Joy Morrell. I think he had her working for him kind of in his private business or something.

Hendrie: Okay. Alright.

Beck: Ladies like that play an important part in the company, soothing relations and keeping things going.

Hendrie: Yeah. Okay. Helped you when you're just focused on particular problems.

Beck: Right.

Hendrie: Alright. Very good.

<crew talk>

Hendrie: Obviously we ought to just spend a little bit of time to understand the interest that you developed after you retired. You were relatively young when you retired, because you went into cattle farming. You mentioned that you had developed some other interests that were in the nonprofit world. If you could tell us a little bit about those, how you became involved in them and why they particularly appealed to you.

Beck: Well, I was introduced to Dr. Leaky, and he was a very impressive man to me, thinking about the future and not just evolution, but the overall problems of the world. And I was so impressed with him that I felt the world could benefit if I supported some of his works. We actually started with other people the L.S.B Leaky Foundation for Anthropology. And it was through that organization that I got acquainted with Donald Johanson. He wasn't very famous at the time, later became famous with his discovery of Lucy, one of the early primitive folks. There again I found his staff and the work they're doing now is very, very fascinating. And they do not entirely old things, but one of the scientists on the tip of South Africa is working on weather patterns and looking at the future to see how the world adapted to the ups and downs of weather cycles. And he's doing very important work, I think, about weather cycles, as well as anthropology on the tip of South Africa. There are other very impressive people in these fields, so it just delights me to associate with them.

Hendrie: Okay. And to be able to be some help to them.

Beck: Yeah. And it gives you a chance to travel. Helene and I a few years ago made a trip to Africa, including this field work in South Africa, and it was just a great experience to mingle with the working people there down at the base of a cliff, working on all sorts of things.

Hendrie: Yeah. Trying to dig out the.

Beck: Tease out the information about the past.

Hendrie: That sounds wonderful. Well, are there any other interests that you've developed since you've left?

Beck: Oh, well, the grove. We have a place called "Beck Grove" here in Fallbrook, California, which is an organic grove, which is very educational to me. It's an organic operation, and since then we've been

certified as a biodynamic organization, which is a little bit more sophisticated way of being organic. And that's been very satisfying to me to see how to do that, how to get by without insecticides and things, and build a soil without sort of depleting it, the way much farming is now done. Commercial farming I think often just robs the soil of good things, and we're building the soil, not depleting it in this grove.

Hendrie: And still producing product?

Beck: Oh, yeah, totally, very successful and because it's a very satisfactory product, tastes very good, you'll get a premium price on it for being what it is.

Hendrie: Alright. Well, I want to thank you very much, Robert, for agreeing to do this oral history on behalf of the Computer History Museum.

Beck: Well, I thank you, Gardner and Al. You've made it a very pleasant experience for me to relive some of the past.

END OF INTERVIEW

