Oral History of Arthur (Art) Beard

Interviewed by:
Gardner Hendrie

Edited by:
Dag Spicer

Recorded: December 15, 2009
Moorestown, New Jersey

CHM Reference number: X5679.2010

Gardner Hendrie: We have with us [December 15, 2009] Art Beard, who has graciously agreed to do an oral history for the Computer History Museum. Thank you very much, Art.

Arthur (Art) Beard: You're welcome.

Hendrie: Could you tell us a little bit about your family history?

Beard: Very good. I was born in New York State, in New York City, actually, but I can't remember that. My parents moved out to Long Island, Old Westbury, before I can remember anything, and I grew up in Old Westbury, which was a nice country town in those days, a lot of estates and so forth. My parents worked in several of the estates, and eventually my father became head of the Water Department in the village of Old Westbury. But, needless to say, I grew up in a country life. We rented a home on a Quaker farm. Quaker family had been there for 100 years. They had horses. They had 30 acres of farmland. I earned my initial pin money by working on the farm. And one of the results and the rewards of working there was we could ride the horses any time we had time off. They had not only draft horses, but hunting horses, so we could take the horses out across country, jump every fence we ran into, and so I had a great upbringing. Old Westbury did not have their own school system, so we got farmed out to different grammar schools, and also different high schools. I went to East Williston Grammar School, which was a bus ride of about three miles, if I made the bus. If I missed the bus, my mother made me walk to school.

Hendrie: How far a walk was that?

Beard: It's about three miles, and as we used to say, it was uphill both ways. Then, after East Williston Grammar School, I went to Rosalind High School in Rosalind. And, likewise, that was about three miles away.

Hendrie: Did you have any siblings?

Beard: Yes. I had a brother and a sister. There were three of us in the family.

Hendrie: What was the birth order?

Beard: I was the oldest, my sister was the second oldest, and my brother Don was the third child.

Hendrie: Did your mother work, or did she mostly stay at home?

Beard: She mostly stayed at home, but she would take an occasional job every now and then, of taking care of somebody's children or helping out as a cook in some of the estate homes.

Hendrie: What is your earliest memory of thinking about what you might want to be when you grew up?

Beard: I'd heard about engineers. I wasn't too sure of what engineers did. But I got interested in radio. I just could not fathom how signals could be sent from one place to another with nothing in between. And so I played with some old radio parts, and I was intrigued with it, and I had heard that electrical engineers

were involved in the radio design, so I said, “I want to be an electrical engineer,” though I had no idea what electrical engineers actually did. But it stuck with me, and it turned out to be, in retrospect, the right decision. And most kids don’t really know what they want to do, and why they want to go to college, or what they’re going to study. But I lucked out. I picked the one area that, in retrospect, I think was the right one for me.

Hendrie: When you were in high school, were there any particular subjects that you enjoyed, and things you didn’t like?

Beard: I liked the science courses. Number one, I guess, the mathematics courses. Number two, I liked history. I think English was the subject I liked least.

Hendrie: Very good. A common answer from people that turned out to be very good engineers.

Beard: Yeah.

Hendrie: Did you play sports?

Beard: Yes. Oh, yes, I did. I loved to play sports, so I played them all in high school: football, basketball, track, and baseball.

Hendrie: Wow!

Beard: Managed to get them all in. Track would compete with baseball, but baseball was my primary sport. But I did the high jump and the broad jump, and I didn’t really have to work out too much to do those, so I was able to participate in the track meets, as well as play baseball.

Hendrie: Wow.

Beard: Yeah. That was a lot of fun. I enjoyed playing sports. It’s... likewise, when I got to college, the same way. It was a great relief from studying.

Hendrie: Was it ordained as you were growing up that you were probably going to go to college?

Beard: My parents did not— my parents both came from Great Britain. My mother was from Scotland, and my father was from England, and they went through... I guess would be the equivalent of a junior high school here in this country. I forget what their system was called, but... they were very well educated. My father— and that’s from not having had much higher education, but my father could always beat me with math questions, even when I got into calculus. I’d give him a calculus problem and whatnot, and he’d solve it in his head, not by calculus, but he’d just figure it out commonsense-wise.

Hendrie: Oh, my goodness.

Beard: Yeah. So... so they— my mother enjoyed poetry very much, and she could recite hundreds of Robert Burns' poems, and... I had a couple of very delightful parents.

Hendrie: Did they encourage all of you kids to go to college?

Beard: Yes, they felt education was the most important thing for their children, and I think they would've liked to have moved south much earlier, but we were in a very good school district for education, and so they kept right there in Old Westbury so that we would have the benefit of the school system that was available to us. Financially, I don't know how we could've made it through college, though we all did. I did get a scholastic scholarship— New York State scholarship— and a full scholarship to Cornell. But World War II was well on its way, and so I enlisted in the Navy when I became 18 in my senior year, and I was encouraged to go to college in one of the Navy programs, to become an officer. And so, as a consequence, when I graduated from high school in '44, I went directly to college as a Navy apprentice seaman. I guess that was the fundamental rank. And so, fortunately for me, the Navy paid for my first two years of education, which was an accelerated program, so at the end of two years, I was a senior.

Hendrie: Oh, my goodness.

Beard: And so in '46, the war had ended, and we were mustered out in the Navy, and I went on at RPI, where the Navy had sent me to get my bachelor's degree, and at the same time I got my officer's commission as an ensign in the U.S. Navy Reserve. So I was very, very fortunate at that time. Actually, I made money going to college. I had the New York State scholarship, plus the Navy was paying me, and paying tuition and so forth.

Hendrie: So it was not a burden on your parents for your college education.

Beard: That's right. Right. And likewise, my sister went to a two-year college, and able to afford that. My brother went into RPI also, and he had some scholarship for help, and also he joined the Navy Reserve while he was there, and I think they helped pay for some of his education.

Hendrie: What specialty did you study while you were at RPI?

Beard: Electrical engineering first, but I was very much interested in physics courses. I stayed on at RPI an additional two years after I got my degree, after three years of accelerated program, to get my master's degree. I was a part-time instructor during that two years that it took to get the master's degree. I got paid for that, plus I coached the J.V. lacrosse team, and I got a small amount of money for that. And I thought I wanted to go on and get a Ph.D., and I had looked for an assistantship at Caltech and Stanford and Columbia, and at that time I thought I wanted to get into nuclear physics. I had taken some nuclear physics courses. But then I was very much concerned with the economy in 1948, '49. I said, "I better get out and get a job." And... that time I decided to go to either RCA or the Bell Labs. I had friends at RCA, and decided to go to RCA at that time, and to take graduate work at the University of Pennsylvania to get my Ph.D. After several years working in RCA's development group, and spending a couple years at night school at the University of Penn, it became evident to me that a Ph.D. was not going to really help me in the kind of work I was really interested in. It would be important if I wanted to be an instructor or professor at some time to have that be on my name, and I had taken all the interesting graduate courses, and by

that time I had a family started, and I decided to forget about a Ph.D. degree, which would've involved a lengthy dissertation at that point in time.

Hendrie: When you got you master's degree, did you have to write a small thesis?

Beard: Yes, I did.

Hendrie: What was that on?

Beard: It was an experimental investigation of the standing waves in an electromagnetic cavity.

Hendrie: Okay.

Beard: <laughs> Turned out to be very, very interesting to do the work, and it actually worked. I mean, I could actually map the different modes of oscillation of electric fields inside of what was a magnetron-type cavity, something that was roughly three inches in diameter and about ten inches long, and you could tune it by moving a plunger in and out. So I was able to map the different modes of oscillation within the cavity.

Hendrie: What pushed you to RCA? Did you know what you were going to do there?

Beard: Yeah, I was interested with Bell Labs because my professor at RPI had a good friend at Bell Labs, and he was the one I did my thesis under, and the study of electromagnetic resonance, and I'd corresponded with him several times, and Bell Labs was noted for its research. I felt I wanted to be in a research-type group. But I also had some, actually, fraternity brothers that had left to go to RCA a year or two ahead of me, and they encouraged me to come down for an interview at RCA. And the RCA people did a full press on me, and convinced me that the kind of work I really was interested in was not the RCA Laboratories, but in a development group in Camden, called "advanced development." And that, plus the personal persuasion of my friends, plus the interest in advanced development work, as opposed to pure research, is what decided me to come to RCA.

Hendrie: Who hired you at RCA?

Beard: The ultimate authority at the time was the manager of the advanced development group, named Stan Cochrane. I don't know you—

Hendrie: I remember Stan, yes.

Beard: And it was very interesting. It turned out to be the right decision for me. I got involved in, initially, the very interesting project. I was the only engineer, initially, for inspecting the inside of empty milk bottles. <laughs>

Hendrie: Okay.

Beard: Yeah. RCA had an industrial group that had developed a Coke bottle inspection system, where they wanted to make sure that once liquid was put into the bottle and capped that there weren't some foreign ingredients stuck to the inside of the bottle. And what they did was that they spun the bottle, after it had been capped and filled, and looked for bubbles, and if there were any bubbles that got created, they rejected that bottle now. But they wanted to do the same thing for the milk bottle industry, but spinning the bottle with milk in it was not a possibility, so it had to be an empty milk bottle. And so I developed a scheme whereby you put some ultraviolet light source down inside the bottle with mirrors, spun the bottle, and scanned it with the ultraviolet light, and it picked up any reflections off the bottle, and those two kinds of reflections— specular, where things hit on one angle and go off at same angle, as opposed to diffuse reflections— if there was foreign material, like a gummy substance or something of that sort stuck to the side, well, it would give off a diffuse reflection. And I had two mirrors in there, inside the bottle that... if it was a specular reflection, it would only hit one of the mirrors. If it was a diffuse reflection, it would hit both mirrors, and that was the criteria for rejecting the bottle. And the reason the ultraviolet was required, as it did not want anything on the outside of the bottle, such as embossing the bottle, to give a reflection. It would give a false indication of something inside the bottle. The ultraviolet light was high enough in frequency that it would not penetrate the glass, so they only got reflections from the inside. So that was— I mean, it was— I couldn't believe they were paying me to have so much fun. And that project lasted about a year, and... came up with a, you know, a prototype, and then it was turned over to the industrial design group. We, being advanced development group, we got to pass off our development ideas to somebody else. It turned out that that never became a product, because they started to do away with glass milk bottles. It went to cartons— paper cartons. So...

Hendrie: The technology moved ahead of your clever idea. I'd like to pause now.

Beard: Sure.

<audio break>

Hendrie: We just finished your first project, which was the empty milk bottle.

Beard: That's correct.

Hendrie: What did RCA ask you to do next?

Beard: <clears throat> Well, RCA had been looking for new areas to move into, and they had commissioned Arthur D. Little Consulting Company to look at possible new businesses that RCA could get into. And the recommendation was that RCA ought to get into electronic data processing.

Hendrie: So *they're* the people that are at fault for that decision.

Beard: That's right. So it was assigned to advanced development, to the group that I was in, to investigate computer systems for the purpose of data processing— commercial operations. And they put together a marketing department, and we formed an engineering team in advanced development to develop a computer, which eventually, hopefully, would be used in data processing type applications. We did utilize some of the people at the RCA Laboratories in our early work. Jan Rajchman in particular, was a great inventor, and I kind of had tutelage under him, since I was one of the first engineers assigned to

this computer project. So I went up and worked at the RCA labs for about six months with Jan Rajchman, who is one of the most inspiring, interesting people I've ever worked for. He had inventions what came out of him, you know, two times a day.

Hendrie: <laughs> Yes.

Beard: Yeah. He invented the Selectron, which was an electrostatic memory tube for storing digital data. And he also was the inventor— I think it was contested with Jay Forrester at MIT, for the patent of the magnetic core memory. I think it eventually ended up where they both agreed that they were— they both had patent rights, basically, both MIT and RCA. But anyway, I had the privilege of working with Jan Rajchman in the early days of our computer development. And—

Hendrie: What were you doing with him? What was he studying at that particular juncture?

Beard: At that time, he was developing vacuum tube circuitry to drive the Selectron tubes. I've got a picture I can show you later on of one of the two big memories that were built for the Institute for Advanced Study, and also the Rand Corporation, using the Selectron memory tube. It's a tube that was about this tall and about this big in diameter, and had the ability to address and store 256 bits of information.

Hendrie: <laughs> Pretty interesting.

Beard: And this was invented and developed initially at the RCA labs, and the RCA tube division undertook to produce them. It was a limited number, anyway, in the beginning. And the price for the 256-bit memory device, just the tube itself, the RCA tube division lost money selling them at $2,000 apiece.

Hendrie: Oh, my goodness. Wow! <laughs> That's pretty interesting.

Beard: Yeah. And, of course, that was the cheapest part of the memory system. It took a seven-foot rack of electronic equipment, plus power supplies, to power a bank of these tubes. But it was presumably a big step forward from the type of memory that was used in the ENIAC computer, which I believe were decade counters.

Hendrie: Yes. Exactly. And in England, they had tried doing just cathode ray tubes, too.

Beard: Right. Williams tubes.

Hendrie: Yes.

Beard: Well, I don't think the computer age would've ever gotten off the ground if it had to depend on vacuum tubes, particularly for memory. And Rajchman knew that, and the MIT group, also, so that's when they thought of developing magnetic core memories.

Hendrie: Do you remember any of the claims and counterclaims that went on between MIT and RCA for a while?

Beard: Yeah. I was never party to what actually went on inside. I mean, I'm sure that it had to be— went into who discovered what, when, and where, reduced to practice, and all those kinds of things. My general take on it was that they both developed it about the same time.

Hendrie: That's certainly my impression, too. I had heard a story, and I do not have a source for it, that when they finally came down to figuring it out, that the lab notebook that Rajchman first wrote something about how to do this, the date was two weeks later than Jay Forrester's date in his lab notebook.

Beard: Oh, my goodness. Yeah.

Hendrie: That's how close it was.

Beard: Yeah. Right. Well, where were we?

Hendrie: We were discussing your first work with this computer group.

Beard: Right.

Hendrie: You're working on circuits for driving Selectrons.

Beard: The marketing group made a study which asked: "What is a data processing job?" And it was the market planners that brought in a consultant that understood the public service of New Jersey building problems. So we figured we wanted to figure out what the logic would be behind a system that would create bills for public service companies. And I remember at the time of flow-charting what went on, in terms of creating a bill, and the data that had to be collected and whatnot, and finally came to the conclusion it'd be cheaper if they just gave everybody free electricity and not have to bill them. It was going to cost too much to create the bills. <laughs> But, nevertheless, we pursued that, and... I think I made some proposals to Public Service and Electric Gas. I don't remember if they awarded any, but the big contract that was awarded was with the Army Tank and Automotive Center in Detroit. And we developed our first system at that application. Well, we— in those days, to be a computer engineer, you had to develop your own circuits. You had to develop your own logic. You had to build your chassis, or whatever it was that was going to put the electronics on, and the power supplies, and so forth. It was a complete— to be the computer engineer in those days was you had to basically invent everything, develop everything, and so it was a lot of fun. And, of course, the early work was with vacuum tube circuitry. Semiconductors had not been really put on the scene yet. And... and so we developed vacuum tube circuitry to be the, basically, the heart of the logic in the system.

Hendrie: Who were some of the people that worked on this at the very beginning?

Beard: The people that I worked with in advanced development were Lowell Bensky [Lowell S. Bensky], Dave Nettleton [David L. Nettleton], Dick Endres [Richard O. Endres]... the three that come to my mind.

Our group leader was a fellow named Walt Halstead, and over him was Nat Marshall, who I'm sure you remember.

Hendrie: Yes.

Beard: He was a great supervisor. I think our original group— oh, Arnold Spielberg was also one of the development engineers. In fact, Arnold got the job, eventually, of designing the arithmetic unit for the prototype BIZMAC computer, which was subsequently— the name of these computers became known as the BIZMAC computers. And Arnold, of course, you know, went on to have quite a career in computers, also.

Hendrie: Yes, very good.

Beard: Yeah. There was also Bill Woods [ph?], who was involved. It was somewhat later. He wasn't in the initial computer work, but in the subsequent computer work, he got involved, he and Bob Wilson [ph?]. So we're talking 1950 to '53. We essentially developed the logic and circuitry and the packaging for a prototype data processing machine. And the big factor in all of this was, where are you going to store all the data? And storing it electronically was just outrageously expensive, and the media choice in those days was magnetic tape, as opposed to punched cards. We definitely weren't going to use punched cards. And so we developed a magnetic tape station to drive magnetic tape, and the customers' data would be basically stored on tapes. And so that was another fairly serious development, developing these tape stations. They would be able to start and stop on a small segment of tape at a time. In those days, computers weren't fast enough to continue to read the data off the tape. You read one message, or one block of data in, and stopped the tape, and when you're ready for the next block, you started up again. And... and in the early days of computers, the customers' data was stored on these tape drives, and the room would be full of tape drives. And there'd be a large computer, also, but the tape drives took up most of the space.

Hendrie: And you'd have lots of tape drives, as opposed to a relatively small number, which you continually mount new tapes and take them off.

Beard: Well, you still had to remove the tapes, and so forth, but... that's basically the beginning of the RCA computer venture.

Hendrie: Did the prototype you built turn into the unit that was eventually delivered to Detroit, or was a production version built using the plans and the circuits?

Beard: Yes, it was one of the latter, and so forth. There were— we developed a type of plug-in to put our electronic circuitry on, the logic circuitry, and the mechanical package for that was changed. The basic circuitry we developed was used. The elements of the logic design that we had developed were incorporated in the next generation computer— not generation, but the finished design product. Our initial product used the Selectron tubes in our prototype, but we realized that this was not going to fly commercially, and by that time, Rajchman had done enough work with his magnetic core memory that we in advanced development went on to develop a magnetic core memory that could be used in this design computer, the production computer. And so the first commercial computers that went out of RCA involved the magnetic core memory. But <clears throat> a whole new design group was set up, brand new, under

Wes Leys [ph?], who became the chief engineer in that group to continue the design of data processing machines, and to deliver it to our first customers.

Hendrie: So, fundamentally, advanced development handed over the work, and probably transferred some of the people?

Beard: Yes. Some went.

Hendrie: What happened to that prototype machine? I don't remember it being there in 1954, when I got there.

Beard: I think it was moved downstairs to Wes Leys' operation on the third floor.

Hendrie: So it was down there somewhere.

Beard: <clears throat> We decided we needed a similar type machine for the work we were going to do in advanced development, and you may remember Lowell Bensky was more or less in charge of what we called the "Nifty Computer," which is a novel instrument for testing equipment. We wanted to use it for testing out some new ideas, particularly with radar. And we set up a link. We put together this computer, which was a version of the first computer we had developed. <clears throat> It had a microwave linked to a Morristown [N.J.]radar, and we would transmit a radar to the computer, and we were able to do some, you know, computer tracking and so forth, potential interest for either air traffic control or fire control type systems. The advanced development group that I was in then pursued— one developed the first magnetic core memories that were later incorporated into the commercial computers. That was shipped out. And about that time, the semiconductors came on the scene, and so we did a lot of semiconductor circuit development.

Hendrie: For digital circuits. For computers, but semiconductor circuits.

Beard: And our advanced development group got involved with digital communications, where we started to use digital circuitry for communicating. And we did obtain a contract from the Air Force to develop a ground-to-air digital data link, which was eventually used in part of the SAGE system.

Hendrie: Is that the GKA-5?

Beard: Right.

Hendrie: I don't know why I remember that, but I do.

Beard: You do, yeah. Very good. So that's what advanced development did. It went on to do more or less advanced— pursuing advanced concepts, and so forth, in the computer field.

Hendrie: I'm going to pause and change tapes.

Beard: Okay.

Hendrie: Okay.

Hendrie: You know, after you had worked in— from a personal point of view after you had spent some time working on circuitry for the Selectron, do you remember what other things you worked on on the computer project?

Beard: Well I had been made a first level supervisor _____.

Hendrie: So you were a group leader.

Beard: Is that what we called it, a group leader?

Hendrie: I remember Lowell Bensky was a group leader so I assume at that time it was sort of _____.

Beard: Yeah.

Hendrie: That's how it worked.

Beard: Supposedly directing and supervising a small group of engineers as well as working directly yourself in the _____.

Hendrie: Mm-hm.

Beard: And that's what I was doing in the development of the early prototype BIZMAC computers.

Hendrie: Ah, okay.

Beard: Somewhat later I became manager of that group plus two other groups that were involved in communications. That's where Bob Wilson [ph?] and Bill Woods [ph?] came under my direction at that point in time.

Hendrie: Okay, yes.

Beard: And some of our digital technology got applied to communications. We had several contracts with NSA for encryption devices. I remember one of our advanced development projects for NSA was a 10 megabit per second encrypting device which was considered to be extremely fast for that time. This was during the '50s.

Hendrie: Yes.

Beard: Yeah. We also as I say developed the— I'd said previously the GKA-5 electronics for the air to ground digital communications to be used in the SASE system.

Hendrie: Yeah. Now I remember the— I can't remember whether it was one of the engineers, Lou Calloden [ph?] or it was Paul Boswell [ph?] talking about how they actually had to work with Summerville [ph?] to, you know, develop a transistor that would be ideal for switching circuits as opposed to what most transistors were made for in those days.

Beard: Right.

Hendrie: Do you remember anything about that?

Beard: Vaguely, my memory is not too sharp on that.

Hendrie: Okay.

Beard: We did a lot of work in conjunction with the semiconductor divisions.

Hendrie: Yeah. During this process of getting digital circuits.

Beard: Right. Right. Because they were interested in developing this new technology as a product for themselves and so— in fact one of the— several of the people <inaudible>, Dick Enders [ph?] being one, Arthur Lowe [ph?] being another…

Hendrie: Oh, I remember Arthur Lowe, yeah.

Beard: …worked with the semiconductor people to develop some of these first transistors and so forth.

Hendrie: Okay.

Beard: In fact they wrote one of the— eventually authored one of the first books on transistors. It was Arthur Lowe and Dick Enders, I forget who the…

Hendrie: Transistors _____. Somebody else?

Beard: I think it was Mike Eberhard [ph?].

Hendrie: Okay.

Beard: So when you look back, if it hadn't been for two things, a core memory and transistors, computers just never would have existed in any practical sense. Doing it with vacuum tubes was a horror. You couldn't do very much and you had a mean time between failure of four hours, eight hours and so forth, something was always going wrong.

Hendrie: Always going wrong.

Beard: Yeah. And costs were prohibitive.

Hendrie: Yeah, _____.

Beard: The semiconductor and the core memory is what really got computers going in the early days.

Hendrie: Mm-hm.

Beard: So I continued in this Advanced Development group which was located in Camden, New Jersey until 1959 when at that time RCA was awarded a very large contract from the Air Force for the BMEWS system, Ballistic Missile Early Warning System.

Hendrie: Oh, yes. And they had the radars.

Beard: They had the radars and…

Hendrie: They had both the search radar and the…

Beard: Tracking radar.

Hendrie: and that spherical scan tracking radar they invented.

Beard: Plus the associated computer equipment that was necessary to work with the radars and to transmit the data back to central headquarters at NORAD, which was in Colorado.

Hendrie: Mm-hm.

Beard: And RCA anticipated getting this contract so they put together— they said it was very important that we be able to develop our own computers. It would help our commercial computer group if we could keep the computer design and develop manufacturing within RCA.

Hendrie: Rather than buying somebody else's computers even though computers were not per se the prime expertise that got you the contract.

Beard: That's right.

Hendrie: Yeah.

Beard: And they decided to put a group together to design these computers using basically my Advanced Development group and there was a— a lot of displays were involved too, they put a display

group in Moorestown would be involved and they decided to set operations in Van Nuys, California in 1959.

Hendrie: Now why did they go to Van Nuys?

Beard: We had a group in LA under Art Curtis [ph?] that was involved with airborne radar and so forth and…

Hendrie: Mm-hm. Near the airframe manufacturers and the airborne electronics firms.

Beard: Right. But I think the primary reason is they wanted this group to be outside of the Camden, Moorestown area because of the unions.

Hendrie: Ah, okay.

Beard: Although I don't think anybody would ever admit that.

Hendrie: Yes.

Beard: So they built a new facility in Van Nuys, California to do both manufacturing and design and development. And they decided to put a core group of display people and computer people out there in Van Nuys. And so my group was the Digital Computer Group and then there was another group heading up displays that moved on out to Van Nuys. And so we transferred a number of engineers from the East Coast to the West Coast, to Van Nuys. And while I was at Van Nuys— well actually we started the development in Camden but we finished in Van Nuys. We developed three computers for the BMEWS system.

Hendrie: Oh, all right. What were those?

Beard: One was a computer that worked intimately with the tracking radar and the second was a checkout data processing computer that was used for automatic checking of the radar site, the various equipments and so forth. And the third was a display information processor which would be centered at NORAD headquarters and that computer would drive the big displays that would display the threat data if any that was coming down from the three early warning sites.

Hendrie: BMEWS system. Yeah.

Beard: One being in Alaska, one being in Scotland and what was the other one?

Hendrie: Thule, Greenland.

Beard: Greenland, Thule, Greenland.

Hendrie: Oh, Thule, yes.

Beard: Yeah. So about practically everybody in my group in Camden moved out to California plus some people from Moorestown moved out, the display group primarily.

Hendrie: Okay. So most of the people that were involved with computers.

Beard: Right.

Hendrie: Yeah, yeah.

Beard: And while we were out there we finished the development and production of these BMEWS computer system and the BMEWS system was basically put together during those years.

Hendrie: Okay. What were these computers called and do you remember any of the model numbers?

Beard: No, I don't. I know the computer that was used to drive the displays and do the communication interface work with the northern sites was called a DIP computer, display information processor.

Hendrie: Okay.

Beard: And I think— I think the other was a radar data processing computer that tied with the tracking radar and the third was a checkout data processor.

Hendrie: All right. So they never became quote "products" in any sense.

Beard: No they were only used in the BMEWS system, one time only.

Hendrie: Only used— all right. One time only.

Beard: Yeah.

Hendrie: Okay.

Beard: And they worked for a long time. I think Philco eventually replaced the display _____ data processor in Colorado Springs about 10 years later, you know. So after I spent three years out there they were looking for a chief engineer back for their commercial computer division and I…

Hendrie: Well who had been chief engineer, do you remember? This was still— Wes Leas still there?

Beard: Wes Leas was running it. I don't remember whether he had a chief engineer or what at that point.

Hendrie: He made not have.

Beard: Yeah, I don't think he had. And I loved California and I could play— I could go skiing on Saturday if I wanted to; we had good local snow when I was out there and play golf on Sunday for instance.

Hendrie: And you still love sports.

Beard: Yeah. But too good an opportunity to pass up so I came back to Camden in 1959 to head up the computer group which had grown quite a bit at that point in time.

Hendrie: And you were working for Wes Leas still?

Beard: No, Wes…

Hendrie: Or was that moved _____?

Beard: That was moved. RCA had gained a major contract, ComLogNet, the auditing program.

Hendrie: Oh, I remember that.

Beard: Yeah. And Wes headed that up as more or less the program manager, very, very large system.

Hendrie: Yeah, and they had their own computers in that too, didn't they?

Beard: Yeah. Right. So I headed up the engineering group or the commercial computer group at that time.

Hendrie: Who did you report to?

Beard: Well actually I reported to Art Malcarney initially. He didn't have a division vice president. They were creating a new division for a computer system division. And…

Hendrie: Now Malcarney, when I remember him was _____ defense.

Beard: But he also was head of— later on became the industrial side too.

Hendrie: Okay.

Beard: He had everything in this area at that time.

Hendrie: All right.

Beard: But he had found a new vice president, headed up— a fellow named Arnold Weber [ph?] headed up the computer division shortly after I arrived there and I reported to him who was the General Manager and Vice President of what I guess we call EDP, Electronic Data Processing, Division.

Hendrie: Okay. Now what machines had they built in the meantime? What were they selling when you— because they must have done the 501.

Beard: They did the 501, which was quite a success, and then they did a smaller machine called the 301, which was quite successful. But at that point in time when they asked me to come back East, there was quite a gap. IBM was continually announcing new product lines and they did not have a successor to the 301 which was a very, very popular machine.

Hendrie: Oh my.

Beard: And they wanted to put together a crash program to come up with a successor to the 301, which had to be at least three times as fast as the 301.

Hendrie: Okay.

Beard: And so…

Hendrie: Now the 601 had been built and crashed and burned by then?

Beard: The 601 had been— was on its dying phase. I think they sold five of 'em and it was…

Hendrie: <Inaudible>

Beard: …and it was— it just wasn't very successful. It was expensive and there weren't that many customers for it and we had electronic problems. And they did not want to encumber me with any 601 problems that were still there. So Clarence Gunther [ph?] who was the overall Chief Engineer in the Defense Division headed up a crash program on the 601, he headed that up. He said, "Don't you worry about the 601, I'll swipe some of your engineers from time to time but you develop a new machine to replace the 301."

Hendrie: "And I'll worry about fixing the 601."

Beard: Yeah. Right.

Hendrie: Why after the 501 and the 301, they were so successful, why— what's your personal conclusion as to what the cause or causes of them not doing well on the next machine?

Beard: I don't if I can answer that accurately but my general impression was it was too expensive, it was a very big machine. There was a limited marketplace for it and they did not want to put any more resources, if you will, in developing that line of computers.

Hendrie: Okay.

Beard: They wanted to really capture the customer base they had for the 301 as those customers moved up to bigger machines and that was a high priority. In the meantime IBM was coming out with I guess the 701, 703, 702, you know that…

Hendrie: Yeah, that whole series. Yeah, they must have been into transistors by then because I think _____ the 7090 showed up about 1959 or '58.

Beard: Yeah, it did, right.

Hendrie: Yeah, so, and there was a whole— there were still data processing machines and scientific machines at IBM still and I think they had transistorized data processing.

Beard: Yeah.

Hendrie: So in some sense the— RCA invested, you know, a lot of their _____ time and energy and engineers on the 601 instead of continuing sort of the success of the 501, 301…

Beard: That's correct.

Hendrie: …and thus fell behind in giving their customers something— I'm reading into that, what you're saying.

Beard: I think it's a very good— it's a very good hindsight observation.

Hendrie: Yes, you never see it at the time.

Beard: No.

Hendrie: Well, you don't know the 601 isn't going to be a roaring success.

Beard: Right. Yeah.

Hendrie: It just creeps on you that it's too expensive and it doesn't work well.

Beard: Yeah.

Hendrie: Yeah. Okay.

Beard: So I was given basically a year to develop a successor to the 301.

Hendrie: Now did you have any really good engineers? Were you able to bring any of your best engineers back from Van Nuys?

Beard: No, but there were some good engineers in Camden at that time, some of whom I had worked when I was at Advanced Development still.

Hendrie: Okay.

Beard: And we did— had a very successful machine called the 3301 which was indeed at least three times faster than the 301. And we did get it out in one year, the prototype.

Hendrie: Really?

Beard: Yeah.

Hendrie: How did you make it three times faster?

Beard: I think two things; the circuitry was faster to begin with.

Hendrie: You had faster transistors.

Beard: Right. But we also made it a wider word length if you will. We didn't _____ — the memory instead of being— I forget what the 301 was, maybe one byte wide.

Hendrie: Yeah, one— characters in those days, yes.

Beard: Yeah, one character.

Hendrie: One character wide.

Beard: Yeah, we made the 3301 very wide. We made it to 10 characters wide and we pushed data out of the memory in parallel.

Hendrie: And then because the memory was limiting the speed then you could move it.

Beard: Right. And of course, for data processing…

Hendrie: You could pick up bytes or characters wherever you wanted.

Beard: The two throttling factors in data processing in those days was getting things in and out of memory from the input/output devices and so the amount of computation was, you know, almost trivial.

Hendrie: In data processing it wasn't very much.

Beard: It was shuffling all that data back and forth.

Hendrie: Yeah.

Beard: The faster you could move the data, the better off you'd be. Particularly in the days of magnetic tape where you're just reading gobs of data into the machine, doing a little processing and pushing it back out again. So the data rates that you could achieve would really determine the speed factor of data processing machines. So after we digested the 3301 and that turned out to be a very successful successor to the 3301…

Hendrie: Okay.

Beard: …RCA was still behind IBM, IBM was coming out with a next generation machine.

Hendrie: RCA was still behind, okay.

Beard: I mean, we were never ahead of them.

Hendrie: Well how would you be _____?

Beard: In fact in hindsight, we probably shouldn't have been because they were the leader in the field so they were setting the standards.

Hendrie: Yes.

Beard: And we determined early on, I guess IBM had announced it somewhat but they announced the 360 line of computer with Gene Amdahl if you know, as one of the leading architects.

Hendrie: Mm-hm.

Beard: And so that was our next crash program is to have a product which would compete with the IBM 360 series.

Hendrie: Okay. And so what did marketing tell you or what did you figure or what would be the best way for RCA to get _____. What they ought to do?

Beard: Well I guess it was marketing and product planning at that time figured that IBM had such a stronghold on many, many large companies that if you're going to be able to penetrate any of those companies you should be able to use the same software that had been developed for them. So the concept was to come up with a computer system that was IBM compatible, it would run the same software that the customers were using. And we did reasonably well I would say on the technology side at RCA developing computers but we're always behind on the software side. And I think IBM in terms of

the systems people they had in the field helping customers plus the operating systems they had and some of the application processes really led all the competitors in terms of type of customers in the commercial field. So that decision was made to be an IBM compatible computer.

Hendrie: Was the best way to compete in the business.

Beard: Right.

Hendrie: Okay.

Beard: It would be a second source if you will.

Hendrie: Okay.

Beard: And we'd try to offer greater price performance to run existing software.

Hendrie: So you would use RCA's engineering abilities to, you know, to maybe you'd come up with higher performance…

Beard: Right.

Hendrie: …but at the same cost or the same performance at lower cost.

Beard: Right. In an effort to get the machines out quickly, we knew what the IBM instruction set was, I mean that was public knowledge, but we did not know what the I/O interface was. So we developed our own I/O interface and we couldn't get that information out of them. Eventually they disclosed it to us but by then we just couldn't— we felt we couldn't wait so we had to design our own peripheral controllers and our own peripherals. And there'd by a software package which would convert input/output instructions that were used in the IBM world to the RCA Spectra world, the computers that were named the RCA Spectra. And so except for the actual codes being used to— for input/output, in all other respects the software was compatible, basically a 360 instruction set.

Hendrie: Okay.

Beard: And we developed very quickly two machines, the 7035 and 7045, the RCA Spectra series and they did reasonably well.

Hendrie: Okay. Were they just different performance levels _____?

Beard: Yes, right.

Hendrie: So they were completely different machines?

Beard: Hardware-wise, but software-wise they were the same.

Hendrie: Yes, software-wise, yeah, but they were completely different hardware.

Beard: Right, right.

Hendrie: Okay. But they could use common peripherals…

Beard: Yes.

Hendrie: …and peripheral controllers.

Beard: Right.

Hendrie: But in terms of central processors and memories they were…

Beard: Right.

Hendrie: …separate machines.

Beard: And of course at that time it wasn't just the computers, RCA had— was developing its own peripherals and developed our own tape stations. We didn't develop a printer, we OEMd the printers. Disk drives were just coming on the scene and IBM led the field in disk technology. In fact, our first disk drives we had in the Spectra series came from IBM. I went to New York with one of our lawyers to appeal to IBM that they should OEM the disk drives to us.

Hendrie: Oh my goodness.

Beard: The argument was that RCA had basically a monopoly in the television field, on kinescopes at one time, but they felt it was in the industry's best interest to sell these kinescopes and so forth to other television manufacturers. Well anyway the argument prevailed and IBM agreed that they would OEM the disk drives to us. So the first disk drives were used in the RCA Spectra series were IBM disk drives.

Hendrie: Wow. Okay. I never knew that.

Beard: Subsequently though there were independent developers that developed compatible 2311 and 2314 disk drives.

Hendrie: That was the beginning of the plug-compatible business for disk drives.

Beard: Yeah. I got a little off the track here I think, but…

Hendrie: Well you had gone back to— you were discussing the different models, the 35 and the 45 were the first things you did.

Beard: Yeah, and there was also a 55, which was the top end of performance in those days. Both the 35 and 45 used an emulation technique— well basically we had microcode that drove the logic of the machine instead of hard-wired logic.

Hendrie: Okay.

Beard: With the 7055, because of the speed requirements, [RCA] decided to use a wired logic similar to what we used back in the BIZMAC days.

Hendrie: Yes.

Beard: It wasn't microcode during— it was a much bigger machine and so forth.

Hendrie: Yeah, okay.

Beard: And consequently it was quite a bit more expensive, but it was a higher performance too. But it turned out, as far as the marketplace was concerned, [that] the 7045 is more or less the sweet spot.

Hendrie: Okay.

Beard: And that's what they sold the most of.

Hendrie: That was a place that RCA could convince somebody to abandon mother IBM and…

Beard: Right.

Hendrie: …buy an RCA machine instead. Okay.

Beard: So I worked as Chief Engineer of the Electronic Data Processing Division from '62 until 1970. Through those years RCA was not profitable, but they didn't lose a lot of money. It was big investment in engineering and development, sales force, software and so forth. But they had yet to break into the black, clearly into the black. There was a change in the RCA management during those later years. David Sarnoff, who was the true entrepreneur of RCA and drove it to all its early years of success, retired and his son Bob Sarnoff took over the reigns as head of RCA.

Hendrie: So this was in the late '60s sometime?

Beard: And he felt that…

Hendrie: This is in the mid '60s sometime?

Beard: Yes.

Hendrie: Yeah, okay.

Beard: And Bob and I guess some of his staff people felt that this computer vision hasn't been profitable yet, what we need is much stronger marketing, we need some IBM type expertise injected into the computer division. And so they did hire several key people from IBM at that time and they eventually took over the leadership of the data processing division, computer division.

Hendrie: Who were these people?

Beard: I have to come back to it, I'll have to think of his name.

Hendrie: Oh, was it Donnigan?

Beard: Donnigan, yes, Donnigan.

Hendrie: Okay.

Beard: He became the president. He came in as head of marketing.

Hendrie: Okay. To do what, you know, Sarnoff said, invigorate the marketing.

Beard: Yeah. But it was obvious that the handwriting was on the wall, he was the one who was picked to really lead the division. I think it was within a year or so he became the CEO of the division. Jim Bradburn [ph?] had been the CEO. He had replaced Arnold Weber [ph?], oh, somewhere around the mid '60s, I forget when that was. And Jim Bradburn had come from Burroughs and headed up our particular division at that time. But anyway Donnigan replaced Bradburn. And he felt he…

Hendrie: So there's a pattern of getting outside…

Beard: Right. And he brought in quite a few of his colleagues from IBM to run marketing and what not. So it was a completely different atmosphere and it was at that time I decided to leave RCA. There was another thing going on too that they'd— RCA had built a new facility in Marlborough, Massachusetts and had planned to send all of its computer activity including manufacturing up there. And so there was a move involved. They were going to move out of Cherry Hill and up to Marlborough.

Hendrie: Had you been based in Cherry Hill?

Beard: I had moved from Camden to Cherry Hill in the meantime, but, you know, it's not a big move.

Hendrie: Absolutely not a big move. Had all the engineering— was a lot of engineering still in Camden?

Beard: Camden— yeah, engineering was still done in Camden plus we had moved a group to West Palm Beach where we did our manufacturing. So we had a support group in engineering initially in Palm Beach and then we augmented it for them to eventually design some computers also.

Hendrie: Okay.

Beard: But the major engineering activity was in Camden.

Hendrie: Okay. So the Spectra 35 and 45 were designed in Camden.

Beard: Yeah, and the 55.

Hendrie: And the 55, but manufactured in West Palm Beach.

Beard: That's correct.

Hendrie: Okay.

Beard: There were a couple of smaller computers, the Spectra 7015 and 7025, which were designed in West Palm Beach and manufactured there of course. But they didn't play too big a role in terms of any major data processing activities.

Hendrie: Okay. They didn't generate lots of revenue.

Beard: No.

<loud sound of dish falling and breaking>

Hendrie: Oh, oh, oh, I'm sorry.

Beard: That's all right.

Hendrie: I lifted this up and the suction raised it up with it and I wasn't watching. Oh.

Beard: Just leave it there.

Hendrie: Oh, I feel terrible. Oh my God. I hope this wasn't Aunt Millie's [ph?] heirloom china.

Beard: So it was at that time I decided to leave RCA. It was a completely different company than the one I had started with.

Hendrie: How would you describe RCA before the IBMers arrived and RCA afterwards, as you saw it?

Beard: Well, I think it was very tough on the old time RCA people because they were no longer the favorite people. These were the guys that couldn't make it, if you will, in terms of the new management. They wanted to bring in their own people to do this, do that and so forth. So I felt it was more of an unfriendly environment at that point in time, at least for me personally. They criticized everything that had gone on before and et cetera. It turned out later there was mostly marketing type hype; they really didn't understand the fundamentals of the business as far as I was concerned.

Hendrie: Okay. Now did they bring people into engineering too or try to?

Beard: No they didn't.

Hendrie: Okay.

Beard: They did some reshuffling. No they really didn't change the engineering. It was mostly in marketing and direction of planning and so forth.

Hendrie: Okay. All right.

Beard: They made one— I had already left the company in 1970—but shortly thereafter they made I think a very serious misjudgment. IBM was about to announce their new series of computers, namely the 370 series, and what we'd been competing with before were the 360s. And Donnigan and his planners felt it was very crucial that RCA have a product announcement close on to what IBM would announce on their 370s. And we were working on advanced computers at that point in time, you know, next generation hardware and technology. But, you know, it wasn't going to be ready for another year or two. And he said, "We can't wait." So they decided to come out and rebrand the Spectra series, put new packaging, skins and so forth so everything looked different and to have a very aggressive rental policy and so that they could claim to making, you know, many shipments and so forth of these new computers as IBM was building up with the 360 _____ not to be left behind at the gate. The trouble was that the computers were no different computers than the previous computers, they had the same performance, in fact; they were the same computers with different skins for the most part. And they had fairly aggressive lease rates on the computers such that existing RCA customers got smart and said, "Well, look, why don't we get these new computers? They're as good as the one we have now, in fact they perform the same work and it'd be lower rent." So computers which had been out on basically short term leases started coming back to the factory and they were shipping new ones out. In fact, the factory manager in Palm Beach told me that— this was after I had left RCA—that we had our first negative shipment in history. We had more stuff coming back in dollar value than we shipped out. Well, the IBM group had grandiose plans and had convinced the board that they were going to put RCA into [the] profitability zone very, very quickly. I think primarily because of this mishap RCA, which was almost break even <loud sound microphone rubbing against something> _____ instead of coming in with the— saying, well we— making good on a promise, this is what the profit's going to be this year, they came in with a whopping loss, I don't know what it was, prediction. They said for RCA to really be up there and compete with IBM, they're going to have to make a much bigger investment than they have been making. And I'm told that after Donnigan had made this pitch to the board they excused him and, in I suspect was an emotional type decision, they decided to get out of the business, "We don't need this."

Hendrie: Wow.

Beard: So he went for broke and he got broke.

Hendrie: Yeah. Oh my goodness.

Beard: And unfortunately for RCA is that they announced that they were going to go out of business and not— in other words he could have decided that, they could have looked around for a suitable suitor while they were still in business. So basically what they did was create a fire sale. And UNISYS bought the business primarily I guess for the customer base plus they got a lot of inventory and that was the end of the RCA computer division. That was in 1971, '72 I guess it was.

Hendrie: Wow. That's really— that's a terrible <inaudible>.

Beard: I've heard this about other people from IBM that, you know, they had a good reputation while they were at IBM and did things and so, you know, had a lot of success. They go out with another company and they try to emulate the same things they did at IBM, but if you don't have an IBM corporation behind you and you're a smaller company or something, it doesn't work.

Hendrie: Right. Exactly. Yes, I've seen that numbers of times that IBM people come in and, you know, that they're just— they did very well at IBM but they just don't quite get it or something. There's a problem. Now I remember hearing about a previous problem like that when with a previous general manager when— or maybe it was the sales manager when RCA was selling the 301 that to— he was having trouble making his sales numbers so he lowered the rental so that more— you know, he'd get more customers.

Beard: Sure.

Hendrie: And all he did was lower the revenue because the balance was that he didn't get enough new customers to make up for the low lease rate.

Beard: I hadn't heard that.

Hendrie: You were probably out at— that may have happened…

Beard: I might have been in Van Nuys at the time.

Hendrie: And I don't think it was on your watch, obviously not on your watch. You were in engineering anyway… that was probably when you were in Van Nuys.

Beard: Yeah.

Hendrie: All right. Well, I need to change tape again.

Beard: Okay.

Hendrie: Okay.

Hendrie: So tell me a little bit about when you decided to leave. What were the options that you thought about? What did you think about doing?

Beard: Well, I really never thought about- hadn't done any planning in terms of a new business. I know some people worked for companies and they kind of half-way developed what their plan would do when they got into business. I hadn't done any of that.

Hendrie: Okay.

Beard: So I decided it was an abrupt change. I said, "I'm not gonna go to Marlborough. I'm not gonna stay with RCA." I've always wanted to be- start my own business. This is the best time. Take the plunge. See what happens, and so I did. And I got a job immediately as a consultant to ITT. I needed to put some bread on the table, and to help them design a communications computer for their telephone switching network in New York. And I said, "I'll use, you know, this time to kind of figure out what I want to do, where I want to go." And in the meantime, the Canada group was being moved to Marlborough, and because of the uncertainty of the organization, some of the key engineers that had worked with me were very hesitant about going to Marlborough and changing. They asked if they could come work with me in my new company. I said, "Well, I don't know what I'm gonna be doing, but you're certainly welcome to come join us." So there were three people that were key engineers that decided to come with me. Ted Franks was one of them. Bob Jenkins was another, and Barry Kessler was the third. And we decided that we would use the first year to develop some sort of a business plan, decide where we wanted to go. In the meantime, we'd try to put food on the table with consulting jobs and whatnot. It might have been kind of obvious. It wasn't to us in the beginning, but we decided by the end of the first year that what we're gonna do was to get into the business of enhancing RCA computers with superior peripherals than what RCA presently was using. There were a number of people in the country that had developed good disk drives, good tape drives, printers, and so forth, which were equal to or better than what IBM was offering on their systems, and what RCA was working on. And we knew the RCA interfaces and knew what it would take to make them compatible with a computer, so we decided to design controllers that would interface say the Telex tape drive to the RCA computer systems, or the ISS disk drives, as a substitute to RCA's disk drives. And so we started on our own to, you know, spend our time when we weren't consulting, design first of all a tape controller. We picked the Telex tape drive as being the tape drive we wanted to use. And we then brought in a marketing person who had been with Product Planning at RCA, Art Mendelson. I don't know whether you remember.

Hendrie: Yes. I remember Art Mendelson.

Beard: Yeah.

Hendrie: Yes. Fairly colorful character.

Beard: Yeah. Yes, to head up our marketing effort. And he started calling on RCA customers, and Art was technically oriented. He was a salesman per se, but he was in product development, you know, the market end and the development end of marketing, if you will, interfaced with engineering as to what type of products we should be developing <inaudible>.

Hendrie: Yeah. So he understood the technology. He had a technical background of some sort. Yeah.

Beard: So he started on some customers, and one of the key customers of RCA was the Southern Bell Telephone Company, which is probably the largest customer RCA had. And they had 301 systems doing their billing, and primarily the billing operations and, you know, had an awful lot of tape stations in all these computers, and so we bid to replace their tape drives and tape controllers. And lo and behold we won the job.

Hendrie: Well the Telex ones were clearly superior.

Beard: Right. The pricing was good, and so forth.

Hendrie: Yeah.

Beard: Performance was better than what the RCA was getting, so that was our first, on the computer, our major launch customer. And we had a couple of smaller customers before that. It didn't go anywhere, but we developed a MICR check reading system for Cumming [ph?] Chicago, a small outfit in Chicago. It was selling equipment into banks and so forth. That was primarily a development job. We didn't have any production behind that. But with the launch of the Southern Bell contract, we had to manufacture a lot of controllers, and integrate the tape drives, and then we needed to install them and service them. And one of the things Southern Bell told us was, "Well, we want to know how you're gonna service these things. We're used to the service people you have here, that RCA has here. We like them, and whatnot, and that's a very important part of this." Said, "Okay, we'll do it. We'll provide service to all of these." And I hired the manager that had worked for RCA down there.

Hendrie: Edward Tuck [ph?].

Beard: 'Cause RCA was going through this dissolving phase, and so we picked up a lot of the service engineers. And so we developed our own service department to service these tape drives. And I forget how many, but they had seven different computer sites and each site must have had at least fifty or so.

Hendrie: Oh, my goodness.

Beard: Tape drives in them.

Hendrie: Wow.

Beard: So it was a major contract that we had.

Hendrie: Yeah.

Beard: And shortly thereafter, in fact, I had seen- Donogan had called me, or I had seen him somewhere, in a restaurant, and he said, "I see you fellows have made a bid to Southern Bell to replace all our tape drives out there." "Yeah." Says, "Yeah. You're crazy. You'll never be able to do that and

whatnot." And so I said, "Okay. We'll see." Then when we won the contract, he says, "You'll never get that contract."

Hendrie: Yeah, yeah.

Beard: That was in like July or August, early August. Sometime in December Art Mendelson comes into the office, and he says, "We did it. We did it." "Come on, Art. What did we do?" He says, "We put RCA out of business." They announced that day that RCA was going out of the computer business.

Hendrie: Oh, my goodness. You put RCA out of business. That's good. <Laugh>

Beard: I said, "Art. I don't think we did it, but.

Hendrie: I don't think that's what we did, but.

Beard: Yeah. Well, anyway, that was a major launch customer. Southern Bell turned out to be our biggest customer during the '70s.

Hendrie: Okay.

Beard: We also installed the disk drives in the systems.

Hendrie: Yeah. You chose—what did you say you chose ISI?

Beard: We had ISS.

Hendrie: ISS.

Beard: Yeah. I've lost track of them. They were out in San Jose.

Hendrie: Okay. Now did RCA actually build their own disk drives? I know you said RCA clearly built tape drives.

Beard: Yes.

Hendrie: Of their own.

Beard: No.

Hendrie: You remember whether RCA actually built disk drives?

Beard: No, I don't think so.

Hendrie: Yeah. They bought, because you said originally they had gotten them from IBM.

Beard: Right, right.

Hendrie: And then, so maybe they went to a plug-compatible manufacturer.

Beard: Right. I'm not sure who the vendors were.

Hendrie: Alright.

Beard: There were several of them at that point in time.

Hendrie: Okay.

Beard: Well, so our business, we're gonna use that launch in terms of adding compatible peripherals to the RCA systems. Unfortunately, RCA going out of business hurt us because Unisys took over the inventory.

Hendrie: Oh, yeah.

Beard: And they wanted to hang onto the customers, and they got all the equipment basically for free, and so they would- our prices were always lower than RCA's.

Hendrie: Right.

Beard: But they would just cut their prices and cut their prices to keep us out, 'cause they had all this inventory of equipment.

Hendrie: Right.

Beard: However, in many cases it wasn't just the price determination on the peripherals, 'cause we added greater performance on our peripherals. So it wasn't just a straight replacement of the peripherals. We had greater performance. Their computer system performed better.

Hendrie: Yeah.

Beard: And they needed more performance, so we were able to continue to make sales into the RCA customer base, even though Unisys was <inaudible>.

Hendrie: Oh, really.

Beard: Cutting their prices on everything we tried to do.

Hendrie: Okay.

Beard: And really during the ‘70s the plug-compatible input-output systems were...

Hendrie: Was really what Formation did. Yeah.

Beard: We also did something similar for Honeywell. They replaced the Social Security tape drives with our Honeywell type controller and Telex tape drives.

Hendrie: Oh. Oh, Honeywell had a lot of- okay, had a lot of computers in Social Security.

Beard: Yeah.

Hendrie: Okay.

Beard: I think that was the only other.

Hendrie: Only other big one.

Beard: Yeah, at least during the early ‘70s. One of the interesting ones, you know, Army Tank and Automotive Center continued to be an RCA customer. And we had developed, when I was in Van Nuys, a random access memory that used wide, long strips of magnetic material, called the RACE machine.

Hendrie: Okay.

Beard: Do you remember that?

Hendrie: No. I don’t.

Beard: But anyway, it was magnetic cards, roughly three inches wide and maybe twelve inches long, that were stacked in cassettes, and I think there were like eight cassettes on this machine. And I forget how much total storage it was, but you ejected one of these cards out into a raceway, like a model railroad train. It flipped around, went through a read head station and back to where it belonged.

Hendrie: Oh, my goodness.

Beard: And it was a mechanical monstrosity.

Hendrie: It was a mechanical marvel.

Beard: Yeah, that it worked at all.

Hendrie: Right.

Beard: But anyway, had modest success with it, and Army Tank and Automotive Center had installed these random access [storage systems]. And the thing was, yeah, that something would go wrong, or some mechanic thing. The card would shoot out the end and escape, but it didn't go back where it ought. It just shot out the end.

Hendrie: Okay, yeah, okay.

Beard: Like straight off the end of a tractor. And we decided, well, we can replace that with this storage, because this was developed before this storage really came into being.

Hendrie: Yes, okay.

Beard: And there were things like 2311, 2314 type storage available at that time. So we said, we'll emulate the RACE characteristic, and we'll reel this drive on there, and whatnot, our controller. And they just thought we walked on water, because they said, "That's the first time, after we put your compatible device in there, first time we ran a bill of materials completely through without stopping."

Hendrie: Oh, my goodness, because something would have happened with the mechanical systems.

Beard: Yeah.

Hendrie: Wow.

Beard: So we had a lot of fun with that IBM-compatible peripheral to that system.

Hendrie: Okay. Right. So, yeah, you did a bunch of different things like.

Beard: There's one more story though.

Hendrie: Oh, okay. I'd love it.

Beard: Southern Bell, they captured us a vendor. And I was going to say they were a captive customer, but we were a captive vendor. They said they had the 3301 computers. "We're running out of gas on these. The 3301s had replaced the 301s. And we're gonna have to go out on bid and replace those systems." So we ended up. We said, "Okay. We can do that. We can build something at least three times as fast as the 3301." Had some of the original designers, and so. So we bid what we called the 9903. It's three times as fast as 3301.

Hendrie: I like that. I like that.

Beard: And Unisys bid against us with their big machine at that time, and IBM bid against us. We won the contract.

Hendrie: Wow.

Beard: This was for fourteen machines.

Hendrie: Oh, my goodness.

Beard: 'Cause we didn't charge for development. I mean we just assumed we could develop it within our <inaudible>.

Hendrie: Right, yeah, exactly.

Beard: They'd pay us when we installed and it was accepted.

Hendrie: Oh, my goodness. Oh, wow.

Beard: But we had made enough money on the tape drives and the other peripherals.

Hendrie: That you could finance.

Beard: We could finance it ourselves. Yeah. Yeah. It was really quite a system. Actually it was a dual computer system with two closely coupled computers, so that it had a graceful degradation. One computer'd go out and the other one would still carry on.

Hendrie: Okay.

Beard: It shared all the peripherals.

Hendrie: Oh, that's pretty good.

Beard: And that was the first time we went away from magnetic memories. We went to semiconductor memories. So we had a semiconductor memory in there. And unfortunately the American manufacturers were not developing memories that were that reliable. The Japanese were way ahead of us at that time, so the first memory chips were from Japanese companies.

Hendrie: Do you remember which 4K memory chips? You don't remember.

Beard: I can't remember now.

Hendrie: Okay.

Beard: Yeah. We thought they were very inexpensive. I think it was like a dollar a byte. I don't know what was the <inaudible>.

Hendrie: Yes.

Beard: So that was a multiprocessing system that we developed at Formation and installed. And we got a check. That first check was the first installation. And I had a small commission system going with Art Mendelson. His people, he wanted to get his commissions. They hadn't accepted it yet. And you talk about bookies.

Hendrie: Yes.

Beard: Like who'd let him book it 'til they accepted. And the service people hadn't got around to writing up the final documentation. Meantime, the accounting department sent us a check for a couple of million dollars, whatever it was.

Hendrie: Oh, wow.

Beard: They said, "We'll get that signed to you." They can always take it back, you know.

Hendrie: Yeah, right. If it isn't signed, they can take it back.

Beard: But they signed it a few weeks later.

Hendrie: I like that.

Beard: Yeah. So that was the '70s. Yeah.

Hendrie: Yeah. That's a great story of developing that.

Beard: Well, moving on from there.

Hendrie: You must have been- now that must have been an integrated circuit machine, too, by that time.

Beard: Oh, yes.

Hendrie: Yeah.

Beard: Oh, yeah. Yeah.

Hendrie: Do you remember whether there were integrated circuits in the 3301?

Beard: They were definitely in Spectra.

Hendrie: Yeah. Spectra was integrated circuit based.

Beard: I'm not sure about the 3301.

Hendrie: Yeah. That might have been a little too early.

Beard: Yeah.

Hendrie: Yeah. 'Cause that would have been 19- early '60s, yeah, probably weren't.

Beard: Yeah. Borderline on just what the switches.

Hendrie: Yeah. I know the 501 was one of the earliest transistorized commercial machines.

Beard: Right.

Hendrie: Okay. Well, that's pretty good. So you were really doing special engineering. You were applying engineering in places that you saw an opportunity.

Beard: Right.

Hendrie: Yeah. Now how big was, you know, sort of at what revenue level was Formation in this period where you were doing these peripherals?

Beard: I don't remember exactly. I would say it's probably the average was up and down, but it probably averaged around twenty million a year.

Hendrie: Oh. That was very respectable.

Beard: Yeah.

Hendrie: Very respectable number.

Beard: Right.

Hendrie: And my presumption is you were profitable because you have to be profitable. You just can't be sloppy about things like that.

Beard: Yeah. I should have mentioned, but about the time we got the Southern Bell tape contract, went out looking for venture money. We didn't have enough money to buy and manufacture all the products that we had sold. And I remember naïvely going to one of our local banks and presenting our balance sheet. I had this big, multi-million dollar contract in my pocket. He looked. Banker looked. He said, "You can't do business with us. You're bankrupt." <Laugh>

Hendrie: Okay.

Beard: I said, "Okay. So much for banking."

Hendrie: Yes.

Beard: So I went looking for venture capital. We needed venture capital to produce these big RCA, whatever we had. I mean, the Southern Bell order.

Hendrie: Yeah, right. How much did you think you needed?

Beard: I don't remember. Went with a company called Davis Science Ventures, headed by Mark Collins. And he was kind of a lead group. It was a working group, but he had two major investors. New Corp Securities was one, and I forget for the moment the other one. But I think they put in four or five million dollars at that point in time. Some of it was in straight equity. Some was in a note.

Hendrie: Okay. There were out of New York?

Beard: Mark Collins' group was out of Princeton.

Hendrie: Oh.

Beard: Or New York City.

Hendrie: Okay. Yeah. I'm not familiar with them.

Beard: Yeah. Lyle Pincus was the president of the group, whose name I can't think of. It's a famous name. It'll come to me sooner or later. But Lyle Pincus was the head person in that group in New York.

Hendrie: Oh, Pincus Warburg?

Beard: That's right. Yeah. Pincus Warburg.

Hendrie: Okay. Okay. Okay. Good.

Beard: Yeah.

Hendrie: Alright.

Beard: You know about them.

Hendrie: Yeah. I know about them. That's right. Don't know about the group in Princeton.

Beard: Yeah. Anyway, so that really got us on- we had enough capital now to do things we had to do. In retrospect, it was pretty good in those early days.

Hendrie: Yeah. Okay.

Beard: But to finish the venture capital story, it became apparent somewhere in late mid '70s that being plug-compatible to the RCA computer line is not gonna go too far. And I had an opportunity to sell it. Our major service was to Southern Bell. We sold tape drives in Naval installations to that RCA computer, so we had a pretty large service group, probably about a hundred people. And Unisys wanted to get into the customer base that we had, particularly Southern Bell. And I also contacted Sorbis, who had a service organization in those days, and we finally made a deal with Unisys that they'd take over our service group for X million dollars. I forget what it was. It was a pretty nice sum of money. And since things weren't quite the same looking forward as we had in the past, the Davis Science people offered to opt out. And so we used a lot of the proceeds of that money to essentially buy back the equity that they had and to pay what debt they had. So we were completely independent after that point.

Hendrie: Alright. Yeah. So you no longer had any venture.

Beard: That's right.

Hendrie: Did you have debt at this point?

Beard: No. Nothing. Working on a credit.

Hendrie: Yeah. Nothing. Okay. Yeah, no significant debt.

Beard: Yeah.

Hendrie: Well, because you were bankrupt all the time.

Beard: Yeah.

Hendrie: That's a great line. But anyway, okay.

Beard: That's why you don't go to ordinary banks for investments. I didn't know the difference between banking and investment in those days. Bankers don't take a risk, at least they didn't in those days.

Hendrie: Well, and they don't now. There was a little time in between where maybe they did. Anyway, so.

Beard: So that was the '70s, and during the '80s we weren't doing the peripheral enhancement business anymore, but we did develop our own minicomputer, which was 370 compatible, which we called the Formation 4000. And it was meant to be of similar capability to the IBM 2331 series. And I was always impressed with what DEC did with their PDP-11 series that you put in the operating system. They really

liked that, and integrated controllers, and you could do so many things. In fact, we used at Southern Bell, like we had a pair set up, and we used a DEC PDP-11 computer as kind of the center of it, and it was a major peripheral device in itself. And so we said, "Yeah, it'd be nice. You should be able to do this for an IBM-compatible type computer." So we designed the F-4000. It had integrated controllers, and tied into the mainframe on a main, come into the same central electronic package, to handle all the I/O, basically 370, 360-compatible type I/O, and so forth, called the F-4000.

Hendrie: Wow. Okay.

Beard: In fact, our advertisement was it's an IBM 370, and thinks it's a mini— It was a minicomputer that thinks it's an IBM 370.

Hendrie: Three seventy. That's- I like that. I like that.

Beard: And competing with the 2331 type of customers. And it was- we had modest success with that. We sold primarily system integrators and so forth that wanted IBM compatible type machines, some software developers and whatnot. We got a major licensing agreement and manufacturing agreement with a Brazilian company called Itautec. They wanted to build a computer down there, and so got a certain amount of money from that, and we licensed them. Sold them some computers to get started, and whatnot. That was a system integrated, putting it in small computers in Saudi Arabia at different centers. So we did reasonably well. But I had much greater expectations at that time. The vogue was IBM-compatible computers. It was National Systems. National Semiconductor had a computer division. Cassando [ph?] did. The person up in Boston had one. IPL, they had a compatible. Magnuson had one.

Hendrie: Magnuson had one. Yes.

Beard: And about the time we got going, all these guys started failing.

Hendrie: Yeah. You have any idea why it was so hard to sell, you know, into the IBM base?

Beard: Yes. We just didn't offer enough bang for the buck, basically, to really penetrate the IBM base, because IBM, particularly with the larger customers, they put so many analysts and service software people in there working with them that the big companies depended on IBM's systems people to keep their operation running.

Hendrie: Yeah.

Beard: The fact that IBM could supply good hardware was, you know, it was important, too, but maybe not the key.

Hendrie: But that may not have been the key thing. Yeah. Right.

Beard: Well, anyway, so the popularity of our 370-compatible machines went down pretty fast for some reason. I don't [know] if you remember that phase, or not.

Hendrie: Yeah. Well, I remember nobody ever became a long-term survivor and grower in that world.

Beard: Yeah.

Hendrie: Yeah.

Beard: Yeah. Even Dell, who I think had the respect, you know, had the most money and had some great machines. They sold what, the Gibson.

Hendrie: The Gibson, yes.

Beard: I wonder what's happened to those machines.

Hendrie: I don't know whether they're still making them now or not. That's very interesting. Yeah. I actually don't know.

Beard: Well, anyway, I would say the F-4000, thought it was the 370, was maybe a break-even sort of thing for us. We didn't make any money. We wrote off all the engineering and it paid for the engineering basically. But we developed an I/O concept with integrated controllers, which [was] fortuitous for us. Siemens, who had a product line based on RCA's Spectra series, because they were a licensee of RCA. We helped them get started in the computer business in Siemens, and they were going to another [ph?] generation computer, and they wanted an I/O system. They heard about us and they came to us, and so we designed the input-output system, the integrated system, for the Siemens flying computers.

Hendrie: Ah, okay.

Beard: So they became major customers. We worked into that major customer.

Hendrie: Wow. Okay.

Beard: Yeah. And that was very <inaudible>.

Hendrie: Sort of as a derivative of something you've done.

Beard: Right, with the F-4000.

Hendrie: The F-4000.

Beard: And one of the things we had there was an integrated disk controller. We actually designed our- oh, what do you call it, a custom chip, if you will, that handled a lot of the disk controller functions. It was proprietary to us. And Memorex came to us. They were selling plug-compatible disk controllers to IBM's smaller computers, and we said, "Yeah, we can do that." And we designed a controller to run disk drives. So they became a major customer to us. Then shortly thereafter, Storage Technology got into one of the IBM fields of small computers. I forgot the name of the computer, where they wanted the integrated disk

controller, selling complete disk controllers systems to them. And that went very, very well. During this period of time, I guess it was early '90s, we got up to like fifty million dollars in sales.

Hendrie: Really. Wow. Okay. Very good.

Beard: And during that same period of time, we won a major contract from IBM, IBM Systems Group, Government Systems Group, which had the primary air traffic control system responsibility in those days to design the communication interface to the host computer use in air traffic control centers. And it was called PAMRI, which was the FAA term, Peripheral Adapter Module Replacement Item. It basically handled all the incoming communications and headed into IBM's 7090, I guess it was, and that was a major contract that we won.

Hendrie: And there was one of these in each of the.

Beard: The air traffic.

Hendrie: Each of the air route- it was it the?

Beard: En route traffic.

Hendrie: Yes, the en route traffic controllers. Oh, wow. Okay.

Beard: That was a very fun business. IBM subsequently sold that division to- they got out of the air traffic control to- I can't think of their name right now, but they became the principal supplier of that system to the FAA. So that was part, that plus the disk controller business we were selling to both Memorex and to Storage Technology got us up to about fifty million a year. Then I think the IBM computer was the IBM [AS]400, I think, or something, a small system. That business started to fade off, and Storage Technology tried to get out of that business also. So we tried to take that another step. We went down to something like seven or eight million dollars.

Hendrie: Oh, my goodness.

Beard: Over three or four years.

Hendrie: Phew, that's very hard to do.

Beard: Yeah. So meantime I had bought the building, built a building in Morristown, owned it. So part of the recovery was not only reduction in force, but to sell the building to somebody else, and then rent back the space that we needed. Managed to get a line of credit, and we were down to, I guess, about seventy people at that time, and one product sort of morphs into another. One of the things that we decided, to try to put together, a server, a disk controller server for aircraft use. And we went to an air traffic control show. I had a person show, you know, a rough setup of it. It wasn't really completely designed, and Hughes had an electronic unit doing in-flight entertainment systems.

Hendrie: Wow, okay.

Beard: They were at the show, and they came to us and had us develop a server that they could use in their system. This is where our disk technology, disk control technology, came into play. So we ended up with a major contract with Hughes Electronics to develop that system for them. And that started- with that we climbed out of the deep hole we were in. And that pretty much takes us to the present, except that we found ourselves morphed into avionics type of systems. One of our big customers right now is a company called Air Cell, that provides the GOGO system. They call it GOGO. That's where you be on the airplane and use your internet service, and we supply the server and the wireless routers on the plane.

Hendrie: That's cool. I've actually used that.

Beard: Yeah.

Hendrie: Yes.

Beard: They're a big customer of ours right now. And we had developed a very expert manufacturing capability. You have to have it. We emphasized quality for the last twenty years, I guess, and met all the highest quality standards required in the FAA business, and whatnot. And so right now our principal thrust is in avionics in terms of products, and whatnot.

Hendrie: Okay. Now did you diversify into any offshore manufacturing?

Beard: No.

Hendrie: You do it all.

Beard: Done right here in Morristown.

Hendrie: Okay. So you make it.

Beard: We make it.

Hendrie: You stuff the boards.

Beard: Yeah. We're not a high volume manufacturer, but, you know, quality is very, very key, and whatnot. In fact, we were able to win basically a contract manufacturing type job for Panasonic for electronics getting installed on the subway systems and train systems in New Jersey. They needed to have America content, and they came to us and we had the required reliability. It's not massive production, so the big manufacturers would put us out of business, but this is the sort of work where it takes some engineering changes, and whatnot, and plus very high quality manufacture. So that's been a very good customer for us right now, Panasonic.

Hendrie: Wow.

Beard: Yeah.

Hendrie: Yeah, okay.

Beard: We're strictly manufacturing. We do very little engineering, engineering support. When certain components go out, you know, are no longer used and have to be replaced with something else, we do it.

Hendrie: That's very interesting.

Beard: Basically where we are today.

Hendrie: Okay.

Beard: The company this year will do about between forty and fifty million dollars in sales.

Hendrie: Really. So it's come back from its.

Beard: Oh, yeah, right.

Hendrie: From its nadir. That's wonderful.

Beard: We were approached about a year ago, a little more than a year ago, by a company that wanted to buy us, and we never had a good expert, exit strategy, was something I found out everybody worries about, right? Like I never worried about us. We just do our job, maybe something will happen.

Hendrie: Yeah. Do a good job and things will happen.

Beard: We didn't have to go public or any of that.

Hendrie: Okay.

Beard: That's what happened to us. They saw us at one of these shows, and culminated basically in the sale of the company effective first of this- about the tenth of January, I think it was. Everything is still in place here in Morristown, the same people, whatnot, just that they belong to a bigger corporation now. And all the employees essentially made out. I established an ESOP [Employee Stock Ownserhip Plan] very, very early in the business, and then we had a lot of stock options for some of our key people, engineers and so forth. Everybody made out.

Hendrie: So you always said this isn't just my company. This is our company. Yeah.

Beard: Oh, yeah.

Hendrie: That's good. Well, it generates the...

Beard: To me it's a very, very satisfying- factory outcome for forty years in the business of running your own shop.

Hendrie: That really is.

Beard: Yeah.

Hendrie: That's a very satisfactory outcome for everybody that sort of stayed with it to do well. Now did Ted Frank stay with you?

Beard: No. Ted left, oh, I'd say somewhere around 1974, '75.

Hendrie: Oh, really, yeah.

Beard: He was the first one to leave. He went to work for a big communication company down in Texas. I forget the name of it right now. He did very well. Ted was very smart.

Hendrie: Yeah. I remember that he was very smart. Yes. That's good. Alright. Well, I had one other question rolling way back to Van Nuys. Were you involved at all in sort of the re-engineering of the RCA 110s for the NASA project. I know it was done at Van Nuys, and it may have been done after 1962. That may have had.

Beard: The thing with— it was under <inaudible>.

Hendrie: Yeah. It must have been. That would be about right, actually, that it was probably done in '63, '64, '65. Yeah, okay, and you were already back here, worrying about commercial computers. Alright. Well, thank you very much, Art. I really appreciate it for taking the time to do this. We're almost out of tape, and I think we managed to get to the end of the story.

Beard: Well, you really dusted off my memory, which is very dusty, thanks.

END OF INTERVIEW

