Oral History of Robert Baron

Interviewed by:
Gardner Hendrie

Recorded: May 24, 2007
Boston, Massachusetts

CHM Reference number: X4066.2007

Gardner Hendrie: Well we have here today with us [May 24, 2007], Bob Baron, who's graciously agreed to do an oral history for the Computer History Museum. And my name is Gardner Hendrie and I will be doing the interview. Thank you very much for doing this Bob.

Robert (Bob) Baron: It's good to see you again Gardner.

Hendrie: Good. Let's see. I think maybe where I'd like to start is if you could tell me a little bit about your family background, such as, you know, where you were born, what your parents did, how many siblings you had, a little bit in that realm.

Baron: I was born in Los Angeles, California. My father was a newspaper man, and when I was born, or shortly thereafter, he became Hollywood reporter for United Press, so I managed to get to Shirley Temple's birthday party a couple of years when I was a child. I always liked older women, although it's getting harder to find women who are older than I am, so that's disappearing. My father misheard. He thought it was "Go east young man", so as a result we left Los Angeles when I was young. I went to high school, or grammar school, in Kansas City, Missouri. We moved to New York. I went to high school in New York City, at Regis High School. And then I went to Philadelphia where I attended Saint Joseph's College, majoring in Physics and minoring in Philosophy. I have one sister. My father ended his life back in Ohio, where he was political reporter for the Cincinnati Post, and my mother eventually moved to Boston where I was living, and then subsequently out to Denver, where she died two years ago at age 93.

Hendrie: Now was your mother primarily just a homemaker?

Baron: No, she was a homemaker when we were children, but she worked, when we were in New York City, for Grolier Encyclopedia Company. And then she worked, when she was in Boston, she actually worked for Houghton-Mifflin.

Hendrie: So she was in the publishing world and your father was a writer. And when we get toward the end of this interview, we'll say guess what happened, as your later career unfolds.

Baron: Well I might have gone down that path except my father was a writer, so I decided I'm going to be an engineer.

Hendrie: Now you said you had another sibling.

Baron: A sister, Kaye, and she's two years younger than I am. She lives in Denver now. She lived for 30 years or so in the Boston area.

Hendrie: And did she also follow any sort of vocation?

Baron: No. She did a variety of things, as you always do when you're in Boston.

Hendrie: Talk to me a little bit about your early years, when you were growing up. Did you have any particular hobbies or, you know, interests when you were younger?

Baron: I was a baseball player. I was tall and skinny, so I couldn't play football. And I tried basketball, but I always got knocked off the court. But when I was younger, I was a very good baseball player. I could catch any fly ball and I could hit anything. I threw like a dead chicken, so I never would have made it in the majors. But when I was in high school, my father took me to a New York Giants game, and there was a young guy named Willie Mays who was a rookie. And I watched him for the game and afterwards I said to my father, "I guess I'd better go to college." He said, "yes, you should." So I went to college. I went to Saint Joe's and I co-op'ed.

Hendrie: Well I want to ask a little bit more about your high school career. What were the subjects that you really enjoyed in high school?

Baron: I went to Regis High School, which is one of the best high schools in America. It's an all-scholarship school run by the Jesuits. My favorite subjects were English; anything with math; history, I loved history; anything to do with languages, I was in big trouble. Freshman year I think we had nine hours a week of Latin. We had exams every single day in every single subject for a couple of years, so I learned how to study very much. I used to come down from New Rochelle on the train, get off at 125th Street, walk through Harlem, get on the subway and go down to 85th Street and Park where Regis was. I…

Hendrie: Did you live up in New Rochelle?

Baron: We lived in New Rochelle, yes. And my father worked in the city. But I went to school in New York City. In fact, one of my high school classmates, Mike Murray, who subsequently went into the Air Force, traveled all over the world, he was in Denver last week, and he and I went up in the mountains and talked about the meaning of life, and why can't a woman be more like a man, and all those sorts of things as you get older you start talking about.

Hendrie: What is your earliest recollection of thinking about what you wanted to do when you grew up?

Baron: I'm still thinking about it. I think, very fundamentally, one should ask oneself what do you want to be when you grow up every ten years, which is why my career's been probably zigging and zagging a little bit. I love the world of ideas. I love the world of the past, learning from the past. So even as a young person, I was reading a lot of history. And I have continued to do that in my career. I'm not very good with my hands, which is why I never became a mechanical engineer. But I did become an electrical engineer, since you can't screw up electrons with your hands.

Hendrie: Do you remember when you got the idea maybe that you wanted to become an engineer?

Baron: Yeah, it was senior year in high school. I decided that my father's career was gonna take him back to the Midwest, and we didn't have a lot of money, so I was going to have to work my way through college. So I went to Saint Joseph's College, which had a co-op program where I could pay for my own education. And I can talk about that a little bit later, but right from the beginning I knew that I enjoyed the creative aspect. I've always enjoyed creative people.

Hendrie: So it was in your senior year, trying to figure out what to do. But did you know you wanted to be an engineer then?

Baron: I wanted to-- yes, I think I wanted to be an engineer.

Hendrie: Were there any role models that gave you this idea?

Baron: You mean besides you Gardner?

Hendrie: You didn't know me then.

Baron: That's true. No, I didn't. I had more role models from the world of publishing, from the world of education, from history, but I was interested in natural science, and that was something right from the beginning that I paid a lot of attention to. But I really didn't know what an engineer did for a living when I was eighteen. And my degree actually was in physics, with a minor in philosophy, so through college I had the option of moving in a lot of different directions.

Hendrie: All right. So you didn't go to school "to be an engineer".

Baron: No.

Hendrie: You just went to college and said sciences are what I like.

Baron: Right.

Hendrie: Philosophy, though, is a little bit different for the typical-- even scientist.

Baron: But science deals with the external world and philosophy deals with the internal world. And so I've always enjoyed that juxtaposition. 'Cause some issues obviously are more organized around science and measurement and all of that, and others are intellectual.

Hendrie: Now during your co-op program, where was the first place that you worked as a co-op student?

Baron: I went to RCA in sophomore year, so I worked sophomore, junior and senior year at RCA. I got to know several of the people who subsequently I worked with, Paul Bothwell, Grant Booth, you and others. I started in surface communication.

Hendrie: I was gonna say what department did you start in.

Baron: It was surf-comm, and we were building the first transistorized walkie-talkies. And transistors were just coming in. I was very fortunate to get in on the ground floor 'cause the older engineers didn't want anything to do with them. And two memories from those times, one, that we built a-- one was sent up to Dave Sarnoff, so it was tuned in only to NBC. And the thing would drift every week, so somebody would have to go from Camden up to New York and adjust it so it was back on the station. But it was one of the first, I don't think it was the first, but it was one of the very first of the walkie-talkies. The second is we used to do field trips which were really nice. We'd go out in fields and try to talk across the field. And if the rain came, we'd go into a bar and test it as well. And as you know, New Jersey has more rain than not, so we did probably more testing in the bars then we did in the field. And then after that, on one assignment, I went to AR&D I think it was called, 591…

Hendrie: Oh, the advance development. Yes.

Baron: Yes. And Grant Booth hired me when Paul Bothwell was on vacation. But when I got there, Paul says, I never hire co-op students. That's how Paul and I got to tell each other. And we worked on, essentially, parts of the first inter-defense systems. As it turns out, Ken Olsen was working up at Lincoln Labs on that same system, but there was an attempt to give ground control to pilots who were supposedly…

Hendrie: Yes, the Sage system. Yes.

Baron: The Sage system. So I worked on that and then the day I graduated from college, I got my draft notice, that I had to go in the next day. Or I got it a few days before. So as a result, I stayed at RCA until the army decided, in their infinite wisdom, they needed me. Which turned out to be another year, so I worked in 591 for another one year.

Hendrie: And who did you work for then?

Baron: Paul.

Hendrie: Okay, for Paul Bothwell.

Baron: On the Sage system.

Hendrie: Was this on the AN/GKA-5 Data Link?

Baron: Yes. And I spent some time up in Boston at Lincoln Labs as well.

Hendrie: Very interesting. Now I thought they had deferments, you could get a draft deferment, if you worked on a government contract at RCA.

Baron: Maybe you did, but I didn't know about it if there was one. I went in under what was called the critical skills induction, which you're supposed to be in the service for 6 months. And then about, I don't know, 150 years or so in the reserves, and fortunately my path did not continue down that direction, otherwise I'd probably be in Iraq now. I think they're working their way into the 50s and 60 year olds. But I got in, and then because Sputnik went up in '57, they released a lot of the engineers to come back and try to catch up with the Russians. So I came back.

Hendrie: You came back to RCA. Now do you remember any of the specific projects you were working on in 591 and this era, like the year before you went and…

Baron: Well, we were doing a variety of things involving transistors, starting to replace vacuum tube circuitry with transistorized circuitry, so we were designing everything from which I guess was called creepy peepy, a walkie-talkie that had a television camera on it, through the Sage system. And we were also doing some of the work for a computer group. So I started working in the computer field about 1956 or 7.

Hendrie: How long were you in the army?

Baron: Well I was supposedly gonna be in for 6 months, but because the Russians set up Sputnik, they released us all after 90 days. So it was a Republican administration, and I thought anybody smart enough to realize I couldn't defend the country is the party I should register for, so when I got out of the army, I registered as a Republican. Something I've sort of regretted since then, but we were <cough> excuse me, the US was behind the Russians in terms of space program and we caught up very quickly. And I worked in that field.

Hendrie: Okay, good. So now you come back to RCA. Are you still working on the AN/GKA-5 Data Link or…

Baron: No. When I got out I decided I did not want to stay in Philadelphia, so I interviewed for a couple of places. And Paul Bothwell had meanwhile moved to Boston. So I came up and he was working for a small electronics company and I joined them.

Hendrie: And what was the name of that company?

Baron: It was a company called Epsco. And we designed some of the first analog to digital converters. So I was…

Hendrie: Okay, so you worked on that. Who was the founder of that?

Baron: Bernie Gordon. And Bernie was a great salesman and a great engineer, so we did one of everything and two of nothing, which is a great way to learn, but it's not a very good way to build up companies. So I worked there for about two years and then I moved on to a small company called Computer Control.

Hendrie: Well now I'd like to hear more about what you did while you were at Epsco. Did you work on just one project or did you have…

Baron: I worked on several. They all were analog to digital or digital to analog converters. We did the first four decimal digit analog to digital converter for companies like AC Spark Plug, for several military installations, etc. As you know, it's an analog world out there, and converting the signals into a digital format was, and continues to be, a major part of the growth of the industry. So vacuum tubes had gotten to a certain quality of design, but the transistor was coming in and we were able to design a lot.

Hendrie: These were all transistorized.

Baron: Yes.

Hendrie: Just exclusively transistor designs.

Baron: Yeah.

Hendrie: Now were you doing circuit design?

Baron: Yeah. I was a circuit designer, predominantly. I did some system design, but I was fundamentally, there and for the next several years, I was a circuit designer.

Hendrie: Okay, now how do you do circuit design when you have no engineering background? You just have a degree in physics.

Baron: Well that's a good question. I've got a theory that if you know what you're doing, you'll never advance any field. But that's separate. We can talk about that a little bit later. There were no books, and so everybody was learning, and transistors went from point contact to junction transistors, so they had different properties. And we were all learning at the same rate, so whether you had 20 years of engineering experience or none, you had to go in and figure out how to do something completely differently. And so we did. And we were able to design some great circuits and they worked.

Hendrie: Okay, just looking, understanding how the transistors worked and…

Baron: Yeah, it's the same thing as the beginning of any industry, which I've written about. But you start by saying what's the problem, and then what are the tools you've got to do that, and how can you go about solving the problem. And I was fortunate in that I got in on the ground floor of both the semiconductor and the computer industry, so there were no experts. There were no PhDs. There were no books on how to do it, so you learned how by either working with good people and developing ideas based on their work, or doing it yourself.

Hendrie: Now was Bothwell a good circuit designer?

Baron: He was okay.

Hendrie: He was okay, all right.

Baron: No, Paul was a better system designer I think. And I tended to be more a circuit designer.

Hendrie: So you figure out how to do those really fast-- the classic problems of the analog and digital converter.

Baron: And at that time there were lots of arguments about whether analog or digital computers would be the way the computer industry would develop. And there were companies on both sides. But the ability to transcribe signals from one to the other was very important.

Hendrie: Now how long did you stay at Epsco?

Baron: I stayed there two years. And then I joined a small company called Computer Control Company. And Computer Control had been started in 1953; 1960 it was a two million dollar company, as was Digital Equipment was a two million dollar company. So these were competitors. And I went to 3C and was assigned initially to design a new family of modules called S-Pac. These were digital modules. They had had serial logic in their T-Pacs and their V-Pacs, but this was a set of flip-flops, gates etc. So I designed all of those.

Hendrie: Now whose idea was it to do this, to design this new line?

Baron: I think it was probably Ben Kessel's, but it might've been Paul Bothwell's. I'm not sure. This small company brought four engineers in. Two to work on serial logic, Howard Hill and Joe DeClew [ph?], and two to work on static logic, which was Larry Gutwell [ph?] and myself. And so they made a major investment in buying four, 20-year old kids to design circuits. And S-Pac turned out to be very successful, because within a couple of years, we were selling eight million dollars of the line itself. And so for a two million dollar company, that was a major step up.

Hendrie: Now why was it so successful? What was your perception of that anyway?

Baron: Well the computer…

Hendrie: And maybe at the time and then later.

Baron: I think it was because we were moving from building a system from the ground up. Every system was different and we hadn't gotten yet to the computer industry where you could take a computer and program it to do different applications. So people who had a certain application needed to have building blocks. And we essentially supplied them power supplies, gates, flip-flops, power amplifiers, all sorts of circuitry, memories, etc., so that you could really become a true systems engineer. You could take the building blocks and figure out how to do it.

Hendrie: Yeah, you didn't have to be a circuit designer.

Baron: You did not have to be a circuit designer. And for both Digital Equipment Company and for 3C, the circuits were the building blocks of the first minicomputers, because we used them inside as well as outside. And the module business really financed both company's entry into the minicomputer industry. So I worked on that for about a year.

Hendrie: Designing the S-Pacs.

Baron: Designing the S-Pacs.

Hendrie: Now how fast were these?

Baron: The clock was about a million cycles a second. That was about as fast as they could go. And they were all germanium transistors. We subsequently built some silicon, but originally they were germanium.

Hendrie: So this turned out to be very successful. What did you do next at Computer Control?

Baron: Well…

Hendrie: Now what year-- I need to roll back. What year is this?

Baron: This is 1960.

Hendrie: Okay, 1960.

Baron: And in the '57 to '60 timeframe, the U.S. was trying to get its' space program off the ground, in more ways than one. And about half of the damn launches blew up in the launch pad, if you remember those days. And I've written about that in the book. They had decided at NASA to go for the moon, and try to fly something near the moon, but more than half of the moon shots didn't make it. Some people at JPL had decided hey the aligning of the planets is such that we can take a shot at Venus. And as you know, the planets go around the sun at different speeds and different courses, so it's only occasionally that you really get this wonderful juxtaposition.

Hendrie: When Venus is really close.

Baron: Well it's like throwing a football to somebody who's running down the field. You've got to lead them, but you can't throw the football a thousand yards. So JPL, they decided they were doing to take a shot at doing something for Venus. And because nobody had done anything in Mars, I mean, sorry, on the moon, there wasn't a lot of attention paid to the program. So we designed a system. We built the modules. We repackaged the modules. We designed a system for a Venus probe. And the Venus probe was due to be shot off in '61 to reach Venus in 1962. It had magnetostrictive delay lines in the system for memory. It had lots of power. It had lots of circuitry. And the issue was since we didn't know anything about Venus, you gotta ask a whole bunch of questions that are yes or no questions, and see what you find out. Well, fortunately, in retrospect, the Atlas Centaur booster that was supposed to do it, blew up on the launch pad. And they said, oh, we can't guarantee that probe. So they switched to an Agena B as a launch vehicle, said could you reduce the power, weight and size by 90%, and could you get the system still on the original schedule? So we went into a panicsville design and we actually delivered the system in 89 days. And it went to JPL.

Hendrie: Now how did you do this? Now these were basically S-Pac circuits?

Baron: No, well they were-- the circuitry was like S-Pac, but they had lower power. They had minimum power circuitry.

Hendrie: Okay, so you'd redesigned the circuits, the same scheme, kinds of gates.

Baron: Same kinds of gates, much lower power. We repackaged them into a three-dimensional rather than a two-dimensional array. We wired the system together and we got it out there quickly. I mean fundamentally we worked around the clock for three months. And Al Picarelli [ph?] and Bill Call [ph?] and a variety of us, you know, just did it. And Mariner I was launched on the schedule. Mariner I blew up on the launch pad. Mariner II went by Venus. That was the first interplanetary probe.

Hendrie: Now which one is Mariner I?

Baron: Mariner 1 was this new circuitry.

Hendrie: The new circuit was Mariner 1.

Baron: We shipped two systems, and one blew up on the launch pad and the other got to Venus, flew by Venus.

Hendrie: And this was Mariner I.

Baron: This was Mariner II.

Hendrie: Mariner II was the one that got by Venus. Now the one that blew-- that was heavy and originally supposed to go to Venus…

Baron: Never did anything. It just sat in the-- we never shipped it, because they didn't have the ability to launch it.

Hendrie: Oh, so it didn't blow up on the launch pad. That was Centaur. They said this isn't gonna work.

Baron: This isn't gonna work. Okay.

Hendrie: So it just stayed at 3C.

Baron: So we designed the system. I guess we shipped three systems. One of which was tested under all sorts of temperature and so on. The second system was launched and didn't get off the launch pad. The third system went to Venus. And were shipping back information real time, 8 1/3 bits per second.

Hendrie: 8 1/3 bits per second. All right.

Baron: And the amount of energy we were getting was some of the can-- say a light bulb that's in California that we're peering at. I mean it's not very much energy coming back. So instead of a signal to noise ratio, we had a noise to signal ratio. And you had to find the signal among all this noise. But we found out a lot about Venus on that probe.

Hendrie: 3C did all the digital portion of it. Did they do anything with the radios or any of that part?

Baron: No. That was done by other companies. And…

Hendrie: And JPL was the system integrator.

Baron: They were the system integrator and there were a variety of scientists around the country, Van Allen for instance, from Iowa was doing some of the instrumentation. And they had to shrink the number of instruments that they could fly, as well, as part of cutting back. But they wanted the digital part to really

get small so they could fly as many instruments as they can. So they had magnetometers and temperature gauges and infrared detectors and all sorts of things. And it worked. So after that we-- and it had been launched before we'd had a successful moon probe, so we sort of came in the back door. We then did the Mariner Mars program and we had to design a different kind of circuitry.

Hendrie: Oh, why's that?

Baron: Because we didn't have enough space and weight to do that. Because this time they were gonna try to store material and ship it back. When we went to Mars we were taking television pictures, and you would take a picture and then you would digitize each little bit, and you'd put that into storage and then you'd ship it back, and you had to then put the picture back together. And since the earth is rotating, you would actually receive it in three different places. You'd receive it in California, South Africa and Australia. And so you had…

Hendrie: Then you had to put whatever you received back together and…

Baron: Yeah, that was a jigsaw puzzle. But we got our first pictures from another plant. And that was, again, sent at very low speeds. I think it was like 16-bits per second.

Hendrie: Okay, but it was some improvement in the speeds.

Baron: Some improvements in the speed. So we did that and we designed a…

Hendrie: Now what was that called?

Baron: That was Mariner Mars or Mariner IV.

Hendrie: Now what happened to Mariner III?

Baron: Mariner III, again, went off course and had to be destroyed. I think it was going to take out Baltimore or some place.

Hendrie: Okay, now but Mariner III and IV were both Mars.

Baron: Yeah, they were both Mars.

Hendrie: And you built both of them.

Baron: Yeah, 1 and 2 were Venus and 2 got to Venus. 3 and 4 were Mars and 4 got to Mars. And then after that we did some work for an Aranga program. We did some work on one of the first spy satellites. Several of us would go out to JPL about every two or three weeks and do systems discussions and so on. And we flew all of this equipment. I mean it all flew and so on. But by then we're into 1965 and suddenly things are actually working, they're getting off the launch pad. It's gone from a 60% failure to a 80% success on probes. So to just sort of follow up…

Hendrie: Yeah, that was a pretty exciting time.

Baron: It was very exciting. 3C at that same time was doing a lot of ground equipment for the space program, for the deep space probes. Antennas, training, the astronauts were trained on simulators that had computer controlled computers in them and so on. So through the 60s we were quite active in that field.

Hendrie: I'd like to sort of go back and talk some more about the details about the Mariner systems. You said the first one was the same circuit type as S-pack, but redesigned to be really low power. And you had magnetostrictive delay lines for the storage. Do you remember how much storage there was?

Baron: Well I don't because it never flew. It got cancelled as a part of the switch to _____. But if you look at the technology from '57, let's say, to '70, which is a 13-year period, circuitry went from vacuum tubes to transistors on boards to transistors and resistors and so on on Mariner as sort of a piggy back, three dimensional thing with the circuits designed for lower power. We then, on Mariner IV, used something called pellet components, which were everything looks like a dot. They were-- I think we're not only the only space thing that ever used that technology, but the only probably one of the few systems that ever used that technology.

Hendrie: So where did this technology come from? Where did…

Baron: Well there were people practicing that. In those days there was argument about thin films and whether thin films were gonna make it. Integrated circuits and transistors-- in those days, you had to test every transistor and you had about half or more of the transistors not meeting specifications. So the idea of an integrated circuit, which had been proposed, didn't look like it was gonna get off the ground, okay. But by the mid-1960s advances were being made at Texas Instrument and Intel, Fairchild and other companies, and integrated circuits began to look to be the way to go. And 3C, and I was involved with this, started building our own integrated circuits. Now by 1970 the technology had stabilized on integrated circuits. But the intriguing thing is that from 1970 to 2005 the only technological change that has occurred is that the wafers have gotten bigger and the components on the wafers have gotten smaller. So you've gone from being able to have, you know, the equivalent of four transistors in a little area to, you know, 4000 or whatever. But in that 1955, '56 to '70 time frame, we went through four technologies. So the circuit designer was sort of center to what you could do.

Hendrie: Let's see, yes. I had a question about the-- rolling back just a little bit, about the pellet components that were used on Mariner IV. Could you describe a little bit more about what they were?

Baron: Yes.

Hendrie: Were there individual pellet capacitors and pellet diodes?

Baron: Okay.

Hendrie: And where did they come from? Where did you by them? Or did 3C make them? If you'd just give us a little bit more detail about that.

Baron: Okay. In the early '60s, we had to decide what technology to use in order to satisfy the needs of the Mariner program, Mariner Mars program. We looked at a lot of technologies. We looked at some of the preliminary integrated circuits, which weren't very reliable. We looked at discreet components. We looked at-- we went back and said, "What could you do with vacuum tubes?" and all of that. Vacuum tubes were quickly eliminated because of the power requirements. We looked at interconnecting components by thin film technology, which essentially, you deposit a thin film to make your circuit interconnections. At that time, Mallory and many of the other resistor, capacitor, and diode companies, as well as transistor companies, were trying a technology which is a pellet. Every pellet is about the size of a dot, and this one's a capacitor, and this one's a resistor, and this one's a diode. So we proposed this technology as a way of essentially shrinking the size significantly. We bought the pellet components from resistor manufacturers and capacitor manufacturers, diodes, Clevite made the diodes. And we then put them in a frame, and we deposited the interconnection between them. And then we epoxy covered them. But we tested the components, and we tested the circuits, and then we tested the interconnected circuits. It was something we wouldn't have done if it was two years earlier or two years later.

Hendrie: Okay. But you did the deposition?

Baron: We did the deposition.

Hendrie: Okay.

Baron: We got all sorts of specialized equipment. It relates to our integrated circuit lab, which I'll talk about a little bit later. But it was--

Hendrie: Okay.

Baron: In retrospect, it was-- it makes absolutely no sense unless you know the time and what your alternatives were at that time.

Hendrie: So it was a point-- at that particular point you had to make a decision. You concluded it was the best technology, but it was a dead end in terms of--

Baron: Yes.

Hendrie: --long term--

Baron: Oh yeah.

Hendrie: --development of technology.

Baron: Yeah.

Hendrie: Yeah. Okay. But everybody was trying to do the same thing, make it smaller.

Baron: Make it smaller, make the--

Hendrie: And presumably, it might be cheaper in the long run if it was smaller.

Baron: Yes.

Hendrie: Okay, good. I have one other question about the circuitry in the S-Pacs. I think I read someplace that one of the circuit elements was a thing called a CRUD gate. Could you talk a little bit more about the circuit design, and the specific kinds of circuits. Is this diode gating or-- talk a little bit more about circuits.

Baron: Well, again, you have to go back to the time.

Hendrie: Yeah.

Baron: Transistors in those days were running three to four dollars apiece. Actually, some of them were a lot more expensive than that. Silicon transistors were six or seven dollars apiece. Resistors were pennies, and capacitors were pennies, and diodes-- there were two companies in Boston, Clevite and Transitron, which were making diodes, and they were very inexpensive. So this is really diode logic, with capacitors and resistors. Capacitor, resistors, diodes, to do much of the gating and circuitry, with the transistor being the amplifying factor.

Hendrie: Okay.

Baron: So we tried to minimize the number of transistors we used. Again, it was an economic situation, and we could produce very good, very reliable circuits, at very low cost.

Hendrie: Okay. So, all right. That's good. So it was because of the cost of things at that time--

Baron: Yes.

Hendrie: --it made sense to have diode logic.

Baron: And also because of the reliability. Transistors, again, were not 100% to specifications. So you wanted as much margin in your circuitry as you could. And you'd actually test the system by changing some of the resistors or some of the functions. Or changing the voltage, and seeing would the circuit still perform as a flip flop or a gate under significantly modified conditions.

Hendrie: Okay. I have to stop for just a second. We're going to do a pause. Somebody once told me that CRUD gate stood for capacitor, resistor, unt (in German), diode. Do you know whether that's right?

Baron: No. I don't think that is. None of-- I shouldn't say that. Only one of our guys spoke German, and the rest of us couldn't understand what he was talking about.

Hendrie: I see. All right. Very good. I actually heard that from Louis Kulow [ph?].

Baron: Oh, okay.

Hendrie: Okay.

Baron: Yeah, maybe I might just interrupt a little bit and say that everything that we did in the beginning of the space program, going back to how the whole industry developed, is in a book that I wrote, "What Was it Like Orville?" Some observations in the early space program." And I'm giving Gardner a copy of this. This was developed because Ed Hampson, at the 40th anniversary of Mariner II, suggested we document the thing. So it describes both the circuitry, and also some pictures from outer space, or from Mars in this case. And what we learned, and what we didn't learn. And it shows how the circuits were built, and it also shows the logic behind how the system worked.

Hendrie: Very good. Excellent, thank you. All right. Let's continue. What did you work on after the Mariner programs? Tell me a little bit about what happened, that was obviously a central focus of what you were doing for a couple of years.

Hendrie: There was a young man named Colin Knight who came into the office at 3C one day, and talked to Paul Bothwell, and I think Ben Kessel, but I'm not sure, and started talking about the future of integrated circuits. We had moved from vacuum tubes, although all of-- it's worth mentioning that every one of the vacuum tube manufacturers never made it to transistors. And there were a whole new group of companies, both in California and in Massachusetts making transistors. Well Colin came in and said that the future was going to be integrated circuits, which essentially takes and deposits a variety of

components. And you design the circuitry differently. And on the back of an envelope, when asked, he started talking about diffusion furnaces and how much they would cost, and all of the other equipment. And 3C said, “Let’s do it.” So Colin hired three people, and we began to design circuitry for this new technology, wafer technology. And I was running that program, Colin reported to me. We designed the circuitry. You design gates and flip flops quite differently when everything is being deposited, because resistors and capacitors cost money, as opposed to--

Hendrie: And transistors are cheap too.

Baron: And transistors are cheap. So you design things differently. So we designed these circuits, and then we worked with companies like Westinghouse and Texas Instruments and Fairchild to have them fabricate it. And we, as a result of that, we built a new line of modules called micropaks, which are providing the same circuitry with power supplies and connections and everything else. So again, you could design a special system the way you wanted to. And I think I’m correct that Computer Control Company (3C) was the first company to build an integrated circuit computer. If it’s not, it’s certainly one of the first two or three. And so we worked on that.

Hendrie: Now who were the-- was there a particular type of circuitry that proved to be the best kind for these?

Baron: TTL [transistor-transistor logic] or DTL [diode-transistor logic].

Hendrie: Okay.

Baron: Two transistors or diodes transistors.

Hendrie: Okay.

Baron: And lower power, smaller. Although compared to today they’re huge, but smaller. And you would build on a wafer that was probably one and a quarter inch across, perhaps 30 or 40 circuits. And then you’d cut them up and you’d test them. And again, at the beginning, we were getting maybe half good and half bad. And obviously today, the circuitry is smaller, the wafers are bigger, and the quality is such that they get 99+%. But at the beginning, it was testing.

Hendrie: That was what was what.

Baron: Yes.

Hendrie: So was this a lab just to test out the circuit ideas?

Baron: Yes.

Hendrie: Yes, okay.

Baron: It was a-- we did the testing. We then would go to Phoenix, Texas, and California, and work with the companies to buy the circuitry.

Hendrie: Okay, to have them fabricate circuits of your design?

Baron: They would fabricate, yes.

Hendrie: Okay. Now who were the vendors that we ended up with?

Baron: We ended up with-- well the ones we looked at, and depending on the time, we-- Motorola, Texas Instruments, which was still a small company, Fairchild, National Semiconductor. This was before Intel had spun off.

Hendrie: Okay. Was Westinghouse a vendor too?

Baron: Westinghouse was for prototypes, but they never could really make the quality. So we used to go to Baltimore, which was--

Hendrie: Okay, fun.

Baron: It was fun.

Hendrie: So the very first circuits in the micropak line, who were the vendors you ended up choosing?

Baron: Texas Instrument, Motorola, and Fairchild were the three biggest ones.

Hendrie: Okay. They built--

Baron: Yeah.

Hendrie: Between them, they built all the different-- do you remember how many circuit types you actually came up with on the original micropak?

Baron: About--

Hendrie: May have had different kinds of cards.

Baron: Yeah. Yeah, we probably--

Hendrie: More kinds of cards than you had circuits--

Baron: We probably had four or five circuits, and then on the cards we combined them, and interconnected them in different ways.

Hendrie: Yeah, yeah, made different things.

Baron: Yeah.

Hendrie: Okay. All right.

Baron: Certainly less than half a dozen.

Hendrie: Okay. That's pretty good.

Baron: The semiconductor people were-- their skills in those days were fundamentally making transistors, processing. They were manufacturing. They had not developed either the circuit capability or the system capability that they were later to do.

Hendrie: Okay. So they actually-- somebody needed to do the circuit design and tell them--

Baron: Yes. Yeah.

Hendrie: --what was a good circuit, a circuit that a customer could really use.

Baron: One of the side benefits, or disadvantages of doing this, was that Honeywell noticed that we were doing it, and they came in and bought Computer Control Company, and with all of the negatives that that subsequently did. But it was, to a large extent, Walt Fink he bought the company because of our semiconductor technology.

Hendrie: Okay. So the company was-- so Computer Control was doing this before--

Baron: Oh yes.

Hendrie: Yeah, on its own.

Baron: Yeah.

Hendrie: Now, do you remember when micropaks first came out? What year?

Baron: ’65 or ’66.

Hendrie: Okay. All right. Good. Now what were you doing at this point, when the micropaks-- you were responsible for the prototype lab. What else were you responsible for?

Baron: I was pretty much responsible for all circuit design groups.

Hendrie: Okay, by this time.

Baron: At this time. And then in ’68, I became manager of the digital products, which meant that I had P&L [profit and loss] responsibility, and sales force, and manufacturing responsibility, as well as engineering, for all of the modules and memory test equipment and so on.

Hendrie: Okay. All right.

Baron: So I slowly but surely moved out of design and more into management.

Hendrie: Okay. Did you enjoy that transition?

Baron: Yeah, I did.

Hendrie: Okay.

Baron: I’ve always enjoyed creative people, as you’ll find out throughout my talk. And so I really enjoyed working with people who had different ideas and did different projects.

Hendrie: Mm-hm. Okay. Good. So maybe you can tell me a little bit of the stories of what happened next during that period of your career? What were some of the projects that you were responsible for?

Baron: Well, 3C was a major supplier of modules. It was a major supplier of memories. We did memory test equipment. IBM was a major customer for us in those days. We-- when Honeywell acquired it, IBM decided they wouldn't continue to buy our test equipment, so I sold off that business through an imaginary character, almost, named Eugene Sunshine from Philadelphia. And Eugene Sunshine helped sell that business, the memory test products business. That would require at least two drinks to tell you about Eugene.

Hendrie: Okay.

Baron: But I was working with the other aspects of the company. By then the company had designed 24-bit computers, 16-bit computers, 32-bit computers, and I was working with all of these engineering managers. The process control operation moved from Philadelphia, or outside Philadelphia, to Boston. And so I inherited those people as well.

Hendrie: Okay.

Baron: So we started doing process control. And then in 1970, I was appointed director of engineering and programming for the whole operation. 3C had been nip and tuck with DEC up until Honeywell's acquisition. We lost about a year and a half through the acquisition, and then we began to continue to grow. And I think the company, when I left, which was '71, was about $100,000,000, if you looked at everything. We had operations in London, so we used to go over there a lot. We were probably selling half of our products now overseas. And so I then worked with really interesting guys, like you and Maury [Morris] Ringer, and Toby Harper, and a variety of people, and had some great fun during that period of time.

Hendrie: Good.

Baron: And Honeywell acquired General Electric's computer business at about that time, '70 or '71, I can't remember.

Hendrie: Yes.

Baron: The people who were running General Electric's computer business decided that you had to be a certain size in order to make it, and they made a power play. And management decided to sell them off. So we ended up with operations in Phoenix and around the country, and <inaudible>, and Italy. And I found out subsequently that as part of the agreement, Honeywell agreed to enlarge the staff in Paris at the expense of the United States. So we had a layoff, a major layoff, the only layoff I've ever participated in. And that was--

Hendrie: At 3C, yeah.

Baron: At 3C. And I mean, part of it was good in the fact that you had all these different divisions, and you began to think through what fit and what didn't fit. But part of it was bad, we said, you know, "We should enlarge our semiconductor lab," and Honeywell said, "No, no, we tried that once, it didn't work." So I don't know what they tried, but anyway, we killed that part and all of those guys went out to fame and fortune in California, in Silicon Valley. And a couple other things didn't work. But my last job, I was worldwide systems manager for Honeywell's minicomputer business. So I traveled a lot and so on. But I definitely decided I did not like the political environment of a very large company.

Hendrie: Yeah, okay.

Baron: So I asked myself, "What do I want to be when I grow up?"

Hendrie: Right.

Baron: And went off and started a new company.

Hendrie: Okay. All right, good. So let's talk about that period.

Baron: Okay.

Hendrie: When you started thinking about going off and starting-- you wanted to do something else. Where did the idea of starting-- tell me about the genesis, the discussions. Who'd you talk to? How did it sort of bubble up, what you wanted to do and what kind of company you wanted to start?

Baron: Well, I think there's two factors. One is that if you've been doing something incrementally, and you can start from scratch, you will end up doing some things differently.

Hendrie: Mm-hm.

Baron: So that was one piece. You would design computers differently, you would design circuits differently, you'd do systems, you'd do programming, etc. The second point of view was that at that time, there were two worlds. There was the world of big main frames, and the world of the minicomputers. These were leased, these were sold. These had memories, large memories, at least for the time, these didn't. These had peripherals, these didn't. These were sold to financial organizations, these were sold to engineers. These were multi-purpose, keep 'em loaded at all times, these were single purpose, recognized engineers are required. Well, every one of those, you can come in the middle and say, "I want to do it somewhat differently." You can put lots of software or little. Software was an afterthought of most of the computer companies. Even IBM, I think, I was told that on the 360-50, only had three software guys at the beginning of the program. So I decided that it might be good to try to do something completely differently. And I got six friends, and we started talking about it.

Hendrie: Now, yeah, you're going to tell me who these were.

Baron: I will indeed. Bob Berkowitz, who was manufacturing; Joe Cashen, from engineering; Sid Halligan, who had been at Honeywell and had left, in sales; Jim Campbell; Johnny Carter, who was an administrative guy; and we started with a guy named Alan Burgess. And Alan was a 632 manager. So we started with him.

Hendrie: Okay.

Baron: We got part way into it, and his wife said, "Oh, you can't take a chance." So he stayed at Honeywell. I don't know if he's still married to the same woman or not, but that's a separate issue.

Hendrie: Right.

Baron: And I went out and got Bill Poduska. So Bill was number six or seven, whatever that was. And we started the company. Took a while to find financing.

Hendrie: Yeah, tell us about the story of finding financing. Where did you start? Wrote a business plan and--

Baron: Yeah, we wrote a business plan.

Hendrie: Yeah.

Baron: If you--

Hendrie: Do you still have a copy of the business plan?

Baron: I think I do.

Hendrie: Well, the Computer History Museum would love to have a copy--

Baron: Okay.

Hendrie: --when you're ready to give it to somebody.

Baron: Okay. We approached all of the venture capital people in Boston. There was no room for another computer company.

Hendrie: Okay.

Baron: We approached a lot of the people in California. There was no room for another computer company. The computer industry was considered pretty well mature, and how could you possibly compete against IBM, with their tremendous resources? Forgetting that IBM was a $40,000,000 company in 1941, and was, you know, $100,000,000 company or something like that in ’46 or ’47. But nobody thought there was room for that.

Hendrie: Okay, now what year are you doing this?

Baron: We’re doing this in ’71, we’re starting to talk about--

Hendrie: Okay, ’71, okay.

Baron: ’71. And let me just continue on the financing deal for a while.

Hendrie: Yes, good, yeah, that’s good.

Baron: I’ll come back to it. I raised-- we raised two rounds. We eventually found a lead investor, then three other investors. And we raised a grand total of $2,000,000 over about a one year, two year period.

Hendrie: Well now how did, tell me who the first initial investors were.

Baron: The initial investor was a company called Idana [ph?], which was the-- came out of oil money out of Texas.

Hendrie: Okay.

Baron: Okay. And then we got-- because of that, we began to get other people. But they were all sort of New York based deals.

Hendrie: Okay, and how much money did you raise in this first round?

Baron: First round was 300,000.

Hendrie: Okay.

Baron: Okay? To give you an idea of how long ago it was, in ’74, when the company was really rolling, we could not raise any money privately. So I brought it publicly. And I raised $2.8 million through a firm in New York. And that was, I think I’m correct, 20% of all the money for IPOs for all of ’74.

Hendrie: Oh, my goodness.

Baron: There was like nine or ten million dollars raised in ’74.

Hendrie: Okay.

Baron: So it’s not like today, where they throw tens and hundreds of millions of dollars. The converse of that, though, is anybody who bought stock on our initial public offering would have made 50 times their money.

Hendrie: Okay.

Baron: And the private investors made 100 times their money.

Hendrie: Yeah.

Baron: So somewhere between that and throwing an infinite amount of money at something is probably where it should be.

Hendrie: Right.

Baron: And I’ll come back and talk about that when I talk about the history of business.

Hendrie: Yeah. We have to stop for just a second.

Baron: Okay.

Hendrie: There we go. I interrupted you.

Baron: Okay. Well, let’s go back to the beginning, and get away from financing. Prime had three things we did differently. The first is, we said “Software first.” We, right from the beginning, got the programmers to specify what they needed in a machine, and we tried to figure out how to do it. And neither IBM nor DEC nor 3C had started from that sense. They said, “Here’s a bunch of hardware, figure out how to use it.” So we started with software first. We designed the machine micro-program, which meant that there was a read-only memory that gave the instructions. So if you wanted to change the computer, you only

had to change the read-only memory, you didn't have to send somebody out to rewire hundreds of wires. And the third, which to me was the most important decision, was we committed right from the beginning to semiconductor memory. Semiconductor-- core memories in those days were costing about one and a half to two cents a bit. Say, 1.6 to 2 cents a bit. And for those who remember core memories, they looked like Cheerios with four wires sent through them. The result was, the minicomputers had 4 or 8K of memory. The big machines, the 360-50s, had 16K to oh, 65K. And I figured out the other day that the digital camera I took to Africa had more memory than all of the computers from the '40s, '50s, and '60s, put together. I'm not sure that's exactly correct, but it's awful close to being correct.

Hendrie: Yeah, okay.

Baron: So we had very clever programmers, who could do a whole bunch of things. But the first memories that we-- semiconductor memories we were doing were 2 cents a bit, and we said, "We think it will come down." Well, we rode that all the way down. So that with Prime Computers, you could get 8K or 16K, but we eventually got up to megabytes of main memory. Digital Equipment had lots of people whose job was to string these core memories. So did DEC, so did IBM. And to me, the most important invention of the last 50 years, even more than the microprocessor, is the semiconductor memory, and the work that was done at Intel when they started that whole technology. But with main memories, with software first, and so on, we were able to develop a family of computers, first 16-bit and then 32-bit computers. And we were able to build the company into a bridge between the big and the small. I spent my time, a hell of a lot of it, overseas. We built an international sales force, or distributor agreement, right from the beginning. We opened with 11 sales offices, right from the beginning. So we recognized software and sales were the two games. Now, because of the problems of raising money, I was also spending a hell of a lot of my time doing that. And I finally decided eventually that that wasn't what I wanted to do, and so I moved on. But the basic team was in place as the company went from a few hundred thousand dollars to a couple million, to several million, and then up to being a Fortune 500 company.

Hendrie: When did you ship your first computer?

Baron: '72.

Hendrie: '72.

Baron: We started in January of '72. We got our first computers out that fall.

Hendrie: Very-- that's pretty fast.

Baron: Well, it wasn't like Mariner in 90 days, but it was fast.

Hendrie: Yes, very good.

Baron: And the first machines were program compatible with the Honeywell machines, because as Honeywell's--

Hendrie: Honeywell's 16-bit line?

Baron: Yeah.

Hendrie: Okay.

Baron: So as Honeywell was de-emphasizing their computer business and moving people around, we were able to go into some of their accounts and--

Hendrie: Okay.

Baron: Like General Electric, and a variety of others, and begin to sell those machines.

Hendrie: Okay, so you had some--

Baron: Yes.

Hendrie: --some built in customers that--

Baron: Well, we started with that. We also-- Honeywell, Computer Control had been the leader in terms of phototypesetting, putting computers into linotypes and others, addressograph, multigraph, and others. So we went into that field very quickly. And there was a technology occurring in the typesetting business from the old linotypes to computer generated, which obviously has continued into the 2000 time frame. So you were on a lot of different modes. And one thing I wish I was smart enough, but I wasn't, but I subsequently realized, is that leasing has both an advantage and a disadvantage. The advantage is, it smoothes out your sales.

Hendrie: Yes.

Baron: The disadvantage is, you always have to think of your installed base, so you can't make changes very fast.

Hendrie: Yeah, right.

Baron: And-- because if you do, you get more equipment coming back.

Hendrie: Yep.

Baron: So you can run rings around the bigger guys who are leasing everything, because you can say, "Oh, let's try that." If that doesn't work, "Well let's try this." And because we brought the best engineers from Computer Control, I had 680 I think, working for me there, engineers and programmers. And I brought some of those, and I brought some from DEC. And I talked to some of the senior management at DEC, and said, "If you've got somebody who's really good and he's not happy, or she's not happy, have them come to us and we'll talk to them." So we were able to have two good, two huge companies as farm clubs for us, which is nice.

Hendrie: Yes, that's very nice. That's good.

Baron: And we started shipping internationally. And we and Digital, right from the beginning, were overseas, half our sales.

Hendrie: Wow, okay.

Baron: So that was an important part.

Hendrie: What was the first computer? What was your first model, or your first couple of models, do you remember?

Baron: Prime 200.

Hendrie: Yep.

Baron: And then we did a Prime 100, and then we did a Prime 300. These were all 16-bit machines.

Hendrie: Okay. And was the Prime 300, did it have paging or virtual memory? That was pretty innovative in the minicomputer area.

Baron: Yes. Yes.

Hendrie: Okay.

Hendrie: -- there. Alright, where were we. Okay. Yes, you were talking about the --

Baron: The software.

Hendrie: Yes.

Baron: If you start software first, and if you look at the employment in the computer industry over the last 40 years, programmers have gone from being a necessary evil to -- in order to sell a computer -- to be the stars of the whole area. And the whole issue is to make their job as easy as you can. And there's a lot of things you can do. And if you look at, from a hardware point of view, and if you look at what the bigger machines evolved from the '40s through the '70s, you can begin to say, "Let's consider doing that."

Hendrie: Mmhm.

Baron: And so we were doing that through the '70s at Prime.

Hendrie: Okay, so you put feature from --

Baron: We put features -- And we always had-- one of our first ads was "Software First."

Hendrie: Hmm, very good.

Baron: And we do that in Datamation in 1972.

Hendrie: Alright, okay.

Baron: And everybody said, "What does that mean?" And we tried to explain that you start with what a programmer would like. What are the tools? What are the features? How easy is it to access memory, switch programs, etc. Now, if you start with that and you also are in semiconductor memory, so that you can double the size of the memory without doubling the cost, core memories at no economy of scale. An 8K memory costs just as, twice as much as a 4K; 16 costs twice as much as that. So if you keep adding memory, and if you can keep software features going, you're going to be okay.

Hendrie: Okay. Who was your first customer? At Prime. Do you remember?

Baron: I'm not positive. I think it was Linotype. I think it was Linotype, or General Electric. General Electric, again technology was changing. General Electric was in the process of installing a telephone system all over Alaska. And if you do a telephone system from scratch, you'll build telephone poles all over and you don't charge on the basis of distance, which is something obvious-- it's obvious today. So they were the first ones to come up with the idea of a satellite, and anybody in any village could call anybody else.

Hendrie: Ahhh!

Baron: And now you bill it on the basis of a call, not on the basis of distance.

Hendrie: Yes, I see.

Baron: And so, a lot of things that we started in the '60s in the space program, suddenly are getting commercial application in the '70s, and certainly the cell phone technology and the whole way the phone systems go. It changed tremendously. We're only about two blocks from where AT&T started, and Alexander Graham Bell was on Exeter Street when he developed the telephone.

Hendrie: Is that right?

Baron: Yes.

Hendrie: Okay, in Boston.

Baron: It's right, right down the street, he was in a rooming house. And if you look at the technology between 1870 and 1950, or '60, it doesn't change that much.

Hendrie: Mmhm, okay.

Baron: Okay, there'd been some automation, but it hadn't changed that much. But it certainly, the last 40 years has changed tremendously.

Hendrie: Yeah, really. Good. Now you were saying that some of the things that you needed to do at Prime were getting a little tiring. When did you decide to move on?

Baron: I was thinking about it the end of the '70s. And because the economic climate for new ventures was so bad, the lead investor was not happy either. So, mutually we decided to part. So I left and got off the Board in '75.

Hendrie: In '75. Okay. Alright.

Baron: But all my friends are, they were still there in the '70s, and I kept in touch.

Hendrie: Good, so what did you do next?

Baron: Three things: I kept my hand in the technology, I talked and worked with several technology based start-ups; I actually spent some time in New York learning the world finance with Chase Manhattan Bank in on banking financial issues, 'cause I'd never really learned that; and I started doing some work on

the environmental field. I joined the board of Massachusetts' Audubon Society, started spending some time on that. And in the back of my mind was also the idea of doing something, getting back to writing, I'd done a lot of writing through my career. I've done a book about ever two years since the '60s, so I wanted to spend some time putting some things in perspective.

Hendrie: And you were doing this while you were working and doing --

Baron: Yeah, yeah.

Hendrie: It's just something that --

Baron: Yeah. Al Pickering and I did a book for McGraw Hill in 1963, which is an introduction to computers. And it was still in print in 1982, even though the field had changed, but logic, gates, memories, the idea of stored program, many of the concepts of the computer industry haven't changed. In fact, if you were to make a list of the hundred top inventions in the computer industry, you'd probably have about 70 of them pre-1975-78.

Hendrie: Yeah, okay.

Baron: So, I wanted to --

Hendrie: Yeah, so you had done that, even while you were computer control and you just --

Baron: Yeah, and I wrote on the space program, I did a couple books on the space program when I was doing -- and I started doing lecturing on the environment and management of environmental organizations. And a variety of things like that. And then about 1980, I went through another one, "What do you want to be when you grow up?" kind of discussion.

Hendrie: Yes?

Baron: And I decided twofold. Well, first, I wanted to a book on business in America, which I'll talk about in a moment. And the second thing is I decided that I wanted to get into book publishing. I wanted to stop thinking about nanoseconds and start thinking about decades. I wanted to put things in perspective. So in '85, '84, we started a company called Fulcrum Publishing, and in '85, May of '85, I moved to Denver, Colorado. And the company's now 20 something years old. We're the leading publisher of environmental. We're the leading publisher of Native American material, one of the leading on the western situation. We started novels, our first novel last year was made into a television movie starring Robert Duvall. We are doing a whole series of books with major political leaders, trying to bring civility back in the political process, talking about that. So, I wanted to do that. And I also wanted to write. I was too close to the electronics and computer industry to begin to put it in any sort of historical --

Hendrie: Put a perspective, yes.

Baron: So, I could start by talking about high technology from the 18th and 19th century in New England, and I did. And I wrote about that, clocks, and textiles, and shipbuilding all that sort of thing. And New England always had a worldwide market. But I couldn't get far enough to talk about electronics so a couple of chapters of a book, and then put it aside; and then in the mid-'90s got back to it. The book is called "Pioneers and Plodders: The American Entrepreneurial Spirit," and the word "Pioneers and Plodders" is from Henry Ford, who defines people in terms of pioneers, those who create jobs, and plodders, those who sort of plug in to job descriptions. And my thesis is that the history of America is a history of -- it's not a history of politicians and laws past, or of generals and wars; the history of America is fundamentally a history of jobs. And jobs are created by new industries and new technologies, and that means entrepreneurs. And so I cover four major industries: steel, automobile, electronics and computers, and write a chapter on the history of each of those industries. And then I write a biography of one major entrepreneur in each field, like Andrew Carnegie in steel. And then I sum it, the last chapter really deals with leadership and growth and a variety of other things. But I've found fascinating the idea of how America has changed, and continues to change, because of our entrepreneurs. And I'm also finding fascinating that the entrepreneurs you can't identify by saying they went to such-and-such a school. They're the creative people, just like the great writers are, or the great anything. And I also believe that anything worth doing has been done by a handful of people. So if you want to understand the United States, you read about Adams, Jefferson, Hamilton, Washington, Franklin. If you want to understand the computer industry, you can talk about Ken Olsen, and the two Watsons, father and son, and so on. So, it's a wonderful thing that, if you want to talk about the automobile industry, you can talk about it through the lives of about six people, eight people.

I've been doing a lot of work on leadership. One of my authors has done a book, a retired physician has done a book on the great explorers, and his last chapter deals with leadership. And he and I are now working on a project; we've contacted about 50 people in all sorts of field, about leadership and what it is and how you identify and so on. You know, Red Auerbach, certainly, in Boston, has done more than probably anybody to the Boston scene, or certain doctors, in Mass General, and whatever. So that's really what I'm working on, and I'm also working a lot in the world of history, and I'm doing a lot on the world of environment. I'm chairman of an organization, International Wilderness Leadership Foundation, which does a lot of work in Africa, and in Europe, and in the United States.

Hendrie: Mmhm. Good. So, what would your advice be to somebody who's young and wants to -- and is interested in science and technology? Maybe they're at the high school level and trying to decide what they want to do, at least for the first ten years of their lives.

Baron: Well, I think the first thing is that there's a discontinuity in education. When you're in high school or college, you have a new teacher every hour, and you have a new subject every hour, as well, and you have new teachers every year. So you've got these various things you're learning about. And somehow, for many people, at age 18 or 19, they get pushed into a very narrow area. And they become the world's specialist on something infinitesimally small. A Spanish philosopher refers to them as educated idiots. And I think that's certainly true. So the first thing is, don't let anybody put you in a box. Keep learning, keep moving. Many of us were trained in history, in the classics, in science, in English, etc. I'm amazed at how many people get out of school and can't read or write. And some of them are Ph.D.'s. So don't let that happen to you. Second thing is work with good people. If you're working with really creative people,

whether you're a doctor, a heart surgeon, whether you're an engineer, or whatever, work with. But if you look around and you're not learning anything from anybody you work with, or anybody, your boss, go find another job. The third thing, I talk about this in my book, is your career is going to be longer than the industry you go into, or certainly the technology. All of this stuff that I learned as a circuit designer is now done on a little piece of silicate.

Hendrie: Mmhm. And there are no jobs <laughs> in this field.

Baron: And there are no jobs. And there's large numbers of fields that that's the case. You know, bookbinders are running looms in the mills of New England or whatever. So, you have to figure you're going to have to keep educating yourself and trying new things. That's also the fun part of life. If you are bored in your job, then get the hell out of it. There's so many things you can do. And it's a very exciting world. The more you read, the more you understand how broad the world is, and how great it is to be an American because you can do almost anything. And you know, I've got friends who are heart surgeons, but they can discuss poetry, or they can discuss the ministry of China, or something like that. So if you keep stretching your mind. I mean, fundamentally, your mind is like your body, if you don't exercise it, it's going to get soft and flabby.

Hendrie: <laughs>

Baron: I'm thinking about a new project which I think we'll probably get off this year, called "The Third Third." Life is divided into roughly three parts. The first part is your, you know, you're a child and you're a student. And although we all romanticize that, by and large you don't have a hell of a lot of freedom in it because your teachers and your parents and your friends are telling you what to do. And then you got a period of your career, and buying things and getting married and raising families, and all that. And much of that turns out to be reactive. But sometime around 50 or 60, you go into the third phase. You've got money, you've got things you can do. You've got lots of capability, your kids are gone, and you don't want to live vicariously through that. And you start looking at some of your colleagues whose highlight is their bridge game or their golf game every week, and you say, "God help me, I don't want to go down that path." So how do you figure out what to do? And put something back. How do you keep learning and how do you keep putting something back? And that's an interesting challenge for all of us.

Hendrie: Very good. Alright, well the -- is there anything else you'd like to say for the record, or that's in your -- ?

Baron: Well, you can read my book, "Pioneers and Plodders: The American Entrepreneurial Spirit" if you want to understand the history of computers, 'cause I did a lot of research and tried to summarize in about 35 pages, 40 pages, how we went from abacus's and punch cards, to the modern computer. And also I've got a chapter in there on Ken Olsen and the rise, and continued rise, and then fall of Digital Equipment Corporation, which is true of, I mean, companies are like people: they're born, they grow, they age, and they die. And when you watch Digital or when you watch several other companies, you can sort of see certain lessons that apply to your own career.

Hendrie: Yeah. Good. Well, thank you very much --

Baron: Well, thank you.

Hendrie: -- Bob, for agreeing to do this interview with the Computer History Museum.

Baron: Well, thank you very much.

Hendrie: Good.

END OF INTERVIEW

