Oral History of Evelyn Berezin

Interviewed by:
Gardner Hendrie

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Gardner Hendrie: Well, we have here today Evelyn Berezin, thank you, who's agreed very graciously to do an oral history for the Computer History Museum. Thank you very much, Evelyn.

Evelyn Berezin: It's a pleasure.

Hendrie: Good. I think what I'd like to start out with, could you give us some family background. I'd be interested in your parents, where they came from, what they did, and maybe you're earliest memories, and whether you had any siblings. Things like that.

Berezin: OK. Both my parents came from Russia in 1905. My mother was born in about 1890 and her family came from Lepel in the Pale of Russia, in batches; her father and sister came first and when they got some money, the next kid came, then the next kid etc. There were eight of them and the last few came with their mother, 4 years later, in 1909.

Hendrie: Oh, wow.

Berezin: And they eventually all ended up on the Lower East Side, where most of the East European immigrant Jews of New York were living at that time. My father, born in about 1887, came here separately with one brother, who died of cancer when I was a child. My parents married in 1917 and moved into an apartment in the West Farms area, which is on the Eastern side of the Bronx.

My father was a fur-cutter. That is, he cut the raw pieces of fur to make mink coats. Neither of my parents ever went to what we think of as a school. In Russia, my father went to what was called Cheder, which was essentially a school to learn the Jewish religion, and very little else. My father learned reading and writing in Yiddish, very simple arithmetic, and Hebrew of course so they could read the bible; religious studies were most of what they did until the age of 13, at which age he went to work like everyone else, because at that age he was considered a man.

My mother never went to any school at all. Some young student came to their house in Russia and taught all the girls in the family to read and write Yiddish, and that was more learning than most women would have had in those days.

I have two brothers; the oldest brother was seven years older than I was and the younger one was five years older, and I was the first girl to be born in my mother’s 8-sibling family. That was in 1925 so, on April 12, 2015, I will be 90. I was born at home, in the Bronx, next to the elevated Subway, in a district that was a few hundred feet from the Bronx Park Zoo. In those days, it was a poor but quite safe neighborhood. I remember that we had six people living in that Bronx apartment. (My mother’s youngest brother was a border with my parents and their 3 children.) Not long ago, I made a scale drawing of the

place on cross-hatch paper, and found that it was 420 square feet, in which the six of us lived. And I never noticed that we were crowded at all. I mean, it never occurred to me.

Hendrie: Wow.

Berezin: I think it never occurred to any of us. My mother told me that when her family lived on the Lower East Side, they all lived in a tenement; eight children, two boarders, and two parents-- 12 people. They lived on the fifth floor with the toilet down in the yard. You had to run down five flights of stairs and then up those five flights of stairs to go to the toilet.

Hendrie: Oh, my goodness.

Berezin: So when my mother and father met and got married and moved to the Bronx, with a bathroom *inside* the place, my mother told me that her mother told her “this place is a palace.”

Hendrie: Wow.

Berezin: My father grew up next to a graveyard which was just outside a Russian town called Shklov on the river Dnieper; his father’s job was to take care of the graveyard. That graveyard job was a blessing because this, the Jewish cemetery, was outside of the Jewish ghetto of Shklov. And during the Second World War, the Nazis came into the ghetto, gathered everybody together in the center of town, forced them to dig a big hole, and killed them all, throwing them into the hole they had just built. And my father's sister, who was still living outside the town near the graveyard, got away by simply walking East to safety; the Germans never saw her. So she was alive after the war and she sent us a letter that told us this story.

Hendrie: Wow.

Berezin: So it was a blessing and she survived the war, which not many Jews did.

Hendrie: Yeah.

Berezin: I don't know if there's anything else you want to know about my family?

Hendrie: Well, talk to me about your school experiences.

Berezin: OK. I went to the local public elementary school, PS 6, which was very overcrowded in 1930, when I started, at the beginning of the depression. There were 40 to 45 kids in a class. I don't think the large class size hurt us at all. Everybody was reasonably well behaved, but I was one of the kids who was always in trouble because I shot off my mouth too much, and this was a time when schools were strict. I had a very good friend named Claire Sandberg, and Claire and I used to giggle a great deal. But the schools were strict and worked very well. If there was any noise, you had to fold your hands on your head and be quiet. You had to line up, graduated by height and in straight lines. We had tests every week, and constant reminders and checks on the studying you did at home, all from a fairly early age. But I loved school. It was more fun than staying home-- except for the public library, which was heaven.

They had a system where there were three grades of each class. The smartest kids were in class #1, the dumb ones in class #2, and the middle ones were in class #3

Hendrie: At the same grade level.

Berezin: Yes, all the same grade level. All of class #1 skipped grades routinely. You would do, say, second and third grade together in one year, etc. Our whole smart class #1 graduated High School at the age of 15.

So when you went to high school, it was only a three-year school, since you had gotten the first year in the junior high.

Hendrie: Ah, so you started in what is basically tenth grade today.

Berezin: From PS 6, I went to Junior High School # 44. Both PS 6 and PS 44 taught both boys and girls, but High School was an all-girls school called Walton High School, where we spent a year. But much nearer to where we lived was a new school with boys in it, Christopher Columbus in the Bronx, and Claire and I managed to transfer there for our last 2 years. Our class was the first class to graduate, in January of 1941. This school was important to me because it was new and everyone who taught there was young and smart. And because it was the depression, my teacher in mathematics had a PhD from Princeton

Hendrie: Oh, my goodness.

Berezin: And my teacher in physics had a PhD from Chicago.

Hendrie: Oh, wow.

Berezin: And so on. They were all wonderful teachers who cared about the kids and spent time with us.

Hendrie: Yes, and they just tried any job that they could get.

Berezin: Any job they could get. And teaching was a very good job in those days. Christopher Columbus was a wonderful, fascinating school, because the teachers were so good and I loved it. They set up clubs and laboratories in that first year, with the help of the students, and you could choose to do whatever you wanted. I went into physics and chemistry, but mostly physics. I used to come home late at night-- six or seven o'clock. So school and the local library, which I discovered at an early age, were the best places in the whole neighborhood to be at.

Hendrie: So you loved to read?

Berezin: I loved to read, I would bring home all kinds of books all the time.

Hendrie: What kinds of books did you love to read?

Berezin: Oh, when I was very young, I read things like fairy tales and novels. But what affected me strongly came a bit later. My older brother was seven years older than I was; he was about 15 or so when he started buying Astounding Science Fiction (at 10 cents each). They were marvelous. I used to steal them from him all the time. That magazine got me interested in physics. That's when I started to read science fiction and science stories everywhere. Unfortunately, there were very few real science books anywhere, including the library, but there was science fiction.

I remember that we had a physics class, even in junior high school, although it was called "General Science."

Hendrie: An introduction to science.

Berezin: An introduction to science. Some of these Astounding Science magazines included real physics. But then, I didn't know the difference. I remember, going to my science teacher in junior high and asking him about something I had read. It was the idea that when something goes very fast, close to the speed of light, it gets smaller in the direction of the movement (the Lorentz contraction). So I asked him about this, and he said, oh no, that's not science. They're making it up.

Hendrie: He didn't know.

Berezin: He didn't. And I have never forgot it, because I believed him.

Hendrie: Yes, of course.

Berezin: But as soon as I got into high school, and I talked to the physics teacher there, I learned that he was very wrong. I was dumbstruck by a teacher being wrong.

Hendrie: The concept of a teacher being wrong.

Berezin: A teacher being, just, wrong.

Hendrie: Oh, wow. OK.

Berezin: So the way I got interested was purely accidental. I was really very lucky, because my parents, having had so little education, had no reason to discourage a girl studying physics because they had never heard of it and did not know what it was or that girls weren't supposed to study it.

Hendrie: Now did they, however, encourage you to go to school or anything?

Berezin: No.

Hendrie: You had go to school.

Berezin: They never said anything about it. I had good grades, but I'm not even sure, now, that my parents could understand the meaning of the grades they were sent. When I was about 10, my mother took a job across the street from our apartment in a factory where she got paid 25 cents to make a skirt, she had to figure out how much she was owed at the end of the day, so I taught her how to multiply because she did not know if she was being cheated.

Hendrie: Oh, my goodness.

Berezin: Yeah. And she learned how to multiply and never asked me again.

Hendrie: So it's not that she couldn't; she just never had the opportunity.

Berezin: In Russia? Are you kidding?

But the schools here then were wonderful. We had marvelous teachers, and although we had very big classes-- always 40 to 45 kids in a class, and sometimes doubling up-- two in a seat. Recalling the classes I was in, quite a number of the kids went to college because the colleges were free. Free. Absolutely Free. Because nobody in that whole neighborhood for miles around could have paid anything to go to college. Nobody. Including me.

My mother took my oldest brother out of high school and he went to work. He never had the grades for a scholarship. But my younger brother studied all the time, and he got a NY State Scholarship and went to NYU with it. Not only to NYU undergraduate, but eventually he went to NYU Medical School, but that was not free. The war had started by then, he was in the Army, and the Army sent him to Medical School. He was lucky, as I was.

Hendrie: OK.

Berezin: I graduated Christopher Columbus before the war started. And I remember, so clearly, on leaving it, that I walked all around the school and told myself that I had been totally happy here, and wondered if I would ever be that happy again.

Hendrie: Yeah. OK.

Berezin: If you passed the NY State exams within a certain percent of the top grade, you could go to a New York City College free. There were no interviews or papers, nothing else. It was purely on merit measured by a set of exams and it was wonderful because everyone knew it was fair; fairness is always a primary worry if you don't have money.

I've always been proud of the fact that City College (which I didn't go to because then, like all the technically-oriented colleges, it was all-boys) graduated more men who got Nobel prizes than any other College in the country. But Hunter was the college that was for girls. So I went to Hunter.

Hendrie: Wow. Talk to me about what you did when you graduated from high school. Did you look, were there any other opportunities?

Berezin: No, I did not look, then, at anywhere besides Hunter. I did not know that any other school was possible for me; I did not know that private school scholarships existed. We did not have counselors in

high school to explain the way things were outside of our own little neighborhood. The only thing I knew was that I could go to Hunter and that my parents could not afford--

Hendrie: Afford anything. And that was the school that was free.

Berezin: It was free. So I simply applied at Hunter, and got into Hunter. I did not know before I went there that, because Hunter was a girl's school, they didn't care much about physics, and I wanted to study physics. But I also knew that nobody could get a job in science in 1941, because the depression was still so bad.

Hendrie: OK.

Berezin: So I started by making my degree major economics. I don't remember why I signed up for that. And then I got lucky. You may remember that WWII started on December 7, 1941. I had almost finished the first year at Hunter, taking all those standard courses in literature, poetry and--

Hendrie: Everything. Just liberal arts.

Berezin: I learned a lot of poetry so it was no loss. But after we were attacked on December 7, the next day, if you remember, was the President's speech on the radio declaring war on Japan and we were at dinner.

Hendrie: Yes.

Berezin: So the knock on the door was strange. We didn't have a phone, but there at the door was my high school physics teacher with the doctorate from Chicago. He sat down at our table, we sat there paralyzed, and he said, well, you may have noticed about the war. He told us that a good friend of his who had graduated with him at Chicago University was running a Research Lab in Manhattan for the International Printing Ink Company (IPI). They made the printing inks for most of the magazines and books in the country. They had a ten-story research lab on 45th Street. On the second floor were newspaper printing machines which were enormous, the size of houses, built into the facility, for research on new inks for the newspaper industry.

All of the assistants in the lab (called "techs") were boys who had graduated from the elite science-oriented NYC high schools which I never even knew existed, so I never applied to them. (But they were all-boys schools anyway so I would not have gotten in.)

The boys who were tech assistants all went to college at night, mostly at City College or, if they had money enough, at Brooklyn Polytechnic. My visiting physics teacher told me that the lab knew that they were going to lose all their techs to the Army. And so he asked me if I wanted a job. It sounded good to me. I would be getting good money, $17/week, and I could go to college at night. The next day, I went to IPI for an interview. I had turned 16 by then because I had almost -- it was December -- spent a year in college. I was prepared for this next problem because I had worked during the summer before and I knew enough to lie. I told them I was 18, which was the earliest age you could work in New York City. I was five foot nine and I wore makeup, so they did not guess that I was 2 years younger than that. Whew!

Hendrie: They had no idea.

Berezin: They had no idea. But of course they also did not want to know. I was one of a number of young women that they then hired as techs because, of course, they did lose almost all their techs to the Army.

Hendrie: Yes.

Berezin: I worked there until the war was over in 1945.

Hendrie: And went to school at the same time?

Berezin: I worked all week plus half a day on Saturday, and went to college four nights a week. I got out of work at 5:30 p.m., had classes from 6:00 p.m. until 10:00 p.m. (two classes) then went home to the Bronx on the subway, getting home at 11 o'clock at night, and to work the next day.

Hendrie: And there was some homework in there you squeezed in.

Berezin: Well, it was an hour's ride to work and an hour back, and I did what all the other kids did-- I did my homework on the subway and during lunch hour. I also did homework on weekends, although I worked a half-day on Saturday, which was pretty much the custom then.

Hendrie: Wow. All right.

Berezin: And I did what I had always wanted to do-- I changed my degree to physics.

Hendrie: What college were you--

Berezin: This is the strange thing. Remember, most of the college-age kids were in the Army. All the colleges in the city had to reduce their sizes. Many of the professors were in the army as well.

Hendrie: Yes, of course.

Berezin: So what the city, or the universities, or somebody, did was fascinating. And nobody really seems to know about this anymore. All the colleges in the city specialized in specific fields, cutting out many courses so they would not overlap. They each specialized, and no matter in what school you were registered in, if you were taking a specific subject, you went to that specific, specializing school. So I took all my math at Brooklyn Polytechnic, not Hunter, because that was where Math was being taught. And I took all physics and chemistry at NYU, and only studied liberal arts at Hunter. And I continued to pay nothing, so some entity must have paid the other Universities for the service.

All classes were given at night, because almost everybody was working, so working was no limitation at all, as it would have been if everybody went to school in the daytime. All the techs also went to school in the summer-- one could get a full year's class in 12 weeks of the summer.

Hendrie: So you split up.

Berezin: There was no other place to take the courses.

Hendrie: But that was allowed.

Berezin: The universities had obviously made arrangements with each other, but I don't know how they arranged it. Because Hunter was a NY City school, and therefore free, but Brooklyn Poly and NYU and others were private schools so somebody (the City?) paid them to provide the courses that were needed by the others.

Hendrie: Yes.

Berezin: I should tell you that, since Brooklyn Polytechnic was an all-boys school, I was the only woman in the school, and at that time the only woman who had ever been at Brooklyn Poly. I always thought that was funny. I had a trail of boys surrounding me as I walked to the subway every night. And I did end with a straight A average there, so I kept the flag flying for the women, which I very much wanted to do.

Hendrie: That's funny. That is. Wow.

Berezin: And indirectly, actually, that's how I met my husband. One of the fellows whom I dated at Brooklyn Poly went to live in Israel after the war was over, met my husband who had gone there from England, and gave him my phone number when he was sent to NYC. A memorable blind date.

Hendrie: Very good. So what happens next to you? You graduated--

Berezin: I graduated from NYU, not from Hunter. I have no memory at all of how this happened, but I somehow got a full scholarship to NYU and transferred there sometime during the 4 years I went to college at night. My physics professor at NYU suggested that I apply for an Atomic Energy Commission Fellowship for Graduate School. (At last! Somebody told me how to get through the system!) I did apply for that, and my first nuclear physics class started in the summer, in August 1945, on the day after the atom bomb was dropped on Hiroshima.

Hendrie: Oh, my goodness.

Berezin: Actually, I knew about the work on the bomb several years before the bomb was dropped. I found out about the Manhattan Project by having some drinks with a fellow student about 1943. He had been working on the Manhattan Project at Columbia University and told me all about it. Not long after that I bumped into someone I knew from high school, in uniform in Times Square, and he said he was at Princeton. Oh, I said, oh, you must be doing research on that bomb. (Why was I so idiotically naïve? Not to speak of stupid? I can't imagine.) And he told me to shut up, and spoke to me sternly about keeping quiet, which I did. And I'm thinking to myself, how many other people already know this?

Hendrie: Yes. And how many of them are not friendly to the United States? Are there any of them?

Berezin: I certainly don't know anyone who might have been. But I did receive that Atomic Energy Commission Fellowship which meant that I had to get a US security clearance, which I did get in spite of my father belonging to a Communist union (which he hated, fortunately). It paid me $1600 a year; that was such a magnificent amount of money that I quit work while in Graduate School at NYU, left home, and moved to a $62/month apartment on the lower East Side (now erroneously called the East Village) which I shared with a roommate who was also in Graduate School.

Three of us at NYU were working on a thesis with the goal of measuring meson energies. A large part of the project was building a cloud chamber up on the roof of NYU. When one needed radioactive particles, we used a strip of caesium-60 hanging in the open air in the middle of a roll of lead sheet about ¼ " thick.

Hendrie: Lead sheet. Yeah. On top of the cloud chamber.

Berezin: Yeah. And tested the cloud chamber. It never occurred to us that we were getting a dose of caesium-60.

Hendrie: Or getting radiation.

Berezin: Or getting radiation at all. I mean we knew it, of course, but we didn't care.

Hendrie: Yeah. Yeah, but you'd never-- there wasn't any data. Nobody knew about radiation sickness or how much you could stand and how much you couldn't.

Berezin: It just sat there all the time, sitting open in the room.

Hendrie: Then you put it back in the lead thing. There was no top on it.

Berezin: There was no top on it. Anyway, we published a paper in-- not a paper, just a letter, in the *Physical Review.*[1] It took five years to build a cloud chamber, Geiger counters, and all the equipment associated with doing an experiment in a University that did not, in those days, have much money. And I met my husband and we wanted to get married.

He had emigrated from London to Israel because his family had always been Zionists. I knew nothing about Zionism and nothing about Israel. His name was Israel Wilenitz. One of his brothers had been in the British Army in India, had joined the Israeli Army in 1948, and was killed in the war.

Hendrie: Oh no. Oh, wow.

Berezin: I finally decided that I would go to Israel with my husband. But I didn't have any money and neither did he.

Hendrie: Because you were working. Yeah.

Berezin: No. I was still at the NYU physics lab. I had only that $1600/year US Fellowship.

[1] Jacob L. Zar, Joseph Hershkowitz, and Evelyn Berezin **,** **"**Cloud-Chamber Study of Electrons from Meson Decay," *Phys. Rev.* 74, 111 (1 July 1948). DOI: http://dx.doi.org/10.1103/PhysRev.74.111.2

Hendrie: Oh, yeah. You were still at the lab. OK.

Berezin: We got married in December, 1951. And he went back to Israel, and I was to follow him. In the meantime, I had to get a job, because I had to earn some money. I told this to my thesis adviser. I didn't know what would happen with my thesis, because I hadn't finished it. We had measured a few particles, but not enough to qualify.

Hendrie: And your thesis was going to be based on--

Berezin: On the measurement of meson energy.

Hendrie: Yes. On meson energy.

Berezin: About then, in 1951, Carl David Anderson, a Nobel prizewinner at Caltech, using an Army airplane equipped to capture large numbers of mesons at high altitudes, had also decided to measure meson energy. He reported an enormous amount of data that we were also getting, but much, much more slowly.

Hendrie: Ahh. So he'd gone up and put a cloud chamber in an airplane and gotten cosmic rays as the source.

Berezin: He also had help building his cloud chamber, I'm sure.

Hendrie: Yes. That's even better.

Berezin: I'm taking too much time--

Hendrie: And so yeah, you'd quit the job as a tech at the research lab of International Printing Ink. Or were you doing that too?

Berezin: I had quit the job as a tech, I think I told you, in 1945, when I went to graduate school on that US Atomic Energy Commission Fellowship.

Hendrie: Ahh. OK. Yes. All right. Good.

Berezin: I did explain that. I could not live without an income of my own.

Hendrie: I understand.

Berezin: So I had to get a job. A better paying job than I had. I went to my thesis adviser, and I told him my problem. And he told me about a headhunter who was pretty good at getting jobs for physicists. So I went down to talk to him. And he said that there were no jobs in physics now, because the Korean War was on, and Truman, who was President then, decided that the US was not going to hire anybody in the near future because the US just didn't have the money for it. And the government was almost the only place there were jobs for physicists. So he told me there just weren't any jobs.

And I said, have you heard of any jobs in computers? I have no idea why I said that. I have no idea of where I had heard or read about computers. It's a complete blank.

Hendrie: Yes, but somehow you knew enough to ask that question.

Berezin: This was in 1951**.** Somehow, I had read somewhere about computers and, probably somewhere else, I knew that the circuits we had designed for our experiment were very like the circuits used in computers. And I just said it without thinking, a reflex and still a mystery to me. And he said to me, you know, I never heard of computers, but this morning I got a phone call from somebody in Brooklyn who's looking for people for a computer company. This morning.

I have been so lucky. I never stop wondering at my luck, all through my life.

Hendrie: Yeah. Serendipity.

Berezin: And that's what happened. I went over to the computer company called Electronic Computer Corporation. I had never heard of it, of course. It was a start-up. The fellow who headed engineering, Gene Leonard, asked me to design a circuit. I designed the circuit, gave it back to him, and was immediately hired as the logic designer, which they didn't have yet. That's how I got the job and that's how I got into the computer business.

Hendrie: That's amazing.

Berezin: Well, I think that I've been just unbelievably lucky. So I got started at the beginning of the computer industry, on October 15 of 1951. The company, Electronic Computer Corp. or Elecom had hired a number of people, most of them kids who had come out of City College. But some of the people who

started the company had already designed computers, because two or three of the people who had been hired had come from UNIVAC.

Hendrie: Ahh. In Philadelphia. Yes.

Berezin: Elecom was started by Samuel Lubkin, who was the President. He had been working in the Bureau of Standards. And they had built a computer in the Bureau of Standards. I forgot the name of it.

Hendrie: SEAC.

Berezin: SEAC. That's right. He had a PhD in mathematics and he was incredibly smart. But he would never have hired me if he had met me and not Gene Leonard. He was afraid of women. He never talked to me. I guess because he was-- he was terribly shy.

But Gene Leonard was not like that. He was perfectly open and, even in 1951, he didn't mind hiring women. I had more education than most of the other people they hired; I mean, I had five years of graduate school. So he hired me at $4,500 dollars a year, from $1,600/year. (Engineers just out of college earned $3500 then, I remember.) It was more money than I ever thought I would make in my life. And they sat me down, and I was told to design immediately, with no education at all, this machine for calculating gun ranges for the Aberdeen Proving Ground.

Hendrie: So the same thing that ENIAC was originally doing.

Berezin: Was it really?

Hendrie: ENIAC was designed to do firing tables.

Berezin: I didn't know that.

Hendrie: Yes. The ENIAC was a project to speed up making the firing tables for guns, because they were coming out with new guns. And they were calculating the firing tables with lots of women in a room.

Berezin: Oh. On calculators. The women themselves were actually called “Computers”.

Hendrie: On calculators.

Berezin: Yeah. I remember that.

Hendrie: Right. And so, they were falling way behind in the war, and so somebody came up with the idea of doing it electronically.

Berezin: Did the ENIAC really work well?

Hendrie: Yes. It worked.

Berezin: Then why did they start getting another machine so soon -- that was before 1951.

Hendrie: Oh, yes. The ENIAC was actually working by 1947 or '48.

Berezin: Yeah. I remember the first UNIVAC was delivered in 1949-- Eckert-Mauchly made it and some of our fellows had built it.

Hendrie: Eckert-Mauchly were the people that did the ENIAC. Yeah. And they left and started UNIVAC.

Berezin: But UNIVAC was a general machine, the first general machine, and it went to GE in-- it was in a factory in St. Louis, I think.

Hendrie: It was in the Midwest. Yes. And it went to GE. But before that, they delivered one to the Census Bureau. That was their first contract, and the first commercial customer, I believe, don't hold me to it, was GE.

Berezin: Yeah. I remember that now. Anyway, the UNIVAC was the first commercial machine, and that was in 1949. So this was only two years later.

Hendrie: Yes. My goodness. And so they had a contract from--

Berezin: Sam Lubkin was from the Bureau of Standards but started Elecom in Brooklyn because his family was from Brooklyn. And the reason he could hire people from Eckert-Mauchly was that it was McCarthy time, the terrible time where that Senator accused people who were supposedly Communists. Most of that was never discussed openly, but they had backgrounds that couldn't get clearance. None of them had any real problems, but they had to leave Univac because of McCarthy. So there were a few people at Elecom who had designed computers before. And one of them sketched out the ideas and said

“design it.” And using what I had been taught, I designed this machine I told you about, which was to have an unusual capability, a vector capability. I don’t think that previous machines had that capability, which wasn’t easy to do when one had only drum memory, with everything operating sequentially.

Hendrie: Yes. Of course they did not. No. It wasn't really a general-purpose computer.

Berezin: Oh, really?

Hendrie: Yeah. The ENIAC had special adders, subtractors, multiply units, divide units, even one square root unit.

Berezin: You mean it was a calculator, really.

Hendrie: But it was programmed. They had figured out how to program it with plug boards, originally. And then some brilliant person figured out how to use the function tables that it also needed, to actually program it faster. But it was not a stored program computer.

Berezin: Oh, then it wasn't really a computer.

Hendrie: Well yes, it was the-- but it had many of the functions of a computer. OK, it's, like a Burroughs--

Berezin: But in my mind, if you don't have a branch instruction, it's not a computer.

Hendrie: I think it did. OK, but it was plug-board program.

Berezin: But still, plug-board.

Hendrie: Of course, you could have a comparator.

Berezin: I didn't know it was built like that. I always assumed it was a stored-program machine because it was called a computer. I never asked anybody about it.

Hendrie: No, no, it was not. They hadn't invented that yet.

Berezin: Much later, I seem to remember that it was a mathematician at NYU who told me that it was Von Neumann who had invented the stored program. Thank you for telling me. I didn't know. The machine that I designed at Elecom had a stored-program, but it was all tubes.

Hendrie: Yes, I'm sure it was.

Berezin: And the memory was a magnetic drum.

Hendrie: Yes, OK.

Berezin: The drum was about so high, and so big around. (About 35 inches high by 20 inches diameter.) Was there a name for it or a product name?

Berezin: It was just called the Argonne machine.

Hendrie: You mean Aberdeen? Was it Aberdeen Proving Ground?

Berezin: Yes, I think I said that already, but I slipped this time.

Hendrie: Argonne was the national lab of the Atomic Energy Commission. Aberdeen was the Army's--

Berezin: It was because I've been on the Brookhaven National Lab Board for such a long time, about 13 years, and I'm so used to talking about Argonne, that I made that mistake. But it was Aberdeen, you're right. It was Aberdeen.

Hendrie: Good. All right, so you--

Berezin:. So we designed it with a magnetic drum. And the active memory was also essentially on the drum. You had a head one place and then--

Hendrie: Oh, recirculating delay lines on the--

Berezin: [Recirculating delay lines were constructed on the drum by putting a writer and a reader at a specified distance from each other which continually wrote the new data onto it at the writing point on the drum as the drum turned, and read the information when it reached the reader point on the drum.]

Hendrie: So it's fundamentally a serial machine, then.

Berezin: Oh, yeah. Almost all the machines built in those days, I think, were serial. I don't know the others, but--

Hendrie: But I think you're right, because it was too expensive.

Berezin: And where would you put it all? It was too expensive to use flip-flops for any substantial amount of memory. Which is the only--

Hendrie: And make them parallel. Yes.

Berezin: Yeah. All you needed was to add a couple of flip-flops at each end of the delay line for a buffer, and the rest of it was all on the drum. It was slow, but it could do the job.

Hendrie: Well it had vector instructions. It probably was very fast at doing certain kinds of calculations.

Berezin: Yes, the original machine was probably too slow, and that's why they ordered another one that was electronic and had an automatic vector operation.

Hendrie: It had a stored program.

Berezin: It had a stored program, and a vector capability. That was interesting, doing that vector.

Hendrie: Were you the only logic designer? Were there others?

Berezin: I was the only logic designer for this early period. We did hire two more much later on, but not at this time.

Hendrie: So you had to design all the logic for the whole machine? Wow.

Berezin: All of it. There was nobody else I worked with. In fact--

Hendrie: Now, other people worked on circuits, and the drums, and things like that. Of course, there were engineers that did that.

Berezin: There were a lot of mechanical devices also. I mean, there was the drum, and the input and output devices that needed to be connected. We had a shop where people who did things with their hands made whatever was needed.

Hendrie: Very good.

Berezin: It was so hot in the sum**mer.** We didn't have air conditioning. It was so hot in Brooklyn in the summer, with all those thousands of hot tubes on, that everybody used to walk around practically naked. I was the only woman in the engineering area, of course, for a long time. And although I did wear clothes, many of the men would walk around with just work-aprons on, and their backsides mostly bare.

Hendrie: Really? [LAUGHING]

Berezin: That was largely in the shop.

Hendrie: Yeah, OK, all right.

Berezin: It is very funny.

Back to the story. OK, so what happened was I worked at Elecom for a while, and my husband finished his job in the US and went back to Israel. And I stayed on a while to earn some money. You had to bring a stove, a refrigerator, everything that you needed to live. There was nothing there in 1952.

Hendrie: I understand.

Berezin: I tried to get a job in Israel. I looked around. Surprisingly, they were talking about computers, and there was a fellow from Princeton University who was interested in setting up a lab at the Technion in Haifa. But it did not exist yet and who knew when it would? There was no job for me and I was pretty depressed because there was just nothing for me to do.

And my husband was very unhappy as well because he had spent more than a year in the United States and he decided that he liked living in the United States, so we came back to New York City. I had written Dr. Lubkin and asked him if I could have my old job back and he wrote me a letter saying yes. It was only

that letter that permitted me to get my husband into the United States from England. The people at the American embassy said they had never seen a situation where it was the woman who got the husband into the United States by proving that she had a job.

Hendrie: Really?

Berezin: Yeah, they said they'd never seen that. That tells you a lot, doesn't it?

Hendrie: They'd never seen it. It was always the other way around. OK.

Berezin: OK, let's go back to talking about the machines we built in that period at Elecom. I told you about the Aberdeen machine. And another machine that we built was a machine for handling subscriptions for *Fortune* magazine. It was still a tube machine, with a standard computer organization, so there's nothing much to say about it, or the other work that went on.

But we also designed and built a small accounting machine, really small in spite of the fact that it was still a tube machine. All the memory was on a small magnetic drum, because they did not have to handle a great deal of data. And when we were almost finished, it turned out to be 1957.

And on March 15, 1957 (the Ides of March, please note) the company that had bought Elecom, Underwood Corporation, which was a typewriter company that wanted to get into the computer business when they found out everybody else was getting into the computer business. But they discovered that they didn't have the money required and Elecom went bankrupt. The management told us about this with a phone call delivered on the loudspeaker announcing that the place was closed. So--

Hendrie: From the main office.

Berezin: Yeah, from the main office, and they asked all of us to just leave. There was practically a riot, but I don't think this is the time to discuss what the people inside did at that moment. Certainly, I didn't take all the telephones.

Hendrie: That gives me a hint.

Berezin: And so we were all out of jobs. But within a couple of weeks, I did get a job at a place called Teleregister.

Hendrie: OK, now you started to talk about a very simple machine that was for accounting, but that never got finished.

Berezin: It was practically criminal that we never quite finished it, although it was very close to being finished. But nothing ever happened to it. It just sat there. It was never sold. It would have taken a lot of money to start a new company and make it into a real business. I hoped they would do something with it, but they did not even attempt to sell the design. It could have been finished in a couple of months.

Hendrie: It was designed and prototyped and everything.

Berezin: Designed and prototyped, and almost all of it was working, and it was a beautifully designed little machine that was very efficient. But it never got anywhere. Most of us were shell-shocked at the time and we did not even think of what would be involved in getting a company started. Everybody was worried about getting a job!

Hendrie: OK.

Berezin: And within a very short time, I had a job at a company called Teleregister, in Stamford, Connecticut.

If you have seen the movies of the 1930s, you often saw a brokerage room with a group of men watching stock prices clicking away on a big wall. And the numbers, which showed the prices of the stock of various big companies, would keep changing. They had maybe a couple of hundred such boxes of little, movable clicker-counters, run from a communication link from the Exchanges. There was no return signal. None was needed. It just showed the information being generated by the Exchange.

Hendrie: Yes, and it was the stock, they took the stock ticker information--

Berezin: Yes, they used the stock ticker information.

Hendrie: And made a visual display so everybody could see it. Rather than everybody having to look at the ticker tape.

Berezin: And it was all done using relays. Of course, electronics didn't exist when this system was originally designed-- I think it was in the 1920s, but when Teleregister started and built this country-wide system that distributed the information about the stock market almost instantaneously, it was a great step forward.

Hendrie: Yes.

Berezin: Teleregister wanted to build a new system for the stock exchange using computers to get information out to the world. And they had ideas for other applications for new areas. But all the ideas that they were working on were not standalone computers, but were computers that were tied together with communications systems. I had actually had some experience with that at Elecom, but very little.

Hendrie: Of communication systems and how to tie in possibly.

Berezin: For connected communications systems, yes. But Teleregister's first job was to build a real computer, which they had never done. Teleregister had always worked only with relays. But they had an engineering staff that was very capable and had used relay logic effectively .

But of course, what they were doing then was very, very limited. And every product used essentially a fixed program, distributing information only. There was nothing that they had ever programmed in a computer oriented system, responding to a variety of inquiries. They had actually started some work on computers, sending one of their engineers to MIT to get some education in the field, but he had never designed one himself before. When I got there I found that he had actually already designed a computer for Teleregister but, looking at the logic and the proposed programming system, it was clear that it was not really a suitable design because it was not what I called a closed system. It was not flexible enough to permit any kind of calculation to be done.

Hendrie: So they had started their design.

Berezin: They had almost finished it. I suspect now that the vice president of engineering was worried about their lack of experience; otherwise why did he hire me? It was not sensible to have a guy with absolutely no background in the industry and with no experience in electronics designing a big new system that their life depended on. So they decided to hire somebody who had done it. I had been head of the logic design department at Elecom for about five years then, and I had hired and trained other people to design machines as well. I was a better bet for them than taking the risk of no one there who had done it before.

Hendrie: And then you hired everybody else.

Berezin: Not quite. When I got to Teleregister in 1957, I saw a better alternative**.** How many people were there anywhere then who had designed computers? At least these engineers knew a lot about their industry already. They had 10 people who were experienced relay designers who knew their industry

well, and I chose instead to teach them how to do electronic design-- I did it myself. And they learned very quickly, because the concepts were the same, even if the implementation was quite different.

Hendrie: Yes.

Berezin: And just let me get-- I just have some notes here.

Hendrie: That's fine.

[**Berezin:** Before going into actual work on the applications, I should tell you that I first had a terrible political problem. Think of it: A respected member of the existing experienced engineering staff, responsible for actually constructing their systems, had designed a computer system that I knew would not work. But how could I say that to everybody when I was unknown to them? I would be insulting a high level friend of all the people who had worked there for many years? It would tear the place apart or they would tear me apart. So I went to the VP of engineering, told him what I thought and asked him to have the ideas of both of us reviewed by someone else who knew computer design. He agreed, did that, the consultant chose my approach, and the situation worked out well. The engineer who had designed the first machine and I became friends. I think he was very likely relieved.]

Berezin: The first system they asked for was a computer for banks, -- on line and in real time for all the tellers. But the communications were all local, within the bank. (The idea for the computer design was to build it so that it was not internally specialized-- it could be attached to any number of terminals or devices.)

Hendrie: It was all drum systems.

Berezin: It was all magnetic drums. That was the only memory that existed up to that--

Hendrie: So this is a serial drum machine, still.

Berezin: Serial drum machines, and all these computing systems also used serial electronics.

Hendrie: Now, is this going to be vacuum tubes or transistors yet?

Berezin: We never used vacuum tubes in that company.

Hendrie: OK, so you moved from relays to--

[**Berezin:** It was all transistors: A commercial machine that had to work on-line could not use tubes-- the machines were too unreliable-- they needed repair too often.]

Hendrie: To transistor logic.

Berezin: We taught the 10-man department how to design electronic logic. And the design department converted from relays to transistors very, very easily. It was not difficult at all, and they were very capable; I was lucky. This particular system had a communication system, but it was a simple indoor communication system between the terminals and the processor which brought the information about each customer up to date. It worked very well and was finished very quickly. Teleregister, later on, sold them to other banks.

Hendrie: Do you remember the model number or anything?

Berezin: Probably, but I can't remember what it was**.** We all called it the Bank system. But that was internal.

Hendrie: The Teleregister banking system. OK.

Berezin: The next instrument we did used the same central computer design, but the connection to the communications system was different. It was for the American Stock Exchange. Remember, the Teleregister people had worked with the stock exchanges for a very long time, decades.

Hendrie: Yes.

Berezin: And they knew each other very well. The American Stock Exchange wanted to upgrade their system. We took the same computer that we had developed earlier, which was already built to have an interface to a new communication system because that was the nature of Teleregister's business. Teleregister had a separate design section for communications; our department did not do that. So we worked together, with me as the head of the computer design department, and somebody else running the communication section.

Hendrie: Can I just interrupt for a second? Now, this machine, the machines at Teleregister-- these were binary machines. Were they character-oriented machines, or were they pure binary? Do you remember?

Berezin: My memory is that they were all character-oriented.

Hendrie: It would make sense that it was.

Berezin: It would make sense to do that. It would slow the machine down if you had to convert all the time. Remember, these were real-time systems, and computers were still slow.

Hendrie: This was a real-time application.

Berezin: So you really had to worry about the speed. And integrating the terminals meant calculation of how fast the message needed to be analyzed and stored, and so on. And that had a lot to do with the communication system which, remember, were also very slow in those days.

Hendrie: So it was probably a decimal character, decimal arithmetic character-oriented machine.

Berezin: After thinking about it a while, I realize that the Stock Exchange machine was fundamentally alphabetic, so I'm pretty sure that all of them were alphabetic, with numbers, letters, and symbols as part of the character set. Note that, with serial machines, additional alphabetic symbols would not have cost much more than a decimal machine.

The third system was really the one I'd like to talk about at some length, because it was the most interesting one, and very new. It was for United Airlines, and it was the first passenger reservation system. But it does differ from the passenger reservation systems that most people know about now. It was much simpler because it primarily kept data on the tickets for each seat on each flight. The systems used now are much more complicated, have much more information per seat, do a lot more and were built some years later. Our design was started sometime in 1958.

Now the communication system became very important. For one thing, the terminals were at great distances from where the computer was. The terminals were scattered all around the country, and there was a sophisticated communication system-- a special purpose communication system-- that was set up to provide connections to 60 cities.

Hendrie: But all based-- the computer was in Denver.

Berezin: The computer was in Denver. But the system requirements were very difficult to achieve that long ago. It had to run 24 hours a day, seven days a week. You could not tolerate a failure of the central machine for anything more than seconds. And so the first major problem was clear-- how did you

organize the system so that wouldn't happen? First of all, of course, one had to use semiconductors. You couldn't design a system with the kind of reliability required until tubes were gone and you had transistors, because the down time would have been too high to tolerate. I know of only one system that had a spec like it at that time and that used, at least for a while, tube machines. It was a United States Government military system that monitored the arctic for Russian planes. But as far as I know, there was no commercial system like the one we were designing that had ever been built before. Systems like these were called fail-safe then. But I liked to call it a fail-soft system, because I wanted to be able to have multiple computers, and to set them up so that the information could automatically switch into a separate second or third etc. computer. And if one computer failed, what you did was essentially pull the computer off the line while the others ran, and you just got slower, but did not stop. I mean, you could handle requests more slowly, but you never lost any of them. So you always had some machine on line and operational.

Many years later, I ran into the engineer who was sent from Teleregister to be permanently in charge of running the system in Denver. He had helped to build the system and knew how it worked. And he told me that the processing system never went completely down in 11 years of operations. So it actually did succeed in--

Hendrie: Doing what it was supposed to.

Berezin: I don't know how I could do it here in my apartment, but I could do a drawing to show you how it was designed, so that not only would the central machine always have some capacity, but the communication system also was built with the same goal-- that is, problems were isolated and fixed so it never permitted the entire communication system to go down. There were 60 terminals in 60 cities, each of which had a number of input/output devices called agent stations. The terminal station was a small separate system which was set up to connect to a privately designed communication system designed by Philips in Eindoven, Holland. Teleregister went to AT&T first for the communications system but they could not build any communication system that operated fast enough at that time.

In each terminal, the group of agent stations were connected to two communication lines, one with the signal going in one direction and the second line going in the other direction. There were two of these double “Loops.” One was in the Western part of the country in a loop connecting to Denver, and another one in the Eastern Part of the country and also going to Denver, where all the processing was done. Within each loop the cities were connected on a long string running around connecting all the cities in the East; a separate one exactly the same was set up in the West. All signals from the terminal went on the line moving data in the direction of the central processing system. The response from the computer went back **to** the terminal in the other direction, separately, on the second line. Each line was physically separate from the other line and the lines were carried through microwave links throughout the country. And supposedly AT&T, who built the US microwave towers, had promised that the two separate lines going to the same terminal -- the one coming and the one going-- were never on the same microwave

link. So we were told. Which turned out not to be true. AT&T put the two lines on the same link in, I think it was Nevada, and some nut-case happened to pick on that tower and blew it up.

Hendrie: Oh my goodness. And that's how you discovered--

Berezin: Yes. If the terminal had a problem, the terminal could have been disconnected and that one city would be out but the lines on either side of that city would be reconnected immediately so all the rest of the 60 terminals worked. But losing both lines would take most of the communication system down. But even though half the USA terminals went down once, I'm happy to say that the central computer system never went down.

Hendrie: So just to get a little bit more clarification, you said there were 60 terminals.

Berezin: And they had to have a response of one second, but I found out later that they never were quite as fast as that.

Hendrie: OK, now were these 60 terminals or were these 60 sort of local hubs--

Berezin: They were hubs.

Hendrie: With multiple agent stations tied into one hub.

Berezin: Yes, they were essentially a system themselves.

Hendrie: Yeah, a little system themselves.

Berezin: And they had a number of stations.

Hendrie: And going to a bunch of agent terminals.

Berezin: Yes, going to a bunch of agent terminals.

Hendrie: But then they'd all be grouped together onto one line.

Berezin: And feeding the messages in, one after the other.

Hendrie: Through this communication system.

Berezin: Through the communication system, yes.

Hendrie: OK.

Hendrie: And you said something about, I think earlier, maybe not on the tape, that they divided the West Coast and the East Coast separately, so there was a communication loop through the West Coast, and then a communication loop--

Berezin: Yes, that is the way it was done**.** Let me just tell you some of the issues.

Hendrie: Yes, why don't you tell me some of the features.

Berezin: What I needed to do for the fail-soft problem was calculate the risk. And it was very difficult to figure out what the probability of failure was. This was one of the first systems using transistors and I did not know if I could trust any numbers given me by the manufacturers. I also doubted that I (or UAL) knew how many messages would be sent 10 years later. And if I was wrong in this respect, and there were lots of delays or lost seat sales, it would be a disaster for both companies and a disgrace for me. I could not take a chance on it.

Hendrie: Yes.

Berezin: I really had no way of being sure of what the mean time to failure would be. And I didn't want the machine to ever be seen as “down” from the outside world. It was clear that we had to have two machines, at least. But I thought that two processors were not enough and, considering how much the whole thing cost, a third processor would not add much cost to it. So I decided that we would use three processors-- complete processors-- each operating independently.

And then I said, how are we going to know when they go down?

Hendrie: Exactly my question.

Berezin: One thing you could do, and it's easy to think of. You could run a special program through constantly. And then if it failed, you just took that machine off. That was easy and obvious.

But I felt that that was too slow. Because I really wanted the computers to be working on messages all the time. So what I decided to do-- and it sounds kind of crazy but it seems to have worked-- is that I would tie these three machines together by monitoring specific points simultaneously and comparing them. And then if you ran it on one clock, you would know when something went down. Because you were actually testing the signals at a number of points inside the machine.

Hendrie: OK.

Berezin: The messages that were feeding into the machine could be picked up by any of the three machines. The first machine would pick up a message and act on it immediately. If the first machine was busy, the message would be switched to the second machine. And if that was busy, the message would go to the third machine. So essentially, if anything happened to any one machine, you never had to stop.

Hendrie: Now what if something happened to the third machine, and there was enough, you know, there was a queue of messages. You just circled it around?

Berezin: I seem to remember that, if we had used all the buffer storage, we sent messages that said “busy” back to the terminal and the terminal or the agent’s device would hold onto the message and send it again later. But this delay would not be seen as a very serious problem to the customer. It would happen very occasionally, and people would see it as a delay of some seconds more than normal.

Hendrie: Ah.

Berezin: When we started, one machine could handle the traffic.

Hendrie: Wow.

Berezin: At that point, the other two machines were for safety only. The traffic would get bigger, but I do not know how fast the number of messages increased. But I never heard that there was a problem of that kind.

Hendrie: Yes. Of course. Why did one communication line go clockwise and one go counterclockwise? Do you remember why they didn't go together?

Berezin: Consider the way the communications systems were organized. On one line the messages had to be all moving in one direction, say clockwise, so they entered the line whenever there was some empty space, and as they ran along the wire in the same direction, one after the other they would eventually be picked up by the processor; the other line is going the other way, counterclockwise from processor back to the agent machine in some city somewhere and delivering the answers. If a specific terminal went down, you could switch the terminal out of the communication system and connect the lines together on each side of that terminal so as to make two loops that both bypassed the single failed terminal.

Hendrie: Oh, I see.

Berezin: If you looked at the Western Loop, say, and closed off one city, what you did was make 2 loops from one. You just switched the terminal out of the loop it was in when it went bad and the two ends of the cut lines permitted you to put them together and continue as a working system for all the terminals on each side of the broken one. (A switch reconnected the lines to make a new loop on **either** side of the bad terminal.

Hendrie: OK. Yes.

Berezin: If they were going in the same way, it couldn't do that.

Hendrie: Yes. OK.

Berezin: It actually got built pretty fast for something as big and as complex. The physical system was ready before the programs were complete. Not an unusual situation, actually.

Hendrie: Do you remember how the memory was connected to these machines? Because, of course, they all have to access the same passenger flight reservation information. But it needed to be written [in] more than one place, presumably.

Berezin: I think that each of the drums were divided into the places where the specific trip information was stored. A small buffer permitted the time to connect to the correct drum. I seem to recall there were about 50 to 60 drums. There was back-up memory also, of course,

Hendrie: OK. And it was a drum?

Berezin: They were all magnetic drums.

Hendrie: All magnetic drums.

Berezin: Big. Very big. And a lot of them.

Hendrie: OK.

Berezin: OK. The system, in spite of the three processors, came in on time and at the estimated cost. (As I said, the programs were late.)

Hendrie: Right.

Berezin: I loved working there, but there was a problem. Teleregister was in Stamford CT. Commuting to Teleregister in Connecticut took me an hour and a half each way. My husband was working in New Jersey, so we had an apartment in New York City and I commuted to Stamford. So after some years and the design of this last machine was finished I went to the VP in charge of engineering and told him the truth-- that I really needed to get somewhere closer to New York City.

And the VP said that he'd find me a job. He knew the people managing the New York Stock Market, and it turned out that the fellow who was in charge of communications at the stock market, which at that time (about 1961) really was the Stock Exchanges' most important technical issue. They had done nothing in electronics.

Hendrie: Yes.

Berezin: The NY Stock Exchange communications was run by a lovely fellow who was retiring. They were looking for someone to replace him. My V.P. knew that, and talked to them. They suggested that the fellow who was leaving interview me, which he did, and he hired me for the job. But this job, it turns out, was at a high enough level that it had to be approved by the Board of Directors of the New York Stock Exchange.

Hendrie: OK.

Berezin: I guess it was--

Hendrie: Well, it was quite vital. Communications were an integral part of the--

Berezin: And so I came back and told the V.P. that I had gotten the job and I would be leaving.

Hendrie: Yeah.

Berezin: He had set it up, actually, so it was all very companionable. We set it up for some months ahead, when the present manager would be retiring. And then the Stock Exchange Manager called me a few weeks later, and said, I need to talk to you. I went down to the Stock Market and talked to him. And he said that the Board said that they could not hire me. Why? At the time, I was probably one of the very few people in the world who could do this job. And he said to me, they said that you're a woman, you'd have to be on the stock market floor from time to time. And the language of the floor is not for a woman's ears.

Remember, I had worked in laboratories all my life.

Hendrie: Yes. With guys.

Berezin: I had worked with practically naked men at times. I said, what in the world was he talking about? But there was no way I could get back to them.

Hendrie: Wow.

Berezin: So that tells you the situation of women at the time. What, I think, made it worse was that I had never had any problems working with men, even as a manager of men-- even within all-male (except for me) engineering organizations.

Hendrie: And so what year is this?

Berezin: In the early 1960s. It was before the women's movement.

Hendrie: Yes.

Berezin: And it was devastating.

Hendrie: Of course it was.

Berezin: I was really stunned. I think now, of course, it's easy to say “now” because the way women responded to things like that at that time was different from “now.” We responded with innocence combined with paralysis. Then, women didn't even know how to object when they were treated like stupid idiots. And so I kept quiet in spite of the fact that I was no longer young and had never had difficult experiences of this kind until then.

The young women who came after me-- who really learned so much from the black movement and started to object to how they were being treated-- that was in the '70s. They had learned their lesson, but not from my generation.

But at that time, it was still the old days. I think this is important so I'm going to give you another example. I was on the Board of CIGNA in 1985 at the same time as Marian Keller who was, in 1975, the woman with the highest level job in the country; she was a senior vice president at GE. And she said to me-- let me tell you *my* experience. She said when she first got a job at GE at the beginning of WWII, she had a degree in physics, and she worked on the drafting board in one of those enormous engineering rooms that has 100 people drafting designs in the days before computers.

Hendrie: Yes.

Berezin: There were only a couple of women there then. GE was hiring them, of course, because the war was on, and they knew they would have trouble getting men for almost any job. Marian was in the aircraft engine design department of General Electric. When she was there about six months, they were each reviewed, and if they passed, they would get a small raise. And so, she got a raise of $2 a week.

And then she accidentally met, in the ladies' room at GE, the other woman who was there, and the other woman told her that she had received a raise of $3 a week. And Marian was really worried, because she thought she had done something wrong. And so she went to the head of the department and told him that she had heard that this other woman had received a raise of $3 and she only received a $2 a week raise. Had she done something wrong? And he said, Oh, no. You are fine. He said, BUT SHE’S A BLONDE.

That's a true story. That was what it was like. And she didn't say anything. And I didn't say anything.

Hendrie: But you both remembered it for your entire life.

Berezin: Boy, did we. What I would have liked to have done was demand to see the Chairman of the Board. And tell him that I have heard all the dirty talk that anyone has heard in my lifetime, and it would not bother me for one instant. And furthermore, you're not going to find anybody else who can do this in this world now. And he didn't. I watched the news and the New York Stock Exchange hired people (all

men), and fired them, and hired them, and fired them. And didn't get anything that worked until many years later. And I certainly hoped that they lost a lot of money doing that, and had a lot of misery.

Hendrie: Wow. OK.

Berezin: So that's that story. I have told that to many young women because I get the impression that nowadays, women don't know what it was like. And I think they should. They need to know.

Hendrie: Yes.

Berezin: OK.

Hendrie: So what happens next in your career?

Berezin: Well, what happened was I talked to the people at Digitronics, which was the name of a company that had been started by the people who had been fired at the same time as I was at ELECOM, in1957. A group of them had gotten together and formed a company and were building various kinds of digital systems. For instance, paper tape readers--

Hendrie: They were very famous for their paper tape readers, because those were the best paper tape readers. Photo paper tape readers that worked [using] photocells.

Berezin: Yes. And so they asked me to come back there and I did. One of the things that I did there that's interesting is there was a job--

Hendrie: So what year is this?

Berezin: I got back there sometime in the early 1960's and this job was a couple of years later.

One of the interesting things I did there was design a digital system for a racetrack. It turned out that Roosevelt Raceway was near Digitronics on Long Island. The raceways had big displays with the information listed on it, but it was not electronic and they had no calculation ability.

The terminals where people bought their tickets were a sort of specialized calculator that showed how much money was bet on each horse, and all the information was sent to a central desk, but that's all they did. And you'll be happy to know how they determined the correct odds to send to the display system

when they did not have computers. There was a quiet fellow sitting at a desk and when the additions were ready the numbers went to this fellow, and in his head and without pencil or paper or calculator, he did the calculations to get the odds which were then sent to the outdoor display. In his head. And fast.

Hendrie: A human computer.

Berezin: A human computer did those calculations, and then they would just type them onto the display.

Hendrie: And it would go up on the display?

Berezin: Yes. I remember that I didn't know anything about racing. I'd never been to a racetrack, actually. So the people who owned the place took me to the racetrack. And I went everywhere, and when I saw that fellow staring into space, with earphones on, they were bringing him the numbers from the terminals. And he just simply -- he just told them what the odds were. I was dumbstruck.

Hendrie: How could he do that?

Berezin: That's what I was dumbstruck about-- yeah. Think of it. How could you do it in your head, continuously, for hours. And those odds appeared fast. Watching it, nobody seems to have asked in the years when they didn't have computers, what did they do? It certainly never occurred to me to ask how they did it. But that's what they did.

Hendrie: OK.

Berezin The racetrack people warned me that if that system went down, there'd be a riot. And the computer system itself never went down. We (other people did much of the actual design work by now) had already learned how to do all that so that sufficient safety was designed into the system. The thing that was most interesting was that one day, the lighting system for the display crashed.

Digitronics didn't design or build the lighting system; we just tied into it. But one day, the power went down, and the lighting system went out, and there was a riot. It was true. There was a riot when the lights went out. They rebuilt them later, maybe with a different display design do you think?

Hendrie: That's fascinating.

Berezin: Okay. And there were a lot of other small systems built at Digitronics. But I had realized long before that when you come down to it, from the first day I went to work in the computer industry in 1951 to the present in 1967 or so, I had held the same job. I ran the logic design department. I had never had another job. And I'm looking up to the next role, to vice president. And I knew damn well that I would never get that job. That job was for a man, and I would never have it. I had learned the lesson.

I was still friendly with all the people I had worked with all these years. Some of them had left the company and started other businesses and done very well. One of them was Mitch Schwartz and he kept telling me "Start your own company. It's the only way to get anywhere." And another friend of mine, this one from my NYU days, had also started his own company, making and selling specialized semiconductors and he told me the same thing. Mitch also said, "Get your own company and I'll start you off."

Hendrie: I'd like to pause. And you told me a story earlier that I just think is interesting. If you could just squeeze it in here--

Berezin: What is the story?

Hendrie: About when they shut down Elecom.

Berezin: Elecom.

Hendrie: And, you know, just go to how a couple of people took the computers, got an agreement to take them.

[**Berezin:** OK. That was very early-- back in 1957, when Elecom went bankrupt. I don't think the Underwood management, who owned Elecom, had a clue about computers. They certainly did not know what they had that was being built and what was close to completion on the production floor. Two of the technical people-- an engineer (Milton-- called Mitch) Schwartz-- and a programmer (Sol Manber) went to Underwood management and said they would be happy to take the machines on the floor away as an accommodation-- they were doing Underwood a favor so they would pay Underwood no money for it. Underwood agreed. (This form of business is called chutzpah.) They then moved the machines to Manhattan, completed and tested them, and sold time on the machines. They knew experienced programmers) so they could deliver working applications plus operational results without the customer having to buy an expensive machine and servicing it. They made pots of money and only a few years later, they sold the company for many millions of dollars and started another company with that money and made 10 times as many millions. All of it done with essentially zero cash (they used their savings for the comparatively small amount of seed money needed at the beginning).The American dream, and they earned it. With no VCs getting most of the money. In fact, there weren't many venture capitalist people or

organizations then. It was a perfect time to do what they did. There were very few computers available then and even fewer people who knew how to run a computer.]

Hendrie: Or programmers.

[**Berezin:** Sol Manber, I knew, was one of the very few unbelievably great programmers then. The most interesting thing about this, though, was that the second company really had nothing to do with computers, although the technology was useful, I'm sure. It was entirely different. Mitch had an idea for designing a new kind of printing system for newspapers and magazines. Essentially the idea was to use a CRT, a fairly small CRT, with a resolution so high that you could use the screen to expose and then print a large newspaper page.

Mitch Schwartz spent a couple of years working on this, getting Sol Manber to help him after a while. Although Sol had been mostly doing programming he had had very good electrical engineering training from the many years (14, I remember) he had spent as an officer in the Navy. They set up a company, and after a few years they did eventually build the machine that eliminated the old way of casting lead lines of type on a monstrous, messy Linotype machine**.** They used their own money (from the sale of the first company) for research and took the company public when they needed money for manufacturing. I think that their first client was IBM, and because of that, the stock went wild. They sold the company after a while and then retired. And that is the way all printing is done now.]

Hendrie: Wow. OK.

Berezin: They had strong patents on it, of course.

Hendrie: Really.

When was this? This is in the early '60s. They made a fortune. Isn't that a lovely story?

Hendrie: Wow, very interesting.

[**Berezin:** One of the more interesting things about that Company is that, essentially, the big problem is an analog problem-- something new to them. Some of it used computer digital technology certainly, but the hard part-- getting the resolution and accuracy needed-- was not a field they knew, and they seem to have taught themselves how to do it or maybe hired some smart consultants. But what they did was really remarkable.]

Berezin: By the time this was done it was somewhere in the mid '60s. With some other people, they then started a small venture capital company themselves and were nagging me to start a company, telling me what I already knew, that I would never get anywhere by working for someone else. I also had a friend, Al Lederman, whom I knew from NYU (and who had dated my roommate for a long while) who had started a specialized semiconductor company and he was also telling me to start a company-- it was great fun. So, with my friends after me, and the fact that I had come to terms with the fact that I was at a dead end and that I would never get anywhere if I stayed in any company not my own, I began to think about it.

I finally did come to the conclusion that the only way out-- or really the only way UP, was to start a company. I was working with two other people at Digitronics that I respected. Ed Wolf was the head of engineering there. Ed was the best engineer that I have ever known, with an extraordinary breadth of knowledge and a great imagination. Ed Richards had worked for me starting at Teleregister, and was in charge of design and very good at it. Anthony Mauro, was head of marketing. His experience was a very different kind of marketing from what we ended up with in the new Company, but he was very capable of setting up marketing organizations. I had known all these people for a long time and knew them well. So we started to plan-- what are we going to make? We did our planning in Ed Wolf's kitchen, after work, because he was closest to Digitronics.

What was unusual is that we didn't start out having a good idea and then start a company to implement our idea. We started by first deciding that we were going to start a company. But what were we going to do? We talked about many ideas, and tried out the ideas by talking to the people we knew who had done it, including a lawyer Mitch knew who had experience working with start-up companies and, with him, we analyzed those we were thinking about seriously. One of the ideas we investigated was building an electronic cash register. But we came to the conclusion that NCR was so dominant a company that they would be too difficult a rival. They would have to get rid of us fast, and they had the power to do it.

Hendrie: Yes.

Berezin: However, almost everything in the computer oriented businesses that we knew about was competitive with IBM. You couldn't not be. Our biggest problem with IBM was that, at that time, they rented everything to customers; they did not sell it. And one needed piles of cash to do that. We knew that we had to find a business where we did not need to rent the product. And we came to a conclusion that turned out to be wrong.

[I liked the idea of word processing as a business. One of the compelling things that made me like the idea was a study I did of what kind of office jobs there were and how many people worked doing specific jobs. I found out, from data in the Washington DC Bureau that dealt with jobs-- this was about 1967 or '68-- that 6 percent of all the people in the United States who worked were secretaries. The US had a population of about 200 million people then, so about 12 million people were secretaries at the time, and growing rapidly. (It was similar to what had happened at AT&T. When they first started selling phones,

connections were made by people, and the number of people (all women) that were needed grew so rapidly that AT&T was quickly compelled to design the automatic connection systems that eliminated people. It seemed to us that we had a similar problem with secretaries; we were sure that we could increase secretarial (i.e., typing) efficiency a great deal and that such a machine should have a substantial market. It was also true that renting the equipment was not common in the typewriter business, and we certainly did not want rentals (it required too much cash) so that it looked OK. Desktop computers were unknown and many years away from becoming available, so that was not a problem. We concluded that word processing was an unlikely area for IBM to enter and that, in any case, the price would be so low that renting would not be an important requirement. As I have said, in this respect we were very, very, wrong.]

We knew that IBM was already offering a machine called the MTST, which had been used for some years for what we now call word processing. But it was very limited. It was apparently built specifically for companies building military equipment with constantly changing specs, not for a secretary, which was our goal. The MTST was very old in every respect and by then-current standards, it was a pretty bad design, and it was not at all popular. It used relays, not electronics and a special kind of electronic tube that operates a relay, a thermionic tube.

Hendrie: Thyratrons. Thyratrons?

Berezin: Thyratron, right. Thank you. I couldn't remember the name-- thyratron. It's been a long time since I said that word. It was a klutzy machine and Ed Wolf thought that, since integrated circuit chips were just beginning to be known, although they weren't yet available, it would be possible to buy chips on our schedule and build an electronic system that would be cheap enough to sell as a standalone system. (Small computers became available everywhere after the 1980s, but at the time we started, which was in 1968 to 1969, nobody really had any desk-type computers on which you could write a word processing program that a secretary would use. I know that desktop computers seem obvious now, but it wasn't so then.

Hendrie: Yeah, PDP-8 was the cheapest thing there was at that time.

Berezin: I've forgotten how much that cost, do you remember?

Hendrie: Well, when it first came out, it was $18,500 for it and a Teletype.

Berezin: Not such a hot output system, and useless to a typist. And the dollar was worth many times what it is worth today, so it was a heavy price.

Hendrie: Yeah, a Teletype [Model] 33, to get output-- input, output, everything. And they did, as they came with newer models, they did reduce the price. The PDP-8S, I don't think the PDP-8S was out yet. It eventually got out; they sold that for $10,000.

Berezin: But you couldn't build a secretarial stand plus a proper printer and memory and sell it at an acceptable price.

Hendrie: No.

Berezin: And you had to add a printer that a secretary would accept, not a Teletype.

Hendrie: The point is, there's no high-quality printer yet.

Berezin: No. Well, a typewriter could and did do it. That's really the only printer that would do it then, but it was unbelievably slow and, since it was originally used only manually, it did not have the reliability that it really needed. Luckily for us, the customers thought that a remotely controlled typewriter was a miracle of fast action and nobody, certainly not us, contradicted them.

Hendrie: I know, a Teletype wasn't going to do it. So I understand. There just wasn't enough there.

Berezin: It wasn't there.

[**Berezin**: At the time, secretaries had very specific ideas about what they wanted and they would not use a machine if it was not what they were used to. We did a lot of work, for instance, on the force curve when one pushed a key. Computer keyboards were hopeless (and many of them still are) for high speed typing. People don’t seem to care about that anymore because they are used to the feel of computer keyboards. But when we started to make word processors, it wasn’t that easy. You needed to be careful to design a keyboard that felt like a typewriter and satisfied the secretary. You also needed printing that looked like it came from a typewriter. At that time, only a real typewriter printed material so the letter looked good enough to send.]

Hendrie: The secretary has to think, "I like typing on this."

Berezin: I like the typewriter, yes. But the secretaries were frightened of it also. I didn't realize how frightened of it they were going to be.

Hendrie: That became another problem, yes.

Berezin: That became another problem. So let me just get my notes again.

[Let's go back to the design issues. One of the big problems was memory. Nothing was available that wasn't a magnetic drum until about 1970. But there was information from MIT that a new form of memory had been developed by Forrester that was going to become commercially available very quickly; that was magnetic core memory, which solved part of our problem. Not long after that, Integrated Circuits began to appear in the form of ROMS. None of this was available to us when we started, in December of 1969. But we knew it would be available soon.]

We were committed to building a computer to run our system, and we knew that we had to use integrated circuits because it was the only way we could make it small enough and cheap enough and reliable enough to sell. Although it seems to be unknown now, Long Island was then an important place for developing new semiconductors and there were companies on Long Island that were manufacturing semiconductors then. Fairchild, from which, indirectly and a couple of moves later, Intel was born, was originally on Long Island. There were also two companies very near us on Long Island: General Instrument and Standard Microsystems-- and both had just started manufacturing using the new MOS chip designs and were interested in working with us. The President of Standard Microsystems, Paul Richman, had developed some of the new MOS technology. General Instrument, I think, was first to manufacture it, although I have read that the Texas company--

Hendrie: TI.

Berezin: Yeah, Texas Instruments, that they were the first. I don't know which is right.

Hendrie: Right. I don't know.

Berezin: Ed Wolf, our head of engineering, decided that this machine had to be very compact, very inexpensive, and that it was going to be a small box with a single Printed Circuit Board. MOS chips included ALL the electronics in the system.

We planned to use some type of magnetic recording of the documents being typed and edited. And in those days, for audio or music applications there were little tape cassettes, about 3x6 inches, in use. We used two of them-- one for input and one for edited output.

Hendrie: They were quarter-inch cassette tapes? Is that what you're talking about?

Berezin: Yes, cassette tapes.

Hendrie: Of course I remember those.

Berezin: Well, many people going to the Museum now would *not* remember cassettes. It's quite a while ago since those were commonly used. But we did use them as our external memory. The machine had two cassette tapes. One was an input tape for editing or printing. The other cassette held output that had been edited or else it was used for special applications. I should also mention that we also had an option to use IBM card readers/writers as input /output for the system. They were commonly used then.

Intel had started as a company in 1968. Redactron started at the end of 1969. Intel had already been around for a while and the story was that they would build memory chips and then processor chips. So we knew they were building a small processor on a chip and we planned to buy this Intel processor for our Word Processor machine. That was the first choice. But when we asked Intel about the delivery date of the processor chip, they said no, they had very large orders for the memory chips they were making, were very busy and would not be ready for quite a while. They could not tell how late the processor would be. We knew that time was our most expensive necessity. We couldn't wait. It was a disaster for us.

Ed Wolf had learned enough to decide that our small group of engineers could design these newly-developed MOS chips themselves. He had talked to General Instrument and to Standard Microsystems, and it was possible to get all the chips made on our schedule if Redactron helped these two chip-manufacturing companies by designing some of the chips. (Just starting out then, the semiconductor companies needed customers, which is why they would deal so early with a start-up like us.) We had done enough so that Ed Wolf (working with Ed Richards, who headed design) decided that ALL of the electronics for the entire machine could be designed on 13 MOS chips. I don't remember how many elements there were on a chip then, but we knew that we could get the entire alphanumerically coded processor on one chip.

We ordered about four or five of the chips from General Instrument. That was all they could do at that time. We also ordered about four or 5 chips from Standard Microsystems. But also, our engineers learned what they needed to learn from these companies in designing the chips themselves, and we did four or five ourselves. (Once the design was done, the manufacturer made them for us without delay. It had been the design that was the delay.) I can't remember the exact split up, but we designed the processor because it was the most difficult. So the 13 chips were split about equally between these three groups. They were all designed in about a year.

Hendrie: You're kidding.

[No. I'm dead serious; we were working all hours and with concentration. And remember, in those early days, the number of elements on each chip was not very large, so the design time was much shorter than it became just a few years later.]

There was something else we did that was important. Remember, time was our enemy-- money was being spent furiously and we did not have much of it. So we had to move fast. I knew that we could not tolerate having an error on this-- the first shot at producing the chips had to be right; if it was not, that would surely mean that one chip or another would have to repeat the whole cycle, and another design cycle was unthinkable. So we built a separate, complete model of the machine, using the same logic design but implemented in elemental parts (transistors, capacitors, etc.), instead of MOS, and it included everything including all the mechanical devices, and tested it thoroughly while the chip design was being done. Because we fixed all the errors before the chips went into manufacture, it worked immediately because all the testing was done before the chips were built and everything was checked carefully.

An aside: I have always preferred elaborate checking of designs very carefully before manufacture to reduce the time it takes to a working product. But this was not the usual way machines were built when I started in this industry. I found that the engineers doing the work in the very early days of computers had very little discipline at all. The way I saw the engineers work then was that: they each designed a specific section of the machine without much, if any, relationship to where it was to be connected. To me it was almost a rough approximation instead of a firm design, but they built all of it, and then they went through a debugging period when the same engineers would go through all the operations of the computer system, fixing the machine so it got closer and closer to the desired machine as they debugged it-- with corrections on top of corrections, making a mess of the wiring, and taking a long time to get it to work. (Other places may have been more organized, but this was true in the few companies I worked in when I started.)

[I had changed the operating methods at Teleregister, which had improved the speed with which we could build complex systems with a very small number of errors, but our problems were much more difficult at Redactron because the technology was changing so fast while we doing the designs. We needed a new way of doing things from the beginning. First, the entire system would be separated into sectors-- processor, memory controller, printer control, etc.-- in accordance with a defined plan. Then we designed a standard interface so all signals between sectors were transferred from one sector to another in exactly the same way with the same timing. Each of the sectors was then completely designed and, once complete, with each sector rechecked by the original designer, the design was then checked thoroughly again by a different individual. I remember one of the engineers chastising me on the grounds that we would have to redo much of the system on the test floor when they put it all together anyway, so why bother? But the system went together cleanly and very quickly and with very few errors. They were better than they thought.]

Berezin: Yesterday, I took a look at Intel. Intel has a public history and they have pictures of the 4004 which was the first processor they designed, a 4-bit machine They built only this chip for some time and then followed it with an 8-bit machine sometime later. What was its name?

Hendrie: 8008, the original.

Berezin: Their machines were much more tightly designed than ours. But we didn't have time for that. I mean they took a long time to design it; they needed an optimized chip design because of potential competition.

Hendrie: As a chip.

Berezin: As a chip, yes. And we were trying to build something for a machine that we were going to sell. And if the chip was not as small as others, or a few pennies more costly to make, it did not matter for this application. We had an advantage in that we knew that the machine was going to be operated by a person, and therefore, it could be, and was, slow. It did not have to function fast and we could cut down the number of elements by doing all operations sequentially, instead of in parallel. Engineers were anxious to make chips function in parallel because they needed the speed to be competitive. But we didn't have that problem. We could be slow and less expensive.

Hendrie: So you could be bit-serial.

Berezin: Yes, and we no longer had drums as our memory. The Invention of magnetic core memory came in the nick of time, from Forrester at MIT. It might be useful to describe the elements of the first machine we built. Remember, this first Test machine was built of whatever equipment was available as long as it was an exact copy of the design of the ultimate machine which was to be sold.

Hendrie: So you had a core memory?

[**Berezin:** We started with a magnetic core memory for the Test model, without any chips because the ROM's were not yet available to us. And this core memory was a fixed memory, like a ROM. We built the logic of the machine using transistors on a bunch of small PC Boards, -- certainly not the clean little single PC Board that was destined for the final machine. And something else that Ed Richards reminded me of-- we did not have RAM's either, yet, while this was going on, so in place of the RAM's we used two magnetostrictive delay lines as serial storage for doing the internal data manipulation. Ed Wolf's plan was that this first Test machine (I should call it the first Test and Model machine, because we used it, not only to check the design, but also to demonstrate the machine to potential agents.) The large numbers of things in that first machine were so jammed inside its small case that it took great strength to get the Test

machine closed. But we had to do that so we could demonstrate the machine and give the impression that it was the final design. But we only had one (stuffed) machine. I still don't know how we got it all in the small case of the final design of the standard machine.]

Hendrie: A little one?

Berezin: [Yes. The machine had a separate typewriter plus a small case on the side with everything else in it-- not much space. I'd like to tell you one story about that Test machine that I cherish. There was an office equipment show in one of the big private rooms in a fancy New York City Hotel, and we wanted to display the only machine we had-- our Test Machine. And this Test machine had so many wires and circuits rolled up together inside it that, if the weather was dry, it bristled with static-- sparks between the circuits inside the case could be heard, and of course it would not work at all. To our horror it was a dry day and the engineers were setting this non-working machine up for our big story, and the reporters were coming in an hour, and everyone was going crazy. Me too. Ed Wolf disappears. We are frantic. Ed Wolf comes back, carrying a full pale of water and without a word to anyone throws the pail of water over the whole thick carpet in the room. The water sank into the carpet which stayed damp for 3 or 4 hours and the machine worked perfectly. And nobody seemed to notice that the machine was sitting on a wet carpet, and that we were walking on it.

Now let me tell you how the first machine sent to customers looked. All of the 13 chips worked, and were on a single (about 12x12 in.) printed Circuit Board. The core memory was gone, replaced by Intel ROMS, which held the program. The only place we had a supply problem was in the magnetostrictive delay lines. We had planned to replace them with RAMs in all production machines, but INTEL could not deliver them to us in time, and they were ready at about the end of 1971. At that point all you saw when you opened the case was a single PC board and a power supply, and a few wires. Almost empty.]

Hendrie: Re-program the ROM and you're--

Berezin: Non-changeable ROM's were OK for the program because you couldn't afford to have changes anyway, because we needed to build a field service organization; you could not rely then on there being people around locally who could fix systems with varying programs. You had to have an instruction book and the secretaries themselves had to be instructed in how to use the machine. Changes would be expensive, we knew. And the various functions that needed doing were quite well known, so a machine with a defined function was suitable for this application at this early stage.

So you couldn't have very much variation and have a big company. And just a few months after we started manufacturing, we were already selling overseas. Anthony Mauro had set up a world marketing organization, using office agents with their own businesses to sell the machines for us. We were selling all over Europe and even in Australia. Our biggest market was Germany, who used the machine very

effectively, to its sophisticated limit. They were the best users of technical equipment, best trained, best service that we saw at that time. We sold a lot of machines in Germany.

[We have started to talk about marketing, so let's stop here and talk only about planning marketing. In planning Redactron, we knew we had very little money for a world-wide company startup if we did everything ourselves, and marketing was the hardest thing for us to plan with any kind of accurate projections. We knew that growing the market using agents would take time because it was such a new idea for the office, and expensive. It was actually a lot harder than we thought to get both secretaries and managers to have any idea of how much it could do for a company.

Because it would take so much time, we figured that we needed an early source of revenue and decided that we needed to get one large company to also market Redactron's machines on an OEM basis. Anthony Mauro did most of the marketing on this; it was big part of his job at the beginning and we did get a partner just about the time we started to make the machines.

The Company was Remington Rand, which was just great. It did what we wanted-- we had a manufacturing building ready to produce and a customer with an order that would keep that plant busy. This was an extraordinary coup for us. Anthony and I heard from Remington Rand that we had the order after working hours one evening and we literally waltzed around the whole plant in celebration. Fortunately, nobody else saw us.

We should also talk about manufacturing. To start manufacturing, we had to build a plant near us from scratch; there was nothing available nearby and I was sure that it had to be nearby. And a fellow I knew, who had good manufacturing experience, suggested someone whom he was sure could run manufacturing well. The prospect had never gone to college but had grown up in manufacturing and had worked in that business his whole life. In fact, we had a number of people working with us who had never gone to college. It was still a world where many people learned by experience and, like them, Manny was very capable and very confident. And he was the one who found our first building (where the engineering was done) which was in Hauppauge, Long Island, about 50 miles from New York City and he ordered our second, manufacturing building to be built next door by a local real estate developer-- before we had completed the design of the machine.

Reading, now, the way we did things then, I realize (only now) how many enormous risks we took. Like building a plant before we had a product. Like designing a machine before we could buy the parts we needed. And more.]

Hendrie: Were you very close to Digitronics, or not?

Berezin: Oh, no. Digitronics was not close. We were much further away from NYC than Digitronics was. And note that I was still commuting 55 miles each way from New York City. It was not the usual situation where the President builds the Company's new building where the President or the Founder lives.

Hendrie: Which has almost no logic associated with it.

Berezin: Absolutely none, but done all the time. The logic of the first plant was that it was 20,000 square feet and rented for $40,000 a year. $2/sq. foot. I mean, it was cheap. And the manufacturing plant was almost as cheap. But remember, this is the end of 1969, the beginning of 1970. We were falling into a terrible recession. That would become a big problem.

Hendrie: It was not quite there yet, but it's coming.

Berezin: Well, the one we just had in 2008-- the last one, was pretty bad. Mostly because it has lasted so long. But then, in 1972, we had interest rates of over 16 percent.

Hendrie: [SHARP INHALE]

Berezin: There was an unbelievable inflation. Do you remember this?

Hendrie: I absolutely remember that.

Berezin: The 1960s was a wild, almost abandoned kind of economy. And then, starting in the early '70s, just when we started the company, the economy collapsed with this terrible inflation, which lasted all through the '70s. We had interest rates of 14, 16, 18 percent--- and worse. And I remember with pain that the market P/E fell down to a P/E of 8. It was horrible.

IBM had started to sell some of their large office machines instead of renting them. I think they did it because they were trying to get ahead of the Courts on an antitrust trial that was going on then. That was a big change for them so they set very high prices for everything they sold, much higher than other companies did. Of course they set high prices so they could continue to encourage rentals. They made a fortune on rentals, because companies used the machines for a very long time.

And then the Court handed down a tough set of rules for IBM, after a very long antitrust trial. And IBM finally agreed, as part of the antitrust contract that they must sell *all* their machines, in addition to renting them. And we convinced ourselves that it meant good news for us. Because if they did get into the word

processing business, they would sell the machines and not rent them, and they would probably be expensive compared to us. So this was a safe place to go.

Berezin: There was no competition with IBM at the beginning. We didn't have any competition at the beginning because they didn't start to build word processors until much later. But a few years later the problem was not competition from the word processor they finally did build-- it was not a good design and not competitive-- but customers wanted to rent Word Processors and that was what they did. We learned, to our sorrow, that many companies did not even have permission to buy office equipment-- they could only rent.

Our manufacturing cost was about $2,400 for the whole system, including everything-- typewriter, keyboard, cassettes, the one printed circuit (PC) Board which included ALL the electronics including the memory needed, and the power supply. The PC Board included the control electronics for the 2 cassette drives and the printer and separate keyboard. It was a gorgeous design for its time in 1970--1971. Ed Wolf had designed the system starting in December 1969, when we opened the place with 9 people, and when some of the parts he had designed into it were not yet being produced; his timing of when they would be available was almost perfect. We delivered the first machine to our first customer in September of 1971. And it was so beautiful-- and amazing that all but one of the non-available parts that had been designed into the system actually made our design schedule. I felt like dancing with joy.

Hendrie: Yes.

Berezin: If you opened the machine, most of what you saw was the power supply. The power supply probably cost more than the PC board.

Hendrie: Right.

Berezin: --which is not uncommon. Also what's not uncommon is that the frame cost more than--

Hendrie: --more than the board, right.

Berezin: Let me just take a look at this and see if I've missed anything.

Hendrie: Could you possibly talk a little bit more about how you financed the company?

Berezin: Oh, at the beginning? Yeah.

Hendrie: --at the beginning, how you financed it. How many people was the core group until you had to get into manufacturing? How did you do sales? Did you have distributors? Did you have direct sales? Talk to me about a few of the business aspects.

Berezin: Well, just let me answer the marketing issue-- we never wanted to have a bunch of our own salesmen. We were too small at the beginning to get enough scale for that early on.

Hendrie: OK, of course.

Berezin: What we did was sign up agents. We had agents all over the world, in this country but certainly in many others, wherever there were people who sold office supplies. I think I mentioned that already.

Hendrie: Ah! OK.

Berezin: And so, we did have a concept before we started of how we would do marketing. I think I told you that the three people who left Digitronics to start this company were me as president, Anthony Mauro who headed marketing for Digitronics, and Ed Wolf who was their head engineer. It was Anthony who started immediately setting up an agency network all over the world.

Hendrie: OK.

Berezin: You will remember that I did tell you about Mitch Schwartz who was the friend and colleague who had made a great deal of money in two companies he started. Afterwards, he had started a little VC group with a bunch of friends of his. And Mitch had told me that if I started a company, he would put his money in it. And that's the way we started, with no conditions on what kind of company it was.

Hendrie: And how much did he put in?

Berezin: $750,000, which was-- I don't know what it's worth now. There was--

Hendrie: You use the consumer price index. I could do that. It's just math.

Berezin: I think it's about a factor of 10. There was a huge inflation in the 1970s and early 1980s

Hendrie: Yeah.

Berezin: That $750,000 would probably have been, now, close to $7.5 million.

Hendrie: Right.

Berezin: I remember the number of people we had at the beginning when I immediately tried to get health care for the employees. In order to get health care, you needed a minimum of 10 people, or you couldn't get health insurance for a company. We only had nine people. So we made up a fake name and added it in, gave it a salary and name, and got insurance.

Hendrie: OK.

Berezin: At the insistence of the Board, we immediately started to hire all the senior managers for the Company. The Board said that trying to save money by not having a complete team at the beginning was a mistake, and they were right. It was good to have people on the Board who had done it before. Some other people from Digitronics came along at the beginning of the Company, particularly Ed Richards, who headed the design group. They told us that the faster we got management on board, the better off we were. By then we had considerable experience; all of us knew many people in the field that we could count on. They recommended experienced people, and they could fill all the areas that were needed to implement the functions of an integrated Company. That included a Chief Financial Officer (John Labiak) and a Manufacturing Manager (Manny) whose first job was to find us a place to live. He showed his capability quickly, by finding us a building on Long Island that was 20,000 square feet and cheap. As I told you, it cost us about $40,000 a year for that 20,000 square feet, and it was a clean, empty building.

Hendrie: Yeah, wow!

Berezin: $2.00 per square foot.

Hendrie: That's incredible. But, OK.

Berezin: Well, there was also the beginnings of a very serious depression or a recession, as they called it then, which happened at the beginning of the 1970s and by 1974 it was a disaster.

Hendrie: Correct.

Berezin: In a company that was renting machines, it could not be worse. And the bigger we got, the more we sold, the more cash we needed.

Hendrie: Right.

Berezin: More of that later.

Hendrie: OK.

Berezin: Now, you asked about how did we start? Mitch put $750,000 into the Company. And we used that to start the company with, as I said, nine people. We found a Company secretary from the previous company that had just gone bankrupt and moved out. She was great. So we really had 10 employees, and a 20,000 sq. ft. plant.

Hendrie: OK.

Berezin: The reason we hired the rest of the management immediately was that we had a schedule that said we had to get this system out into the market in a year and a half. And if you're going to do that, you'd better get your manufacturing--

Hendrie: Up and running right away.

Berezin: --all set up, and running right away. Apart from everything else, manufacturing had to work with the design engineers so they knew how to build the machine and were ready for it when the machine was ready. And we had to start marketing immediately as well, before we had a machine to market. The agents who would sell the machine had to be sold on the idea, trained and ready.

Hendrie: Yes.

Berezin: Manny was a great guy who was all practicality. He knew just how to do everything.

Hendrie: Wonderful.

Berezin: He was great. But within the year we were running out of money. And it was very hard to raise money when interest rates are edging on 16 percent. Who would want to put money into stock when they could earn 16 percent with a bond? So Mitch invested another $500,000 in 1970 as a bridge. By 1971, when we needed money desperately again, Mitch knew somebody who worked in an investment bank who did offerings for small start-up companies. And just about then, in a strange aberration, the market

suddenly went up (from a P/E of 8) for a couple of weeks and we got our public offering done. I think it was for about $4 million.

Hendrie: Yes, when you went public.

Berezin: And that kept us going for a while. And then, about a year later, we had another offering of stock, for about another $4 million. So the total amount of money we raised was about $10 million. And when I think that we designed a product full of new technology, built a worldwide marketing network, commissioned a whole new plant and started to manufacture the product, and over the next few years moved up to just under 500 employees in a 200,000 sq. ft. plant we moved to …..

Hendrie: At your peak?

Berezin: At our peak. Although, the peak was--

Hendrie: Now, I don't think you've actually said on tape the name of the company.

Berezin: Yes! Well, none of us knew what to name it. But my husband, who was born in England and who was interested in linguistics and had a wide vocabulary, volunteered. He came up with the name “Redactron” in about a day. The English word "redact" means -- it’s the same in almost every language you can imagine-- “to edit.” To redact a document is to edit it, in English, in French, in German, in Russian, etc. We expected to have agencies all over the world, so that was important to us.

Hendrie: OK.

Berezin: The other thing I did was contact Roslyn Willett, an old friend of mine from my college days. I knew she was very smart, very capable. She had done Public Relations for many companies for years and was running her own Company by the 1970s. I had learned from her that Public Relations is a much more efficient and a much less expensive way of getting the Company’s name everywhere, than advertising.

Hendrie: Mm-hmm.

Berezin: We spent $2,000/month with Ros on PR, and she was right. The whole company became very well-known. There were articles in all the magazines and newspapers-- even the *New York Times*.

Hendrie: Wow.

Berezin: Some of the PR that Ros did had (indirectly) to do with the fact that there was a woman running Redactron. That was extremely odd in the 1970s and Ros took advantage of that as much as she could. In 1976, she actually got me on the *Business Week* list titled something like “The 100 Top Business Women in the United States.” I thought it was hilarious; I had been a CEO for 6 years and we were fast running out of money. And this is one of the hundred biggest business women in the US? It tells you how limited the technical world was for women in the early 1970s

Hendrie: Very good.

Berezin: We did all these things very quickly. Many of these people were found through friends, and friends of friends-- one of the major advantages of not being young.

Hendrie: Yes, of course.

Berezin: This was in 1970 to 1971. I would have been about 45.

Hendrie: Yes, you had a lot of experience.

Berezin: I had been working in this field from the time I left University and was stuck at that level.

Hendrie: Yeah, OK.

Berezin: So I made myself President.

Hendrie: [LAUGHS] Very good.

Berezin: I told you that we had raised about $10 million over this period. Do you know of the Bank of Boston?

Hendrie: Well, yes. Can I just interrupt for a second?

Berezin: Sure, of course.

Hendrie: So your peak sales were in the neighborhood of $20 million revenue?

Berezin: Not quite. Because they turned out to be mostly rentals. [I remember now having seen the numbers in the 1974 Annual Report before I sent it to the Museum, and in that year our total Revenues were over $16 million. Of that, about $14 Million were sales-- to Remington Rand or to our overseas customers, and over $2 million were rentals. You can bet that they cost us a lot more than that to deliver to those customers. It went up from 1974, but the rentals grew slowly, as one might expect.]

Hendrie: Ahh!

[**Berezin:** I'd like to change the subject for a while now to tell you something else that was important. Somewhere or other I had met one of the people in the management group at Xerox; he was responsible for research as well as other aspects of planning for Xerox. He called me and the upshot was that they wanted to talk to us about buying Redactron. We spoke to the lawyer who had acted as our mentor when we started the Company. We thought he could do the negotiations. We talked together about the price we should ask. It is not sensible to talk of the value of Redactron now because I don't have enough information now to explain it and it doesn't matter anymore. But I can tell you about the price of the stock which, when they called, was about 8, I believe.(Down from 20 in the bad economy.) We decided to ask for about 15 and we left the negotiation to our lawyer.

Then, when we got to the meeting, our lawyer was asked for what price the Company would accept, and he said "30". Anthony and I somehow managed to keep from falling off our chairs. Xerox said that there was no way that was possible. They could not go above 12 so there was no point in continuing our discussion.

Immediately after this was over, Anthony and I, both thinking of the current financial risk we were in, agreed that we had made what was probably the biggest mistake of our lives. It is still too sore a situation for me to permit myself to think about, even 40 years later.]

Berezin: Let us go back to the rental issue. What you have to do to survive with rentals is that you have to build them up over enough time to have the income from them pay for the cost to manufacture and sell.

Hendrie: Exactly, it's an annuity.

Berezin: And then, it becomes wonderful. But if you keep proper books-- many people, in those days, used to just capitalize rentals and put the number on the books as revenue. But that was stupid, because the cash flow wasn't there.

Hendrie: Yeah, right.

Berezin: So we did it in--

Hendrie: --in the right way.

Berezin: We always worked in accordance with good practice. The fellow we had hired as CFO (John Labiak) had had a high-level job at Revlon in New York City. He had four little boys, and was commuting from far out on Long Island to NYC, and wanted a job near his home, so he came to work for us.

Hendrie: And he was--

Berezin: And he was very experienced. And you must remember that, at this point, I had never really understood a financial piece of paper in my life.

Hendrie: OK.

Berezin: So he sat down with me over some time and taught me accounting. Went through it all from scratch, so I understood the principles. (Years later, the former President of Burroughs and his retired VP of Research started a company that I was on the Board of -- being on small start-up company Boards was the kind of thing I was doing then-- We were meeting with potential investors and needed a projection of our financials in a hurry. Overnight. Neither of them had a clue of how to calculate such a thing in spite of having seen financials all their lives, so I prepared acceptable financials for the proposed Company and avoided disgrace. I was quite proud of that. John had trained me well.)

Hendrie: Yeah, you had a little business plan put together.

Berezin: More than a Business Plan. It looked like a proper financial report for the SEC. The numbers were estimates, but the format was convincing. And the President of Burroughs didn't know how to do it because his CFO never taught him what the financials meant.

Hendrie: Right, and he didn't! [LAUGHS]. Very good. One other question that I'll ask right now is you started the company, what month did you actually leave Digitronics?

Berezin: November of 1969.

Hendrie: OK, and when did you ship your first system?

Berezin: We shipped our first machine--this is from the prospectus, which says "the company began manufacturing the product in September of 1971 and through September 15, 1972 had produced and shipped approximately 1,020 units of which 596 had been sold, 176 had been rented," "194 were on consignment," to all the agencies who were selling them--and it went up from there.

Hendrie: Yes, they had to have demos.

Berezin: --they all had demos-- "and 54 were in transit." for sale or rental.

Hendrie: Very good.

Berezin: That's in one year.

Hendrie: Wow. And you shipped 18 months after--

Berezin: 18 months after we opened the door with nine people.

Hendrie: Yes, very good.

Berezin: When I look at it now, it looks even better than just good.

Hendrie: That's right. All right, so let's--

Berezin: I have to say here, it is largely because Ed Wolf was so good. I told you, he was a superb engineer.

Hendrie: He knew everything a great engineer needs to know.

[**Berezin:** --He was wonderful. I'm saying all of this now because it ended tragically-- he died when he was very young. A couple of years later-- an aneurism at LaGuardia Airport. Terrible, because we all loved him, and he wasn't much past 40.

Hendrie: Oh, my goodness.]

Before we get back to the subject of financing, I'd like to discuss a technical issue that I think is interesting and important to Redactron. It's about a subject we have already discussed to some extent. I did tell you that since we couldn't get the processor chip that we wanted from Intel, that we had designed our own computer chip--

Hendrie: Processor chip.

Berezin: --processor chip, yes. That chip could be designed somewhat differently from what was the common current technology because we didn't have a high requirement for speed. And so we designed that chip to be a serially functioning chip. In other words, the calculation was done, not as a number which could be added in parallel with other numbers, but instead was a stream of bits, acted on one bit at a time.

Hendrie: Yeah, you had a one-bit adder.

Berezin: It was a one-bit adder. And that made it possible to put everything on a single chip, which we could do, and keep it inexpensive.

Hendrie: Yeah.

Berezin: It was fully workable. It did everything that any other computer in the world could do.

Hendrie: Right.

Berezin: But it did it slowly. And we did that to cut the cost of the machine. As I said, $2,400 for it all, including the cassettes, including the printer, including everything, was our factory cost. That was pretty low.

Hendrie: That's very low. I agree. It was all MOS. I'm sure it was P-channel chips.

Berezin: I know it was MOS but I really don't remember that it was P-channel.

Hendrie: Yeah, for a General Instrument [MOS integrated circuit] in that era, that's what it would be--

Berezin: Well, then that's what they did.

Hendrie: P-channel MOS. Yeah.

Berezin: It was very early in MOS. Come to think of it, do you think that this was one of the first, and maybe actually the first commercial machine built anywhere using integrated circuits? It certainly had to be one of the first machines--

Hendrie: '71 is very early, absolutely.

Berezin: Well, the point I wanted to make about this one was that it was a serial chip. But it was a full--

Hendrie: Computer.

Berezin: --processor doing everything. And we actually delivered usable product in September of 1971, according to our report. I do have that record.

Hendrie: I think that's very interesting.

Berezin: It brings up a question**.** It has been presumed everywhere that it was Intel who designed the first integrated circuit processor in '71, and they do say in their history summary that they delivered the first such chips in November of 1971.

Hendrie: Yeah.

Berezin: I'm not so sure that it wasn't Redactron who designed the first computer processor, since we delivered a complete machine with our processor built into it in September of 1971.

Hendrie: Well, we have the records. Because we have the oral history of the 4004 Project. And so, we can verify when they had the first working chip, when they delivered the first chips to the calculator company [Busicom—ed.]. Because they first delivered 4004s to the Japanese calculator company.

Berezin: I don't know when it was delivered, except for what they say to everybody.

Hendrie: Because it was a contract. And I don't know when. But we can look it up. And then, they offered them for general sale and delivered them to the general public.

Berezin: So it may be earlier than I thought.

Hendrie: Yeah, I don't know. I'll let you know when I find out, OK? Because I bet you're curious.

Berezin: I would like--

Hendrie: I'm curious too.

Berezin: For all these years, Ed Richards, who headed the design group has always nagged me about this, saying that we were the first, and I have wondered about it.

Hendrie: You were very close if you weren't.

Berezin: Yeah.

Hendrie: And certainly, independently. You didn't look at what they did.

Berezin: I never saw the inside design of one of their processor chips, and I am sure no one else at Redactron did either, because they would have told me within 10 nanoseconds. Besides, we would never have thought of designing a 4-bit machine-- it did not fit the fact that we dealt with the whole alphabet, plus numbers and symbols. If I remember, the 4004 was designed for a calculator, wasn't it? And because our chip was serial, it didn't add much to the number of chips we needed, because the bits went through the system one bit at a time.

Hendrie: Yeah, and just because of your background, you would have put a computer controlling it.

Berezin: Of course.

Hendrie: Because that's what you knew how to do.

Berezin: Yes, the engineering crew had built quite a few computer systems by then. We knew how to do general-purpose computers as well as quite specialized systems.

Hendrie: You'd done many of them.

Berezin: And that whole system, which was the computer chip, memory, and all the connections to the input-output systems, was the same in general as every other computer in the world being built. The whole thing was programmable in every respect.

Hendrie: The whole nine yards. Do you know whether you happen to have any logic diagrams or instruction manuals for the computer?

Berezin: I do have some written materials I'll show it you, but I haven't looked at it in many years..

Hendrie: All right. We'll get at that afterwards.

Berezin: If anybody has the logic designs, Ed Richards would have them.

Hendrie: OK. All right.

[**Berezin:** Later, long after this interview, Ed Richards found a photograph of himself with a blackboard and the chip layout marked on it in a worked-over image. I will get a copy and send it to CHM.]

Berezin: We were talking about financing the Company, so let's get back to it. I think I've told you that we raised, at various times, about $10 million of equity over a period of a few years.

Hendrie: Right.

Berezin: We also had a good relationship with the Bank of Boston. It saw itself as the experts that supported start-up companies. They had been very successful in Boston doing that very early on. So they set up a group in New York City to support start-up companies in the city. We had a Bank of Boston representative who worked with us, and because we were doing more and more rentals, we ended up borrowing $11 million by the end of 1975.

Hendrie: [SHARP INHALE]

Berezin: And the economy just fell out of bed, starting in about 1972. Interest rates kept going up. And when interest rates arrived at-- I think it was 18 percent -- it was costing us 23 percent for the cash required for a rental.

Hendrie: Wow.

Berezin: And you cannot make a living on that. You cannot make money when your interest rate is 23 percent. And so, really, because of the economy, which was falling into a terrible recession-- I think it was worse than the one in 2008-- we were in trouble.

We did have some luck; we had a cash business with Remington Rand and to agents all over the world, but particularly in Germany. But the pressure for money was impossible. We had equity of $10 million which we had spent. With such high interest rates on bonds available, no one would invest in any equity and we were living on the bank's money. And that cannot go on forever.

Hendrie: No, and you could not go to the market in '74.

Berezin: And we realized-- well, it isn't just that we realized the situation. Our Bank came to us and said they couldn't go on. We had to do something. And it turned out that a company, knowing that Boston was our bank, had gone to the Bank of Boston and asked if they could be introduced to us because they wanted to buy the company.

Hendrie: Right.

Berezin: Do you want to hear anything about what happened after this?

Hendrie: Yes. I want to hear the rest of the Redactron story. But then I'm probably running out of time because I have to pack up too.

Berezin: Well, I think the rest of the Redactron story is short. We were told by the bank to sell the company and they had somebody they knew who was interested.

Hendrie: And so who was this?

Berezin: Burroughs.

Hendrie: Oh, OK.

Berezin: The person who was doing the work for Burroughs was the retired former CFO who was on the Burroughs Board. He brought some technical people with him for a meeting in New York City, at a

lawyer's office. Surprisingly and fortunately, one of the people he brought with him was someone I had known from a previous life. And that turned out to be a big plus, because when you know somebody, you know whether you can trust them or not; important when you are getting hitched.

Hendrie: Yeah, exactly.

Berezin: Mitch Schwartz, who was the Chair of our Board plus the biggest investor, became one of the 2 Board members of the negotiation team. Our stock, before the collapse of the economy, was about $20 per share. After the crash , by the time of the negotiation in1975, it had gone down to 2-- as fast as the rest of the market.

I remember that we sold the Company for about $8 a share but during the tough times, we had been heavily diluted, so none of the people in the Company made a grand amount of money.

Hendrie: That you could-- that it should have.

Berezin: Yeah. But it did not. Start-ups in the sixties were good, but not in the seventies.

Hendrie: And so how many shares did you-- Do you remember what it added up to in terms of that $8 a share--

Berezin: Well, remember we also owed $11 million.

Hendrie: Yeah, so you have to subtract that.

Berezin: So it was $11 million plus about $15 million in share value. (I don't remember the actual number of shares.) So it sold for about $25 million, a very bad number considering what this company had done.

Gardner: OK. All right.

Berezin: At the time, I was distraught about it. Which I'm sure is why I now have so much trouble remembering the details of selling the company. About things like the company's finances, I was usually crystal clear. Now what I try to remember is that everybody else was going bankrupt in 1974–1975, and we were lucky to get anything.

Hendrie: It wasn't that bad. That's a lot better that zero, which is what happens when you go bankrupt.

Berezin: Most of the small companies like Redactron did go bankrupt at that time. In a way, we were very lucky. [The image that I have to this day is the enormous room that the Bank of Boston had on a low floor that hung out over the street, with all its windows and rooms of glass, so you could see groups of people in every room, looking miserable, and everywhere surrounded by clouds of cigarette smoke. There were meetings going on everywhere, in the halls, on the stairs, everywhere, and I suddenly realized that another basic problem was that it was the bank that was in trouble.]

Hendrie: Well, you had a valuable asset.

Berezin: Yeah.

Hendrie: OK, so now, what did Burroughs do with this company?

Berezin: The answer, really, is nothing. I mean--

Hendrie: There's sort of a story there, isn't there, about how you--

Berezin: Yeah, there is a story. In a short time I wanted to stop running Redactron because I wanted to get inside of Burroughs. I thought I'd like to get into the product planning department and see how a big company functions when designing new products-- I'd never worked for a big company. I also thought it was better if Burroughs got one of their people to run Redactron, and I spent my time trying to integrate the two companies.

Hendrie: Yes.

Berezin: I wanted to see how a big company worked. And I found it really shocking, just shocking. Their Product Planning Group consisted *entirely* of marketing people. The President of Burroughs, Ray MacDonald, was well known because he had set up a superb marketing organization. But he also had a great feeling for technology, a great interest in technology. But marketing people are notoriously bad at developing new products unless they are interested in and knowledgeable about advanced technology, as Steve Jobs was. If, like this Burroughs group, they have essentially no technical knowledge, how can the group imagine the jump to the next technical generation?

They cannot.

[You may be interested in a single incident in the Burroughs Product Planning Group that caused a battle between the head of product planning and myself. One day, the President of Canon, together with a troop

of about 8 or 9 assistants, came to Burroughs to demonstrate a new machine that they wanted to license to Burroughs. It was a printer version of the successful ink jet copier that Canon had developed some years before. After the Canon group left Burroughs that day, the Head of Product Planning at Burroughs said he did not want to waste time on this because such machines were not reliable. I protested that this was nonsense and that this was a great idea, and that Canon had demonstrated that the resolution they could achieve was adequate. About reliability, I tried to persuade them that Canon sold these machines very inexpensively and it was a very good bet that greater reliability could be achieved with some additional cost and intelligent design. It should be investigated. Burroughs Product Planning would not speak about it to me and turned it down. Hewlett Packard, who had probably been shown the system as well, built that concept into a printer business worth Billions of dollars. So much for Burroughs Product Planning. The only immediate consequence was that the whole product planning committee hated me because I made it clear that I thought they were idiots, which they were.]

Now back to the effect of Burroughs on Redactron. This was also a disaster, and it concerned the man who controlled engineering policy for the whole Company. What can I say? In my opinion he was incompetent. He had once, not long before this time, done something very smart and very important at Burroughs in the design of Burroughs previous line of Computers. He specified, and this was very early in the programming game, that everything was to be written in high level languages. It certainly had advantages for the big, fast machines that Burroughs was building at the time, but it was not suitable for machines like ours.

He told the engineers at Redactron that they would be fired if they wrote the software using anything but high level languages. Our Redactron people weren't doing that. All their operating systems and support and whatever were being written in--

Hendrie: Machine language. Absolutely.

Berezin: Absolutely.

Hendrie: In that era.

Berezin: Because it was fast. You had to run it fast.

Hendrie: And memory cost a lot. So--

Berezin: Burroughs at that time did not ever use machine language, they said, because they said the way to design accurately, completely, and without errors was to always design using high-level languages. They had done this on their machines and they had very successful machines-- good

operating systems, good software, and so on. Burroughs did have good support and also a very good service department. They had been in business for something over100 years, starting with calculators. MacDonald, the President of Burroughs, apparently bought the whole idea.

Hendrie: Yes, right.

Berezin: MacDonald was the important name in that company.

Hendrie: I remember that name. Now who was the technical guy? Was it Bob Barton, or no?

Berezin: No. Bob Barton was the guru. He was not in the Company anymore; he was a consultant to the company.

Hendrie: OK. He acted as guru.

Berezin: He was the guru, and he went around and commented on everything going on. And he was very smart and very interesting to have around, but he never did anything dealing with Redactron.

Hendrie: OK. Got it.

Berezin: He essentially advised Burroughs people. And he thought and commented on what people were doing. He was very good for the company.

Hendrie: Yes. He'd probably retired by then.

Berezin: Somebody else was in charge of engineering by then. And I have his face in front of me but I can't remember his name.

Hendrie: That's fine.

Berezin: But he was terrible for us because, as I told you, he immediately insisted that everything for the word processor be done in a high-level language. But our programs were fairly simple. His need for his big machines was not the same as our need. We could not tolerate the loss of speed that he was talking about, especially since we had already taken advantage of our lack of need for very high speed in the design of the system.

Hendrie: Yes.

Berezin: We didn't have very complicated programs to write compared to big machines.

Hendrie: Yeah.

Berezin: Well, he insisted. And Ed Richards, who was running the Redactron design group, was driven crazy. I told Ed to do what his boss said because Ed would be fired if he did anything different. My thought (which was stupid or at least naive) was that when the Burroughs Engineering maven saw the next word processor design run like it had a bad case of molasses, he would come around to doing it right-- that is, in machine code.

Hendrie: Yeah, OK.

Berezin: And so Ed wrote in high-level language. And if you pushed on a key of the typewriter, the character appeared five seconds later on the screen.

Hendrie: Yeah.

Berezin: And I couldn't convince that engineering manager, even with the evidence Ed could show him, that no, that's not the way to write code for this particular special purpose machine. And he said, you heard me. Everybody in your company will be fired if they do anything else. I said, all right. I'll do it your way. (I'm thinking, it's the end of the Company; everybody from Redactron will leave, including me.)

Hendrie: Right.

Berezin: I didn't want to be there anymore.

Hendrie: Of course you wouldn't. Because it was irrational.

Berezin: Nothing at Burroughs was rational. I told the management that I would like to leave. Someone from Burroughs was sent to run Redactron on LI. They also decided they were immediately going to move the Redactron Company out of NY State because they didn't want to be in a state where unions were common. I had told the management of Burroughs that I had fought off three different unions that tried to unionize Redactron and I had beaten every one of them.

Hendrie: OK.

Berezin:. And we had the most efficient factory in the country. And they--

Hendrie: Because there weren't any work rules, and you killed them by really taking care of the workers.

Berezin: That's right.

Hendrie: And being good to them.

Berezin: I have to tell you this. About 20 years later I was in the train going to New York City from my house on LI. And some fellow comes up to me, he's about my age, and he says, are you Evelyn Berezin? And I say, yeah.

He looked familiar to me. He said "I recognized you. I worked in your company. And it was the best company I ever worked for."

Hendrie: Oh, isn't that nice?

Berezin: I loved it.

Hendrie: That's great to hear.

Berezin: I was very happy to hear it.

Hendrie: You should be. You should be proud and happy. Very good.

Berezin: We had a great time. We just happened to start when the economy was due for a bad crash and we didn't have enough money to build it into a real company.

Hendrie: Yeah. The wrong time.

Berezin: We made a very bad mistake in thinking that we were in a sales business, not a rental business. We needed enough money to be able to finance that rental business. And we hadn't planned on it and, in

that terrible inflationary recession of the 1970's, I don't believe that we could have gotten that money in any case.

Hendrie: Yes.

Berezin: And that was stupid of me, particularly.

Hendrie: But--

Berezin: I suppose that one of the reasons I was so optimistic was because, before this, in the '60s, my friends raised money so easily-- you could raise money in quantity, and you did not have to pay for it with outrageous amounts of stock.

Hendrie: Yes.

Berezin: By the time we started, you couldn't do that anymore. Our timing was perfect in that respect.

Hendrie: Yes. Right. At a reasonable interest-- You know, just sort of--

Berezin: It's luck. It's just luck.

Hendrie: Yeah, yeah. Exactly. And the cash flow just didn't add up with those kinds of interest rates.

Berezin: OK. So let me go on about Burroughs. Working there, I had a number of ideas for Burroughs. And I tried to talk to some of the Burroughs people about them, and they said, oh, no, you can't do that. You can't do this. Effectively, they all said that I could do nothing.

Hendrie: Yeah?

Berezin: And I didn't figure it out until a few years ago-- I'm a pretty slow learner when it comes to these things-- that it was an "old" kind of company and had started many, many years ago. I seemed to be the only woman who was at a fairly high level there. Almost all the people I met came from the middle of the country, mainly from the South and Midwest and from small towns, went to small colleges, started at Burroughs after they graduated and stayed all their lives. And except for 2 technical people I met there, one of which had retired (Bob Barton), and the other was an advisor to MacDonald, they were not very smart. But the problem was, I realize now, that they thought I was from outer space, from New York City

of all things. I was not one of them. At the time, I was too confident and quite insensitive to that kind of man, and they were all men. Worse, I told them what I thought. A Loud Woman they did not know how to deal with, so they disconnected and so did I. By that time, I was over 50 and this kind of behavior had never happened to me before on anything technical and I felt that I did not have to stand for it.

Hendrie: Yeah, from where it ended up. Yeah.

[Berezin: I had two ideas for Burroughs that I still strongly believe could easily have increased Burroughs revenues substantially. One of them was about the Canon printer that I told you about earlier. The other was about the ATM's that only Burroughs and NCR were manufacturing at that time. These machines were just beginning to be sold, but only to banks. Again, the Burroughs people would not listen to me. My idea was that Burroughs did not sell ATM's only to banks, which is what they were doing then. Instead, I thought Burroughs should, using their own money, which they had plenty of, put them in Supermarkets and other stores and make arrangements with ALL (or as many as possible) of the banks in every town or neighborhood to use the Supermarket ATM, which would be free except for a very small fee per transaction, paid by the customer.

I still think it was a neat idea for its time, and that Burroughs might still be around if they had that business. I also think the only ideas Burroughs ever had was for what their customers told them they wanted. I did not hear a good idea anywhere while I was there.]

They bought Redactron and, as I told you earlier, destroyed the new machines we had been planning. And the only work they did was to take the ideas of the word processor and program them on a standard shared computer system that had terminals to be used as a word processor. And of course it wasn't successful. Secretaries were not used to anything but typewriters then. What I told them was ignored, and it was a good bet that it would fail. About 5 years later, the engineer who was second in command and who had retired, called me to tell me that I was right about my arguments. I heard him out but I had a pretty hard heart about it all.

Hendrie: Right. The terminal needs to have human interface--

Berezin: They needed a human interface that people could--

Hendrie : --that worked for them.

Berezin: -- And they just didn't understand the issues.

Hendrie: For being run by marketing people, that's very strange, isn't it?

Berezin: But they were marketing people for a computer company, not for secretaries.

Hendrie: Yeah, that's true.

Berezin: At that time the idea that a person who was a manager might give up his secretary because he could do it himself did not exist. The men did not want to buy those machines because they were afraid they would lose their secretary, which would mean some diminution of status for them. Our salesmen had to understand that problem to sell the products, but the Burroughs people didn’t seem to want to learn the issues.

Hendrie: Yes.

Berezin: That was a very tough problem in the United States. It was not a tough problem at all in Germany.

Hendrie: Really? OK. That's interesting.

Berezin: I thought that was interesting from a cultural point of view. Of course now almost everybody does their own typing.

Hendrie: Of course.

Berezin: But it happened gradually over 20 years or so. It didn't happen all at once in a flash.

Hendrie: Yes.

Berezin: OK. So how much time do I have? Do you want me to spend a few minutes on what happened afterwards?

Hendrie: Yes.

[**Berezin**: There was no way I could be effective in Burroughs, so I left in about 1979–1980. Sol Manber, the friend of mine whom I told you about and who had done so well with building two technical

companies, was interested in starting a small venture fund, with me as president, using an unusual kind of financing which turned out to actually inhibit the operation, so it was not appropriate. It was a trial, only about $10 million in size, and we did invest in a few companies, then sold the VC company to someone else who was interested in the companies.

I had found that being a VC was not something that I wanted to do. Dealing with a great many companies at once was not my ticket, although, over the many years following, I did go on the Boards of quite a number of small, start-up companies, for fun and profit, but not many at the same time.

Meanwhile, in about 1976 or 1977, I had been invited to join the Board of Connecticut General, a large Life and Health Insurance Company. I stayed there until my retirement in 1995, by which time the Company's name had become CIGNA. During the next few years I joined the Boards of Koppers Co., a large company primarily in building materials, and Datapoint, a company making the best distributed Computer Systems of the time. Unfortunately both Koppers and Datapoint were taken over in the merger (and money) hysteria of the late1980's. At that time, in the 1970's, the woman's movement was riding high, and companies were scrambling to get a woman on the Board, which is why I was on Boards of very old and very big companies.]

Hendrie: Absolutely.

Berezin: Companies were hiring the WIVES of people who were the presidents of companies. Did you know that?

Hendrie: No.

Berezin: You can't imagine the idiocy of what was going on.

Hendrie: Yes.

Berezin: So they had to find women who had done something, like being president of some company, no matter how small.

Hendrie: Yes, who actually knew something about business and something?

Berezin: And I had an advantage because I had a legitimate technical background in this hot new field.

Hendrie: Yes. You were on the board of Datapoint?

Berezin: Yes, but very, very late in the game.

Hendrie: Oh, OK.

Berezin: I found that they were already in pretty bad shape.

Hendrie: Oh, so Edelman, or whatever had already, quote, "invested," bought the company. Had Edelman done his thing?

Berezin: I was asked to join the Board by a Board member who was the former CFO of Burroughs, whom I had met while selling Redactron to them. The original Board was still there and--

Hendrie: Oh, I knew a lot of people there. . .

Berezin: Then Edelman came in and basically took over the company by getting 6 of his colleagues voted on the Board, while Datapoint, after the takeover, had 5. This happened about a year or so after I got on the Board, something like that.

Hendrie: Yeah, see I knew Ed Gistaro there and he did sales for many years.

Berezin: No, I didn't know him.

Hendrie: All right. OK.

Berezin: I remember the guy who had been the original technical leader, who was very good indeed, but he had left by the time I arrived.

Hendrie: He was a brilliant guy.

Berezin: He was indeed a brilliant guy. They made one big mistake that really hurt them.

Hendrie: Yes?

Berezin: It was clear as soon as I got there but by that time it was too late-- there was no way they could recover. Datapoint had made their system proprietary some years before. They had a beautiful system. It really never went down. But then Xerox had built a system they made available for licensing to anybody who wanted it for no money, and every company was grabbing it to use in their distributed system. It was a smart marketing move by Xerox because Xerox was behind it so people trusted it; Xerox could then sell their distributed computer systems and push Datapoint out. And the Xerox system, Ethernet, took over--

Hendrie: And ARCNET died.

Berezin: And Ethernet was nowhere near as good as ARCNET.

Hendrie: Absolutely.

Berezin: But what Datapoint had done was keep it private. So they wouldn't rent it out to anybody. It was proprietary.

Hendrie: They wouldn't let other people make chips for it or--

Berezin: Anything. And that turned out to be a disaster.

Hendrie: Yes.

Berezin: I knew the fellow who had designed ARCNET. I've forgotten his name though--

Hendrie: Yes, I have--

Berezin: I talked to him once about why they hadn't given the license away the way that XEROX did. And he said, well, it was the marketing people. They thought it would be better that way.

Hendrie: We have his oral history.

Berezin: Good. I would have liked to know what he thought.

Hendrie: We, in fact, my partner and I, went to Florida to get it [the oral history].

Berezin: From whom?

Hendrie: The fellow you're talking about. Whose name I can't remember either.

Berezin: Nice guy.

Hendrie: Yeah, very nice guy. Totally self-educated. No college degree.

Berezin: Really? I didn't know that.

Hendrie: Oh, yeah. He designed the ARCNET. And he and a kid designed the 8008 architecture. And it still lives today.

Berezin: But he was gone when I got on the Board and the person who was in charge of engineering-- of the design was not--

Hendrie: Very good.

Berezin: --not really up to the job. And just when I found that out, Asher Edelman took over the company. There were only 5 people on the pre-Edelman Board by the time things settled down. The original idea was that the original Board would stay on and would increase the size of the Board by bringing Edelman's six people in, so he had the majority. And it became apparent pretty soon that Edelman did not want to listen to anyone on the Board and he did not consider important the issues that we (the pre-Edelman Board members) considered important.

Hendrie: Yes.

Berezin: And so, not very long after, I talked to the original Board members for their opinion, and then I visited Asher in his office. And I asked if Edelman planned to run Datapoint including the opinions and cooperation of the people on the original Board? He said NO, he was not.

Hendrie**:** Right, there are no consequences.

Berezin: And I said that I would resign. So I just got off the board. And what's more, all the other people who had been there before Edelman, within a few months they all got off the board.

Hendrie: Of course.

Berezin: We just did not want that kind of relationship with him. And, you know, I was so naive at the time. I thought that when the five original Board members together leave the Board of a big, public company, it would be examined by the SEC immediately.

Hendrie: Yeah.

Berezin: I thought that the SEC would call up and say, why? They never did. They never noticed. There was not a single question to anybody of us on why did we leave this board, why did everybody leave at once?

Hendrie: Yeah. Well. It's a sad story.

Berezin: I know. It's a bad story. Anyway, all the other Boards that I was on never had any trouble. And I was on a lot of small company boards as well and enjoyed it.

Hendrie: Yes.

[In 1976 my husband and I had bought a house on the water in Long Island, right near Stony Brook University, and I became involved with the University. SBU was planned as a science-oriented university and was committed to new ideas, -- basic research and local economic development. About 30 years ago they built a new incubator to support the development of new companies.]

Hendrie: Yes.

Berezin: And the place was full from day one. [It's a pleasure to tell you that one of the first companies there was Renaissance Technologies, a Hedge Fund that was started by the head of the Math Department, Jim Simons, and it's still now one of the most profitable funds in the country.]

Hendrie: Really?

Berezin: Yeah. [SBU now has, I think, 5 incubators scattered around the area, and doing well.]

Hendrie: OK.

[**Berezin:** The Professor (Dick Koehn) who started the incubator ran the Biology department which was where so many ideas were generated. He encouraged it. The Dean of Engineering (Yacov Shamash) was similarly interested in making SBU into a Center for new development and new companies. The University convinced a number of people, who wanted to be helpful, to act as mentors to the new employers starting out. I agreed to help and it has been fun.

I have also been on one of the Oversite Boards of NYU, a very different situation from Stony Brook, but equally interesting. So I have been very busy all these years.]

Hendrie: Right. Absolutely.

Berezin: You should get ready. You've only got 10 minutes.

Hendrie: Yeah. I know. I need to wrap up because I have to pack up, too. But first, I want to say, while we're still recording thank you, Evelyn, so much, for doing this.

Berezin: It's a pleasure.

Hendrie: Your stories are wonderful. And it's good to have a record about the Redactron-- the earliest full word processor that we know about so far.

Berezin: And that first one was a computer.

Hendrie: And a computer with a single chip processor. So thank you.

Berezin: Yes, we can wrap up. OK.

END OF INTERVIEW

