Oral History of Jon Rubinstein

Interviewed by:
Dag Spicer

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Spicer: Thank you for joining us today, Jon. We're here today with Jon Rubinstein. It's August 14th, 2019. Jon, we're so happy to have you here today. You've been a friend of the museum for many years, and thank you for sitting with us today.

Rubinstein: Hey, it's my pleasure. You know, my history at the museum goes back. Dan'l and I were talking about this at dinner. So I don't think he realized how far the museum goes back, because I got here in the Valley in '86, and Gordon used to drag me over here to, like, not here but to Moffett Field to, like, haul boxes around when they'd get shipments from the Boston Computer Museum to here. So that must've been in, you know, '87 or '88, something like that, and--

Spicer: I think that was more around '96. Is that possible, that-- because I started in '96 and--

Rubinstein: No.

Spicer: --and Gor-- really? Okay.

Rubinstein: You know, I mean, I'm pretty-- I don't know. Mean, maybe I'm confused. I got to the Valley in '86. That I'm sure of, and I worked at Ardent, was my first job. So, you know, that was from '86 to '90, something like that, in '87. Maybe, yeah, no. Was '86 to '90, and I'm pretty sure that in that time frame we were hauling stuff around over there, so...

Spicer: <laughs> Okay. Well, we can come back to that.

Rubinstein: Yeah, it'd be interesting to find out.

Spicer: Yeah, yeah. Okay. Well, let's start at the beginning. Tell us about where you were born, what your parents did, and did they shape the way you looked at the world?

Rubinstein: So I was born in New York City. I grew up on the-- I was born and started off on the Lower East Side of Manhattan, and then when I was a little kid we moved to the Lower West Side of Manhattan. My mom was-- interesting history. So she's Israeli, and my dad had been over in Israel sort of helping out before the war, and my mom was, like, a Nursing Corps Second Lieutenant in the military, and also a member of the Stern gang, so she was sort of doing lots of different things while they were trying to get their independence, and so they got married and came to United States, and then a few years later I was born, so--

Spicer: What year would that have been?

Rubinstein: I was born in '56.

Spicer: Okay.

Rubinstein: So the war was in '48, so they probably, I think they wandered around Europe for a couple years trying to get a visa, and then once she came to the U.S., you know, I was born a couple years later. So she was a nurse originally. She worked as a nurse, you know, at, you know, in the hospitals in New York and my dad was an engineer, had a chemical engineering company, and basically, she started going back to school and ended up becoming a sociologist and ended up teaching at the Fashion Institute of Technology for 50-something years, teaching the sociology of fashion. My dad started a business and it was doing electroplating, sort of brush plating for repair of aircraft engines or, you know, cylinders on any kind of cylinder where the tolerances have to be tight or, you know, later on electronics, printed circuit board repair, that kind of thing.

And so I grew up in an environment where my mother was at school, you know, going to school all the time, because she, when she came to the U.S. she didn't have a-- she didn't really even have a high school degree, so she lied to NYU to get into do her undergraduate, because she'd gone to high school, or hadn't gone to high school in Jerusalem, and because of the war, the records had been all destroyed during the war and so it couldn't be proved one way or the other. So she just told them she had a high school degree and they accepted her to NYU and then she, you know, she went on to Rutgers to get her PhD and so she was in school a lot and my dad was doing his company, he was traveling a lot, and so, you know, I grew up on, initially on around 19th Street and First, Second Avenue, and I had couple aunts from Israel come over to take care of me when I was little kid. I went to public school. Think it was P.S. 40,which was across the street, and, you know, that was kind of my first couple years. You know, when I got a little bit older, around first or second grade, we moved to the Lower West Side, 26th Street and 9th Avenue, and I went to P.S. 33, so I continued public school, and, you know, from very little kid, I mean, you know, I sent you that Dilbert video [cartoon -- called "The Knack."] I mean, that was me, right? I mean, I was, you know, two years old, I was taking shit apart.

Spicer: The Knack.

Rubinstein: I got the knack, right, and by, you know, it took until six or eight or whatever to put stuff back together, but, you know, but I had the knack so--

Spicer: That's great.

Rubinstein: Went to public school through elementary school. I did one year at the local public school for junior high school, whatever it was. It was intermediate school, and that place was a disaster. I mean, it was-- the New York School system was bad anyway, but that place was really awful, and so my parents decided to send me to private school and I applied to a variety of places. I don't really remember any of this but I know it's what happened, and so for junior and high school I ended up going to Horace Mann, which was a fancy private school in the Bronx that you'd have to take the train an hour each way. Now they have buses for the kids, but in those days you took the subway, and so I took the subway up there and back every day.

Spicer: Can I ask, did you have a lot of spare time? You were an only child; is that right?

Rubinstein: I was not an only child.

Spicer: Oh, you're not an only child?

Rubinstein: I am not. I have a brother.

Spicer: Oh, okay. Can you tell us a bit about your siblings then?

Rubinstein: My brother is-- I have a younger brother and a younger sister. The sister's the youngest. My brother is also an engineer, but mostly he's a doctor. So he did his MD/PhD in Bioengineering and now runs the Bloedel Hearing Institute at the University of Washington Medical School and he does cochlear implants. He's one of the world's leading cochlear implant guys. So he did his PhD in, you know, nerve response to electronics and ended up doing cochlear implants. So he's, you know, he helps people hear again. I mean, it's really remarkable to watch the videos of people being able to hear all of a sudden, and of course it's a lot of digital, you know, digital stuff. They implant the electrodes and then they stimulate the electrodes with, you know, using digital signal processing, and so it's a constant software evolution and, you know, improving the algorithms to--

Spicer: We're going to get to this later but I wanted specifically the iPod ecosystem, but what do you think about, as you're speaking with this I'm reminded of hearing aids now are Wi-Fi enabled and you can actually control them through--

Rubinstein: Yeah, I think Bluetooth--

Spicer: Or sorry, Bluetooth. Yeah.

Rubinstein: --enabled, but yeah, yeah, yeah. In the old days they had plug-in things so you could actually plug your--

Spicer: So that's really--

Rubinstein: --iPod into the hearing aid.

Spicer: Oh, okay. I didn't know that.

Rubinstein: No. Yeah, yeah, so--

Spicer: But so we'll get to that later, but--

Rubinstein: Well, yeah, yeah, absolutely.

Spicer: But it's interesting that what the two Rubinstein brothers did, that's kind of <laughs>.

Rubinstein: Yeah. Yeah, and my sister's useless. So she grew up as a, you know, basically useless and continues to be useless, so...

Spicer: Oh, dear. Okay.

Rubinstein: Yeah. Yeah, she's got-- nothing to talk about her. But any case, my brother is, you know, he's done a great job and so any case, that's...

Spicer: Tell us about Horace Mann. So we'll just step back to where we were and what that was like for you. Did they encourage science and that kind of thing or more arts?

Rubinstein: You know, they really didn't. They really didn't, and in those-- Horace Mann's very different to it, and I was honored to get an Alumni-of-the-Year award a couple years ago and I went back and visited. I hadn't been many, many years, and the school's completely different now. It's got great science programs, robotics programs, you know, and it's, you know, it's co-ed. It was all boys when I went. It was, you know, it was a strange place when I was a kid, and this was the, you know, late '60s, early '70s, because I graduated high school in '74, so the world was going through a dramatic change. You know, Horace Mann was in those days sort of following the British system of molding young men, right, and there were, you know, there were group of us that were not particularly moldable, including me, and so it was a difficult experience and, you know, they didn't really encourage science, per se. We had no computers, which seems today to be, I mean, ridiculous. How could a high school not have any computers? But there was nothing on the technology side. I got involved in the theater, because that was the closest you could get involved with technology. Not on the acting side of things, but on the technology side, so I did, you know, set, construction of sets. I did lighting, you know, lighting design, lighting for shows. For my senior project I redesigned the sound system for the theater, so we threw away all the old, they had really old stuff, and me and my best friend at the time, you know, took this on as a project to completely rebuild the sound system for the theater, so--

Spicer: That's pretty serious project for some high school students.

Rubinstein: It was a really serious project, and it was great. I mean...

Spicer: Wow.

Rubinstein: For one, I didn't have to go to class, which was the best part, right, but I learned a lot, right, so I mean, you learned about basic project management. You learned about procurement, because we bought a lot of shit, right, and we bought a lot of wire and amplifiers and, you know, all kinds of audio equipment and speakers and, you know, we did all the wiring. I mean, it's not like you went and hired an AV guy like you did today. We did all the wiring ourselves, all the, you know, in those days was a minimum amount of programming, but, you know, all the programming, and so was a full project start to finish, so it really gave me a good sort of idea of what it takes to do a project from beginning to end. I don't think the school actually intended for me to get quite as much experience out of it as I did, but we went way overboard and, you know, I was very good friends with the teacher who ran the theater, and he

kind of gave us an open checkbook, and so we kind of went wild and, you know, the stuff we did lasted for, you know, for over 30 years. I mean, they--

Spicer: Oh, that's amazing.

Rubinstein: --basically tore out the whole theater, you know, in I don't know, 10, 15 years ago, but when they tore out the theater and rebuilt it, I mean, literally a whole new building and everything. It's beautiful today. The stuff that we had done was still there and operational all those years later, and, you know, was easy for anyone to debug because we did such a good job on the wiring and everything was really clear and labeled. I mean, all the things you'd expect from a high-end audio kind of job and, yeah, we did that as, you know, 17-year-olds and, you know, in high school.

Spicer: Okay. So I have to ask, how did you get from a kid to being-- how did you acquire the skills to do that as a kid?

Rubinstein: You know, I had the knack, right. So, you know, as a six-year or eight-year-old, whatever, I started doing Heathkits and, you know, that kind of stuff. You know, I, about seven years ago, eight years ago, I took up golf, right, and I'm terrible at it, right, and it's very frustrating, and some of my friends who I play with have children who, like, are really, really good, you know. I mean, you know, 14 years old and they're fabulous and I'm like, "Well, how you get to be so good?" you know, "How you get to be so good?" and they go, "Well, you know, I went to golf camp this summer," and I'm thinking to myself, "Golf camp? I didn't get to go to golf camp. I had to go to science camp," and, like, you know, I went to the Dalton Science Program in the summers, you know, I did that. I hung, I mean, I worked as a bike mechanic for a bunch of years, right, and, I mean, basically from the time I was probably 14 I was working as a bike mechanic in the summers, right, and I learned how to do bike mechanics at American Youth hostels. They had a training program, right, so, you know, I don't know. I was probably 13 years old I went to the training program. I did a cross country trip with them, so we went from New York to Portland, Oregon on bikes. It started off with 12; we ended up with probably 8, but was great trip. Was great trip.

Spicer: How old were you when you did that?

Rubinstein: Probably 14.

Spicer: Wow.

Rubinstein: Yeah, and my wife goes, "Who in their right mind would let a 14-year-old go--" I mean, we had, you know, no cell phones, we had no sag wagon. It was us and, you know, and two, you know, two people to keep an eye on us and they were, I don't know, 18 or 19 or something, right?

<laughter>

Rubinstein: Interesting enough, they still run the-- it's not American Youth hostels anymore, but they still run that trip. It's a little fancier than it used to be, but it's still you're kind of on your own.

Spicer: Wow, that's a serious...

Rubinstein: It was great. But so any case, I learned to be a bike mechanic. I worked in bike shops, various bike shops in Manhattan, you know, every, you know, during the year and during the summers and stuff. I rode a lot. I mean, that was my big thing is I really liked to ride bikes in those days and so, you know, so that was sort of the mechanical side of things. The electronics, you know, sort of came from doing Heathkits and, you know, reading stuff and, you know, the audio was trying stuff out and, you know, we had Radio Shack and Radio Shack equivalents in the neighborhood. We had a-- there was a lumberyard, like, four blocks away, that's still there. I walked by it the other day. I was over at Peloton visiting the guys there, and two blocks-- their office is, like, four, five blocks from the apartment I grew up in, and, you know, the lumberyard that I used to go buy wood from, still there after all these years. Amazing. So I don't know. I just kind of picked it up, and then hanging around the theater. I got to do lighting and I got to do, you know, audio and it just sort of came natural. No computers yet though.

Spicer: So one thing that some professors of engineering have noted is that, in electrical engineering that I've spoken with, said when we had met people who were hobbyists, as in their-- to the program, they actually seem to do slightly worse than <laughs> people who have no background. Now, this is as a general rule.

Rubinstein: No, no, could be. It could be.

Spicer: And this could be possibly because they're overconfident was the suggestion, but did you find your knowledge to be helpful when you went through engineering, maybe in the final years more on the practical side or...?

Rubinstein: Yes and no. Yes, yes. I mean, I would, you know, probably agree with that a little bit. So, you know, I did theater all through high school, right? Or not all through, but the last couple years of high school I did theater. I did summer stock theatre after high school, and I was technical director of a summer stock theatre, so that kind of encompassed everything. In Upstate New York I did that, and so I got to Cornell, and so my first thing was, you know, "I'll go hang out at the theater," and I went to the theater and the theater was not interested in some engineer, you know, some ratty-looking engineer hanging out there, right, so they kind of rejected me, and so I had to find something else that, you know, sort of, you know, intrigued me, and I ended up going, hanging out at the radio station, which kind of filled in the need for doing, like, tech stuff, and so through a lot of my, you know, college years I worked at WVBR, and again, not on the air, but, you know, as one of the techies, and so that was really fun. As far as school went, well, so, I mean, my first year was, I mean, a disaster, right? I mean, my first semester I got, like, four D's and an A. Got A in Computer Science. I got four D's, you know, Math, Physics, Chemistry, whatever. I mean, all those other things, because it wasn't interesting. So I think-- I don't think it was overconfidence. It was that I wasn't stimulated, right, and-- because I was already kind of beyond, you know...

Spicer: That's a more sensible explanation, actually.

Rubinstein: I mean, I have to say that, you know, there's probably a bunch of stuff I didn't learn when I was at-- didn't learn well enough at Cornell in those intro classes that, you know, but I don't really use them today, right? I mean, there's a lot of math that--

Spicer: Yes, you never use again. <laughs>

Rubinstein: --you know, now, you know, I mean, today I hang out at a quant hedge fund in New York, and we'll get to that later, but, you know, those guys use, I mean, I look at the math they use and it's like, "Phhth." You know, and I'm a, you know, I'm a pretty good engineer and I have really good math background and it's like way over my head, you know, from anything, so yeah. I mean, I would agree with that, right, and the first couple years at Cornell were bumpy for me, because it was all kind of background stuff. So as long as I was doing computer science or circuit design, those type of things, it was, you know, it was great, and interestingly I did really well at, you know, Einsteinian physics, quantum physics. For some reason that just kind of clicked. Newtonian physics, not so much. Who knows, right? It's weird, right. It's however your brain works, but once I got through the introductory stuff, the first two years, then it just kind of, I mean, it was a rocket ship for me. I got to absorb so much stuff and, you know, taking computer architecture classes, you know, and electronics classes and digital signal processing classes and all those, I mean, it was just great, and-- but I hadn't seen my first computer until first semester freshman year, where I took Computer Science 101. It was--

Spicer: Sorry. What year would this have been?

Rubinstein: Nineteen seventy-- I graduated high school in seventy-four. So went to Cornell in '74; '74-'75 was my first freshman year there, and the computer thing just, like, it was love at first sight, right.

Spicer: Mm, what computer was this, a mainframe or...?

Rubinstein: Well, it was-- yeah, it was a 370 [IBM System/370], right, and, you know, we wrote in PLC, right.

Spicer: I don't know that one.

Rubinstein: Yeah, yeah, it's a long time ago.

Spicer: <laughs>

Rubinstein: You know, it was a Cornell version of PL1, right, was PLC, and so we started off in PLC and then when you got into the heavy shit, you basically ran on a 360 emulator. You know, did assembly language on a 360 emulator. I mean, that was, you know, for the--

Spicer: The emulator was running on the 370?

Rubinstein: It was running on 370, yeah. So everything was punched cards, and, you know, and printed outputs, right, and whatever it was, it just clicked, right, and, you know, that really-- so I took a lot of, you know, those kind of courses, you know, obviously digital design. But, you know, in those days we had to take motors and power systems and all that stuff, so, I mean, I have a, you know, had a full-- labs and background and big motors and switches, you know, these big knife switches and stuff.

Spicer: Switchgear. <laughs> Yeah.

Rubinstein: And, I mean, it was interesting. Again, not something that, you know, ever used again, but a little bit different. I don't think they have that requirement anymore. But engineering was tough at Cornell. It was a hard program. It was a really hard program, so, you know, the first couple years I struggled with it, and then I kind of hit my stride and it was, you know, easy from there. I, when I was going to graduate from college, I didn't really, didn't feel like I wanted to go to work yet, and so the easiest thing was just to matriculate straight into a graduate program, and so I decided do the Master's of Engineering program, which is a one-year program, and, you know, I stayed <inaudible> because I was working there at the time.

I was working at one of the first ComputerLands [a retail personal computer store]. So I had, I don't know, was probably junior year maybe, I had taken a course on city planning. I know that sounds weird, but the cool part about it was it ran in a simulation that had been done by, you know, I forget which government agency [EPA]. It was, you know, it was environmental response to what happens in a city, and so it had a full simulation of a city with, you know, you got mayors, you got real estate developers, you got, you know, you got all the different aspects of a city, and we'd meet as a class once a week and we'd put our inputs in for that simulation. It was a big batch simulation that ran. Was a big simulation, and, I mean, not compared to today, but in those days it was big, right? I mean, it would take, you know, a day or something running on a, you know, on a 370 to finish or whatever, so--

Spicer: Wow. Is that like SimCity today?

Rubinstein: No, it was long before that.

Spicer: No. No, I know it's long before that.

Rubinstein: Yeah, it was a similar kind of thing. Yeah.

Spicer: But it's a simulation.

Rubinstein: Yeah, same kind of thing, except it was more focused towards environmental, you know, sort of what happens to the environment around a city when you do various different things? Right. Because it was written by that part of the government. But it was a great class, and it was really fun because, you know, you got-- you really got to learn about simulation and how that all worked, and I think I was a real estate developer and, you know, it was really fun. But the big thing was the woman who ran it, her

husband was one of the senior IT guys at Cornell, and together they opened this ComputerLand [store]. It was one of the first ComputerLands in the U.S., and I was one of their first employees, right, so...

Spicer: How old would you have been, 21 or something?

Rubinstein: No, not even. I graduated when I was 20, so I would've been, you know, 19 or 20 at the time.

Spicer: Okay. So hold on now. You graduated 20, that's not normal. What happ--

Rubinstein: Well, I was 17 when I went to college. I--

Spicer: Did you--

Rubinstein: No, I never skipped. It was just sort of--

Spicer: You skipped a grade or...?

Rubinstein: --October baby and just timing worked out.

Spicer: Okay. That explains one year, but not two. Anyway, yes, that's good. <laughs>

Rubinstein: I think I was 17, 18, 19. Yeah, I was 20 when I graduated.

Spicer: That's pretty young to graduate, 20, but anyway.

Rubinstein: Yeah, because I did ungraduate. I mean, I was 21 when I grad graduate school, but...

Spicer: Okay. So you started at ComputerLand--

Rubinstein: Yeah, started working part-time at ComputerLand, which was great, so we had, you know, in those days it was IMSAI 8080s and Cromemcos. I mean, you got a bunch of that stuff downstairs, right, or at least in the warehouse, and Apple IIs, right, and so I started off as the guy who actually was in the back room assembling this stuff. Because it came all as kits. Didn't come... The Apple II came pre-assembled, but everything else came as kits, and--

Spicer: And people who walked into ComputerLand, they were not hobbyists.

Rubinstein: Mm-mm.

Spicer: They didn't want kits. They wanted a--

Rubinstein: Mostly was sold for business stuff.

Spicer: They wanted a solution.

Rubinstein: They wanted a business solution, and particularly the Cromemcos were sold-- IMSAIs were more sold as a hobbyist thing, but the Cromemcos were sold as a business solution, and they had basic, you know, sort of inventory kind of packages and stuff like that on it. I mean, was very primitive. It was very primitive. I mean, to boot an IMSAI 8080 you have to toggle in the, you know, the boot sequence, right.

Spicer: I know. <laughs>

Rubinstein: I mean... <laughs>

Spicer: Were you out on the floor or sort of in the back?

Rubinstein: Well, I started in the back building this stuff, and, you know, I'd assemble it all, and then, you know, I'd repair it when it broke and I'd repair Apple IIs and, you know, I think Woz screwed up the keyboard chip or something or didn't do something, because the keyboard chip would always die. It was up on a second board above. It was too hot. I don't know what. I don't remember what the problem was, but that was like the biggest failure mode.

Spicer: How did you learn to fix Apple IIs... or anything, for that matter?

Rubinstein: Just had schematics. Just had schematics.

Spicer: Just work your way through?

Rubinstein: You work your way through it, yeah. Right. I mean, you have scope and a, you know, analyzer and--

Spicer: No special reference material or...?

Rubinstein: No, they didn't have any of that in those days. Yeah, you just had to fig--

Spicer: Troubleshooting guides or anything.

Rubinstein: Just had to figure it out. Yeah. Just had to figure it out.

Spicer: Thank you.

Rubinstein: So yeah. So I worked there, and then I ended up on the sales floor as well, selling computers, and so for the last couple years I was at Cornell I worked there, you know, summers and weekends and nights and, you know, that type of thing, and absolutely loved it. It was great, right, because I was working with real computers, not this big, you know, mainframe thing that was hidden.

Course, by then we'd gotten, you know, TI Silent 700 terminals and stuff for the 370 so you could actually, you know, actually do stuff at home and I did my master's thesis in computer controlled adaptive filtering, so I had, you know, smaller computers to work with there, well, what were in effect microprocessors. We had PDP-8s and, you know, stuff like that. You know, all those smaller systems that were, you know, old. But, you know, I did a lot of what I did on the personal computers. I mean, it was pre-personal computer, but, you know, at the time we're hobbyist computers or, you know.

Spicer: So did your work on the computers spill over into your graduate work at all?

Rubinstein: Yeah, yeah, because I used the same stuff. I mean, I did my adaptive filtering work on an IMSAI 8080.

Spicer: Right, and could you just tell us a bit more about what that's for? Is that a form of signal processing or...?

Rubinstein: Yeah. Yeah, yeah, yeah, yeah, yeah, so--

Spicer: And how would you use that?

Rubinstein: Well, it's like-- you remember the TI Speak & Spell?

Spicer: Yeah.

Rubinstein: The TI Speak & Spell was the first product that used, you know, a TI DSP to basically do voice synthesis, right, and, you know, the work I was doing was kind of the precursor to that and that product came out, you know, shortly after I graduated, I think, or right around the time I graduated, but I remember looking at going, you know, "Wow, this is really cool," because they basically integrated all the stuff I was doing. But basically it was a, you know, digital signal processor that would, you know, have adaptive filtering, and so you could use it for a variety of things, speech was one, you know, creating human speech was one, but I was funded by a DARPA grant and it was for low-frequency communications with submarines, right, was what they wanted it for, and my professor and my advisor was both at Cornell and he worked-- I think he was at TRW. Was, you know, was visiting professor or whatever at TRW in-- because they were on the same, I mean, I remember visiting them and they were on the same government contract that my DARPA grant was on, so... But, you know, basically pre-DSP DSP work. I mean, it was all CCD bucket brigades with feedback loops and you, you know, you tap off each tap of the CCD and you'd adjust the, you know, with--

Spicer: RC networks?

Rubinstein: --A to D converters or whatever. You would adjust the feedback of the, you know, from the whole loop and the computer would do this all real-time and they'd monitor the output and adjust all the coordinates and parameters and stuff real-time.

Spicer: What was the mix, like, were you kind of unique in using a personal/microcomputer for your graduate work as opposed to other students who may have went to the mainframe?

Rubinstein: Yeah, I don't, I can't, I mean, most people used the PDP-8.

Spicer: Oh, PDP-8, okay.

Rubinstein: PDP-8 or '11 [PDP-11]. I guess we got an '11 sometime in there towards the end of it.

Spicer: So your department had some mini--

Rubinstein: Yeah, we had a bunch of minis. Most people used, did stuff, on the minis. Yeah, I was pretty unusual in that, I think. I was big into the, you know, sort of hobbyist computer movement at the time, right, so that was really good, and so yeah.

Spicer: Okay. Moving on. Any major events either in your life or in the world at large that influenced you--

Rubinstein: At that time?

Spicer: At that time.

Rubinstein: Well, I mean, the world was going through a dramatic transition. I mean, I got to Horace Mann we were wearing coats and ties, right? And, you know, we were, you know, Future Leaders of America kind of stuff, right, and a year or two later out went the coats and ties. By the way, we used to leave the coats and the ties at the school, right, because you'd get beat up on the subway if you wore a coat and tie, so, you know, and a lot of times people left their shirts in school too, so you can imagine how bad everyone smelled after a couple of months of wearing the same clothes every day. But a year or so in they got rid of that.

I mean, the world was changing. I mean, the Vietnam War, like, had a dramatic impact. You know, the, you know, it was, you know, the United States was going through dramatic changes. The whole hippie movement and all that really had an impact on it. I mean, I went to, you know Communist summer camp when I was a kid, like, when I was a little kid and stuff. You know, it was, you know, it was very socialist or communist or whatever. Very peace, love and Woodstock kind of place, and so, you know, that all had a tremendous effect on me, and I think it's one of the reasons that Steve and I resonated, Jobs and I resonated so well when we first met, was we'd kind of had a similar-- I actually finished my education, but we had a similar <laughs> background from that kind of perspective, of having those years impact us, and so that had a huge impact, and the-- I think from a high school point of view the, you know, my theater professor had a huge impact. I mean, he was just great, and he was not only my teacher but he was my friend, and we remained friends for many years after, you know, until he unfortunately passed away a bunch of years later. But he had a really big impact, and-- but the times are really changing, right, and the Civil Rights Movement was going on, you know, the getting out of Vietnam, the, you know, and I

was sort of, you know, when I graduated from high school I was at the very tail end of, you know, the draft had just ended and, I mean, you know, that stuff was scary, you know. Yeah, yeah.

Spicer: Did the space program have any impact on you?

Rubinstein: Of course. Of course it did.

Spicer: Tell us how that affected you.

Rubinstein: Well, I mean, you know, watching people land on the moon and circle the earth and all that stuff, and the tremendous focus on scientists and engineers really legitimized that as a path. I mean, I'd always wanted to be an engineer. I just didn't know what it really meant. I mean, intuitively inside. But to see what they were accomplishing, the white shirt thing didn't grab me, but, you know, but it's interesting, because if I'd been born, you know, I don't know, five years earlier? Right? I mean, today I'd be working at IBM wearing a white shirt and pocket protector, right.

Spicer: <laughs>

Rubinstein: So it was, you know, it was really a, you know, 5 or 10 years earlier it would've been completely different. So I was very much a product of the times, right, and, you know, there's that book about the-- Malcolm Gladwell's book about the timing of everything and, you know, I mean, Steve, you know, Jobs and Gates and, I mean, those guys are year or two older than I am, but we all kind of came through, you know, at the same time, through the same period of both upheaval in society and the technology shift that was going on. So it was a great opportunity.

Spicer: Couple of related questions, related to television programs.

Rubinstein: "Star Trek," first season.

Spicer: You took the words out of my mouth.

Rubinstein: Wouldn't have missed it.

Spicer: "Star Trek" and "Mr. Wizard." Did either of those impact you, and if so--

Rubinstein: "Star Trek."

Spicer: --how?

Rubinstein: I mean, I was, like, a Trekkie. Like, just glued to it, right? I would never, I mean, I watched the first season. I would never have missed an episode. It was so, I mean, so eye-opening, right, and, I mean, still is today. I mean, if you look at a lot of the products, you know, the precursor came out of "Star Trek," right, and I remember talking to the guy who used to run the T. Rowe Price Technology Fund

[David Eiswert], and I'm like, "Well, what's your major investment thesis?" and he goes, "If I saw it in 'Star Trek,' I invest in it." "Ah, but I'm serious," right, I mean, and he was sort of serious, right, so-- and he's done very well, and so it's a good investment strategy. But yeah, no, "Star Trek," absolutely. "Mad Scientist Club." Great book. Great book. It is out of print, but you can find copies of it, because I bought a copy recently for someone, and, you know, it was a book about a bunch of high school kids doing science stuff, doing cool science stuff, and it was really fun. You know, big impact on that, and, you know, and look, you know, I also had my dad's factory. I mean, in those days his factory was in Manhattan, off of Union Square in an old industrial building, which is now all condos. I'm not sure I'd want to live in one of those condos because they use, you know, arsenic and all kinds of other poisons were just poured down the drain in those days and, you know, scary stuff, but, you know, it was a big chemistry lab basically, because it was all chemicals in laboratories and stuff like that, so I got to-- that was kind of my playground.

Spicer: Right.

Rubinstein: Yeah.

Spicer: Well, that's great, so just moving on here. We've actually managed to scoot through a bunch of questions, which is great.

Rubinstein: I mean, my bedroom when I was a little kid was a disaster, right, because I had a workbench.

Spicer: Oh, yes. Tell us about that.

Rubinstein: Well, I mean, you know, was like no other room. I had a workbench and I had all kinds of equipment on it. I had all kinds of tools and, you know, there was a little room for my bed, but most of it was, you know, places to work. I had hooks hanging in, I mean, I grew up in apartment on the 21st floor of an apartment building in Manhattan, right, so, you know, it was a small, small apartment, and my brother and I shared a room but I-- kind of half the room I built a divider, so I had my own space and, you know, I had hooks hanging from the ceiling to hang bicycles from so I could, you know, work on the bicycles and I had a workbench with all my electronic stuff and other tools and, you know, for working on bikes and, I mean, it was mostly a workshop with the beds kind of in the corner of it.

Spicer: <laughs> That's great. All right. Let's see. Okay. Colorado, I guess. Would that be the logical next step, when you went there?

Rubinstein: Well, it was interesting, because I didn't want to graduate, you know, undergraduate, so I went to graduate school, and when I got done with graduate school, the program there, I was ready to go to work. So I interviewed at probably 10 companies. It was interesting. You know, round up the usual suspects, right? Intel, and it was interesting because when I got to Intel the interview questions were about their development systems. This wasn't the microprocessor group. This was the group that built the systems you used for actually doing development, and--

Spicer: The Intellec, I think it was called.

Rubinstein: Yeah, I forget what they were called, but yeah, the old development systems, and so we were going through the schematics as part of the interview process and, like, you know, I mean, this stuff, I mean, I've been doing this for a couple years already, right. You know, these small computers, and, you know, based on Intel processors and other processors and stuff and so we're going through, you know, so I'm going through schematic and like this, this, this, this, and I get to this one page and I go, "I have no idea what this is," right, and everyone around the room looks at it and they all kind of look at each other and go, "We don't know either," right.

So there was some circuit in there that had a, you know, one page that nobody knew, but so I blew through a whole bunch of interviews and I got a bunch of job offers, but, you know, I really wanted to build personal computers. This is pre the PC industry, but, you know, small computers that people could use, and I ended up in Fort Collins, Colorado, interviewing at Hewlett-Packard at their Personal Systems-- it wasn't called Personal Systems. It was called-- it was the Workstation Division [Desktop Computer Division]. I forget what it was called in those days, but it changed names a few times, but basically it was their Engineering Workstation Division, and working on the lower end, you know, engineering workstations, and so I got to Fort Collins.

I, you know, having grown up in Manhattan, I get off the plane and, you know, you're in Colorado and it's like, "Oh, my God, this place is so gorgeous," and, you know, Fort Collins was probably 40,000 people at the time, mostly, I mean, was three things there. There was the university, Colorado State. There was a company that made gyroscopes for, you know, military stuff, Woodward Governor, and so they had tons of high-end machinists doing these things, and then there was Hewlett-Packard's Systems Division there, their Workstation Division, and that was kind of it there, and, you know, but I got there and it was like, "This is it. I'm going to go build small computers," and so I accepted the job offer there, and turned down everybody else, and flew to Fort Collins and started working there.

When I got to Fort Collins, the first project I was on was actually doing software for networking stacks, and I'm like, "I don't want to do networking stack software. I came to build computers," right. "I mean, maybe I came to the wrong place," and I, you know, "I got other-- I mean, I could call DEC or Intel or one of these other companies up and say, 'Hey, I changed my mind, can I come?' and I'm sure they would take me if, you know, if you guys, you know, want me to do this stuff." So basically, I threatened to quit, mean, in a nice way, and they went, "No, no, no, no. Look. We'll get something else. How about you go down to Production Engineering for a little while and then we'll find the right place for you, right, when a spot opens up in one of the computer design groups?" I'm like, "Well, I don't love the idea, but okay. I'll go do that." Best move I ever made. So I moved down-- so in those days in Fort Collins the second floor was engineering and the first floor was a factory, and we made computers, right. I mean, not the raw PC board. That was done in Boise, Idaho, in HP's facility in Boise. They actually fabbed the PC board, but we got the raw PC boards and we loaded the parts and, you know, and we had production lines and, you know, we'd assemble the stuff and ship it from there. I mean, was amazing.

Spicer: Do you remember any model numbers that you were working on?

Rubinstein: Yeah, sure. I mean, you know, I worked on the-- well, so when I got there they were just releasing the 9826, and--

Spicer: And that is a workstation?

Rubinstein: That was a workstation. Yeah. Small screen, dual floppy, keyboard attached workstation, and I came back to engineering and I did the 9836, and then I did the HP9000 Series 300 and-- Series 300-- I think it was 310, 320, I forget. But there was that whole series of workstations that I did when I was there, but in production I was doing, you know, some of the earlier products just before that, so it was 9845. Some of the early 9835/45, 9825 Series.

Spicer: By the way, the first time we met was you coming over to the warehouse with a bunch of these.

Rubinstein: With some of these. Yeah, and I brought a whole bunch--

Spicer: <laughs>

Rubinstein: Yeah. Because I had a bunch of that stuff, I bought it.

Spicer: That was great.

Rubinstein: HP used to sell, like, once, twice a year, they get rid of excess inventory or the old, old things, right?

Spicer: Oh, do they? <laughs> Wow.

Rubinstein: And they'd have a big sale in the parking lot and you could buy whatever you want.

Spicer: Really?

Rubinstein: Yeah.

Spicer: Just for employees?

Rubinstein: Yeah, for employees.

Spicer: Wow.

Rubinstein: Now, what they didn't know was we had a gray market between all the divisions, right, and so anything you wanted you could basically trade for. So, you know, we had computers, so we were constantly building up computers, and, you know, Instrument Division had scopes and all that kind of stuff and then there was the, you know, the guys doing digital analyzers, and they had their stuff, and so we would all trade. So there was a going rate, you know, for each of these things, and we'd all trade for stuff

and you'd basically stick them on a Greyhound bus to ship them, right, and you ship them to the other division and they would ship you whatever product you want, and this was, you know, for all of our home use. So we all had, I mean, you know, I was there seven years.

Spicer: Really nice home laboratories.

Rubinstein: We had really nice home labs, yeah, really nice home labs.

Spicer: <laughs>

Rubinstein: So any case, so I spent almost, you know, sort of a year, 11 months, 3 days, 4 hours, 2 minutes in production. I mean, I loved it and hated it, all right, and I ran the Auto Test group, and so that was a time when HP was developing production line test equipment, right, so at that time I think it was like the DTS-70 or something, and these were bed and nails testers, right, and you'd put the PC board on the tester and the vacuum would suck it down onto the fixture and then it would test both analog and digital on it, and they'd just started shipping these out of Loveland [Colorado], and so I took over the group and so I had, I mean, you know, I mean, I was right out of college and I had a bunch of people working for me, so I had both test technicians on the line and I had programmers, right, working for me, and--

Spicer: How many people would you say?

Rubinstein: I don't know, dozen people or something like that?

Spicer: Is this kind of your first serious management--

Rubinstein: Serious management, yeah.

Spicer: Management role? Yeah.

Rubinstein: Yeah. Right, and so, you know, we did, you know, we ran this test group and then we were an alpha site for the HP360 tester, which was their next generation one, which was very well done, right, and so basically, we program this thing to, you know, to test all the different boards that, you know, in manufacturing. So I learned so much about manufacturing, you know, because I was part of the Production Engineering team, right, and having spent almost two years there, I learned all the things not to do. It made me so much of a better designer. It was really a phenomenal experience that I never would've chosen to do on my own.

Spicer: Can you give us one example of how that made you a better designer?

Rubinstein: Well, you learn all the things that don't work, right, because people make mistakes and, you know, or how to prevent, you know, how to prevent failures, right. So there's-- at the time HP was just getting into the whole quality, you know, how to improve quality of products, right, and things that now we

all kind of just, you know, are natural, you know, doing statistical quality control and all of that. You know, lot of stuff that came from Japan, right, HP was just starting to adopt that, and adopting some of it from the military, you know, and so we learn about all of that stuff there. I mean, they had very good training, and we were also doing a lot of research into what works and what doesn't work, because, you know, we could build 50 systems and put 15 in three different environments and keep 5 out of the environment completely and be able to run a broad set of tests, because it wasn't like today where, you know, you put the-- you plug the last part in and an hour later it goes out of the factory, right. I mean, it would take us a long time to build these things and we had lots of test time and we would test for days and days before they would ship, you know, in ovens and all that kind of stuff, right. So, you know--

Spicer: Did you learn things that you later used or--

Rubinstein: Oh, absolutely.

Spicer: --next in--

Rubinstein: You between. Absolutely. You know, a lot of the stuff that I learned about developing processes, of how to develop-- both how to develop products and how to ship products, I got the foundations, you know, learning at HP, and HP was lifting it off of Xerox PARC and some of the military stuff that was going on at the time and it was really interesting. It was an interesting time to be there, so this was sort of '79 through '86, right, and it was a very formative time in the computer industry for learning how to do mass production. I mean, not mass production how we think of today because we would build 25,000 systems a year, but, you know, it was no longer handcrafted, one-at-a-time kind of products, it was we had production lines, we had, you know, we had automatic testing capability. We had burn-in facilities. You know, we had all of that and how to optimize that. You know, does it make sense to burn in for an hour, a day, a week? You know, where does the curve fall off? And, you know, when I got there we were doing all of our-- well, so any case, after the year and 11 months and couple of days or whatever, I went back to engineering and then I was working on a project, and that was the 9836, which was a [Motorola] 68000-based workstation, and in those days we would lay out PC boards by hand, using tape and stuff. It was ridiculous.

Spicer: Tell me, how big was the team that worked on that machine? Were you the architect or the designer or how did you--

Rubinstein: No. I was doing one of the subsystems, right.

Spicer: How did you contribute?

Rubinstein: I was doing one of the subsystems. I was doing the floppy subsystem. Was dual floppy and so I was doing the floppy subsystem, but I got involved in the whole thing and I quickly evolved into being one of the lead architects for the low-end workstation, oh, the 68K, you know, the commercial microprocessor workstation group, versus the other building [which] had the team that was doing all of the HP developed processors and the products based on that. I forget the name of the processor, but that

ended up being HPPA [[HP Precision Architecture] and all of that. But I ended up being the architect of the workstation, of the commercial microprocessor workstations, which were all based on 68K family stuff.

Spicer: What's the single most important decision a computer architect can make?

Rubinstein: Balance.

Spicer: Can you explain that a bit for us?

Rubinstein: Yeah, you need to make sure that all the subsystems are balanced. Like, we'll get into this little bit later, but one of the big mistakes we made at Ardent was we had blazing, you know, fast integer scalar [performance], we had blazing fast, you know, floating point vector [performance] and we screwed up the scalar floating point, right, and it was a big hole. Right. You can screw up bandwidth to memory. You can screw up bandwidth to I/O subsystems. I mean, so you need to have balance in a system, right, and to make sure it all just kind of flows.

Spicer: I don't know if you knew this, but that is also the answer Seymour Cray gave [to that question], just to let you know.

Rubinstein: Love Seymour Cray.

Spicer: Pretty good.

<laughter>

Spicer: Okay. Hewlett-Packard. Do you want to--

Rubinstein: That's really an honor, by the way.

Spicer: Oh, thank you.

Rubinstein: No, no. I mean, that's, like, awesome, but that's what it's about. It's all about balance, and Seymour's really good at that, right, and the funny thing I always, you know, I always told the team about Seymour, and I never knew him personally, but obviously I'd read about him and I'd watched some videos and stuff about him and things, right, but I think I met him once personally here, but the thing is that everyone saw Cray as, like, you know, he was this genius who would, like, the computer would just pop out of his head and that was kind of it, and what people didn't understand is that he would kind of jot something on a piece of paper and he'd hand it through little window and on the other side there was like a thousand guys who were busy, like, doing the actual circuit designs for everything to make it all work and stuff, and so the lesson from there is, you know, there is no one creative genius that can make everything work. These systems are much too complicated for any one person to hold the whole thing in their head. They have to have a team that, you know, has to be built from subsystems up, and that's experience true today given the massive complex-- it was true when I was, you know, when I was

younger doing this stuff, but it's especially true today, that given the massive size of things, that you could hold an awful lot in your head, but you can't hold it all in your head.

Spicer: We struggle with this when we nominate our Fellows, because there's-- everything is by team now.

Rubinstein: Right. Yeah.

Spicer: So it seems almost unfair to pick out one or two people.

Rubinstein: Yeah, exactly.

Spicer: It's a challenge for us. All right. So can we wrap up Hewlett-Packard?

Rubinstein: Oh, no. So much stuff about HP that was cool.

Spicer: Tell us about HP. Yeah.

Rubinstein: There was so much stuff. So, I mean, we were really the leaders in workstations, right, in fee [ph?].

Spicer: Competitors were DEC?

Rubinstein: Sorry?

Spicer: Who were your competitors?

Rubinstein: Well, you know, [that] was kind of funny. I mean, there was sort of, towards the end there was Apollo, right, which HP ended up buying. I mean, clearly there was DEC, but they were really-- they never got down to the small-- I mean, they sort of did, but not really very well, because they were really hung up on minicomputers, right, because what's-his-name was a minicomputer guy. In--

Spicer: Ken Olsen?

Rubinstein: Ken Olsen. I mean, I got the honor of meeting Ken much, much later in his life, and he wasn't really all there anymore, right, and he was still, like, you know, PC thing is just a fad and, you know, he still hadn't got the fact-- this was when he was at his startup that he did after he got booted out of DEC, right, and he still hadn't gotten the fact that the world had changed, right, and--

Spicer: There's an interview that we did with Bob Supnik, who you-- do you know him?

Rubinstein: Mm-hm. Yeah, yeah, I know Bob. Yeah.

Spicer: Yeah. He reflects upon showing I think it was the VAX 9000 and an Alpha [to Ken Olsen]. He says, you know, they're basically similar, and Ken said, "I just can't get my head around this," and that was essentially the problem.

Rubinstein: Right. That was the problem, and that's what killed DEC, right. That was what killed DEC, so-- but we were building really cool stuff, and like, you know, I was the first one to ship the 68020, right, and I got to be very close with the Motorola guys during that whole process, and I got a My Way award, because they wanted to ship a 12 MHz [version]. This <laughs> really dates us, right, and I wanted to ship at 16, right, and I forced him to bin the parts so I could get enough 16 [MHz parts] to ship my workstations at 16. So I still have that plaque from the Motorola guys, but--

Spicer: Was that their sort of euphemistic way of saying, "Thanks for giving us a kick in the...?"

Rubinstein: Yeah, sort of, but, you know, yeah, they just added another level of sort on the fab and it worked out, but, you know, that was really good. It was a transition time in software as well, because we started with, you know, HP Basic, I think, right, and by the time I left, I mean, things were all Pascal-based or UNIX-based, and so it's a dramatic shift on the whole software front. It was a shift in expectations, right. I mean, you know, when I got there if a computer crashed every now and then it was okay, but when I left, I mean, we'd have computers running for six months, nine months, and, you know, not failing, right, so I remember spending months, maybe a year, doing memory testing, right, to figure out, "How do we build reliable memory subsystems?" right, because you had particles coming from the sky that would, you know, disrupt the bits inside, the memories, and, you know, we looked at all kinds of error correction and all that kind of stuff to build in our future systems and how bad was it really? Because no one really knew, you know, how long a memory system would actually be reliable for, right.

Spicer: It had never been characterized?

Rubinstein: Never really been characterized, so, and, you know, we had infinite resources, right, because our margins were 60 percent margins. I mean, yeah, it was crazy, right. I mean, you know, it's a whole different time, right, so-- and projects took three years. I mean, I was really lucky. I put out, you know, several products during my seven years at HP. A lot of the guys I worked with had never put out anything in seven years, and our primary competition wasn't DEC or somebody. It was another division at HP, right. I mean, it was really stupid. It was too bad, because HP was a great company in those days. It was a great company. Unfortunately lost its way over the years, but it was a great company, and I was very grateful for the education I got, because I got a really good education there on processes, on reliability, on manufacturing, on how to design products, you know, and while I was there, I went, I took a course a semester at Colorado State University and got another master's degree in Computer Science.

Spicer: So was just going to ask, yes, first about that, but also were there seminars and courses--

Rubinstein: Yeah, all kinds of stuff.

Spicer: --internal to HP?

Rubinstein: And management courses and, you know, because I didn't really want to be a manager. I mean, I did it in production, but that was kind of different. When I got back to engineering I wanted to be an architect, right, and so I became sort of the lead architect for the lab, for our lab, and, you know, but they kept wanting to be a manager, because the logical evolution was, you know, you'd move up into management, and I'm like, "No, I don't want to be a manager. I want to be an architect, but I want to learn about management." So they'd send me to lots of management classes. They had really good management classes in those days, and so I would take management classes. I was continuing my schooling, you know, at Colorado State. I felt bad for the other students at Colorado State because we had, you know, the HP people and then the regular students and there was this bimodal distribution on scoring, right, and, you know, I mean we would have this competition of like who could score hundred percent on everything throughout the year, right.

<laughter>

Rubinstein: Which would, you know, drive the other students crazy, because they thought we all cheated, right, but you know, I mean, we cheated in some ways because--

Spicer: You worked together probably, right?

Rubinstein: No, we didn't actually.

Spicer: No?

Rubinstein: But we had computers.

Spicer: Okay. Oh, okay.

Rubinstein: Right. I mean, you know, I had a workstation at home. I had the most advanced personal computer in the world sitting on my desk at home.

Spicer: That is a bit unfair.

Rubinstein: Right?

Spicer: Yeah. <laughs>

Rubinstein: It's, you know, and so if we're writing an operating system, right, like, I can compile everything, you know, order magnitude faster. There'll be--

Spicer: All their stuff works too.

Rubinstein: They're working on-- I don't know. Was a Cyber 70 mainframe or something. Some, I mean, was horrible thing, which was great for any Lisp or SNOBOL or stuff like that, but, you know, no

relation at all to doing stuff in, you know, I guess we were doing Pascal at the time. But no debugger or machine language. You know, debugging and all that stuff, I mean, was so much easier having your own computer right there. So, you know, not being on some old batch system, so yeah, we did have an advantage from that point of view.

Spicer: Why did you go back for another master's? You felt a need for more skills or...?

Rubinstein: Look. So me, building computers is about system design, right, and what I realized is that I'm really a system designer, and so to build systems you got to know about the software and the hardware, and I knew a-- I mean, I'd already taken some operating system courses, stuff at Cornell, as part of my graduate school, so I had, you know, and I'd taken lots of computer science during that time, but, you know, I start taking, at Colorado State I was taking sort of compilers and more advanced operating system stuff and formal language theory and, you know, those kind of classes, and I did my master's thesis on RISC computing, right, which was, you know, sort of just coming of in vogue, right?

Spicer: Great timing.

Rubinstein: Yeah, it was good timing.

Spicer: What was your topic, your thesis, do you remember?

Rubinstein: I think it was "Keep It Simple, Stupid," was the title of it. <laughs>

Spicer: What does that mean? <laughs> I'll have to look it up.

Rubinstein: Just--

Spicer: Maybe it's on the web somewhere.

Rubinstein: <laughs> You know, was-- no, I don't think it would be on the web. So, you know, it was just about the transition from CISC to RISC that was going on and--

Spicer: Like a market analysis or...?

Rubinstein: No, no. Was about the technol--

Spicer: Technical.

Rubinstein: You know, deep in the pipelines and stuff and the comparison of the two, and because, I mean--

Spicer: So like architectural arguments for why RISC might be superior to...?

Rubinstein: Right.

Spicer: Okay.

Rubinstein: Yeah, exactly. But remember, there weren't any RISC machines yet, right. I mean, this stuff was under development still, right. I mean, it was just sort of happening at that, I mean, MIPS had just gotten going around then. I mean, there'd been a bunch of, you know, the 801 had been done at IBM. You know, there'd been other research I think at Berkeley and stuff, but, you know, and Stanford, but I don't think MIPS had come, or was just coming out at the time or something. I forget, but it was all around the same time, so--

Spicer: And HP also had the PA-RISC [architecture] too, right, so--

Rubinstein: Well, that's right. Each-- yeah.

Spicer: --was that about this time or later?

Rubinstein: Yeah, you know, before I left HP, you know, it was at that time. So before I left HP, I'd been going back and forth between the Workstation Division and HP Labs, working on what was called Spectrum at the time, which became HPPA right, and there was an architectural committee, actually, several architectural committees, but trying to basically develop the processor, the buses, the, you know, the entire sort of system architecture so it was scalable across the needs of many divisions. You could only imagine what a nightmare this thing was, right, and so we'd have these meetings at HP Labs and, you know, and then you'd have a bunch of different divisions all going, "I need this. I need this," and you got a--

Spicer: Do you remember if there was, like, a vast performance range that was required, like--

Rubinstein: A huge performance range.

Spicer: --100 to 1 or something like that.

Rubinstein: Yeah, you know, so, I mean, the buses were dramatically different. I mean, you know, the range of performance on it, the processors. So I was working with HP Labs on their low-end processor at the time. I forget what it was called, but it was basically their entry-level processor, and then around that time, yeah, I'm trying to remember but-- because I'm confusing two time periods, but because I got sort of involved with HP a little bit later on as well. Aside from going to work there much later, but I'll get back to that in a bit. But no, no. So there's lots of stuff going on with Spectrum [Internal Project Codename], HPPA. I was going back and forth on the corporate jet from Fort Collins to San Jose, you know, and hanging out at the labs and, you know, there, and, you know, so I was very involved in that. I was very involved with the future of 68K architectures, working with Motorola.

Spicer: Oh, really? You fed back into Motorola's--

Rubinstein: Oh, absolutely, yeah, yeah, yeah.

Spicer: --design team.

Rubinstein: Yeah, absolutely.

Spicer: Really?

Rubinstein: Yeah, yeah.

Spicer: Can you think of an example where you did a-- the thinking went--

Rubinstein: Nah, not really.

Spicer: But you remember a--

Rubinstein: But, I mean, we were building systems, so we gave them lots of feedback on how to do a better job building processors to fit in the systems and stuff and--

Spicer: Right. And they listened to you because you were HP, so--

Rubinstein: Yeah, and look. We were the first, you know, we would typically have the first bring-up of their chip in a system.

Spicer: Oh, really?

Rubinstein: You know, oh, absolutely, yeah.

Spicer: Okay. No wonder they liked you. <laughs>

Rubinstein: Yeah, no, no. I mean, I remember, because when, I mean, when we did the 6-- I wasn't on the team, but when they did the first 68000, you know, it went from 6800 to 68000, we got the first 68000 chip in our lab outside of Motorola, right, and the guy who was doing the project, I won't mention any names because frankly I don't remember his name, but he plugged it in backwards and blew up the chip, so-- but I did all the 68010 and '020 bring-ups, right, in which I did not plug the chip in backwards, <laughs> and you know, so we basically were the, you know, sort of the extension of Motorola that was actually building systems to bring up their early chips. We, you know, continued that relationship. It was great. I loved HP, and my big issue with HP at the time was they just wouldn't move fast enough, right. They were very plodding, and, you know, and there was always fighting, in-fighting between the divisions, right, and because of that everything got slowed down, and so they had incredible technology, right, and they had incredible people. I mean, the labs was filled with really smart people, and, you know, it was, you know, Bill Worley was there, and I forget the guy who ran it [Joel Birnbaum]. I see him at the opera

here occasionally, but he was great, and they had a bunch of great architects. I mean, you know, Ruby Lee, you know, were busy working on all this, and-- or at least Ruby was, and--

Spicer: Yeah, she did PA-RISC.

Rubinstein: She did-- yeah, she was one of the lead people in PA, but it was really smart people. Karnazes, not Dean but the other one [Peter – Dean is the crazy runner]. <laughs> You know, who'd been on the 801 project with Worley. I mean, those, you know, trying to remember all the names, so long ago, but, I mean, was great people. Bunch of IBMers. Bunch of HPers. You know, lifetime HPers, and really smart group of people and it was really fun, and, you know, we were doing great work. I mean, I got to bring the first Daisy PC layout systems into HP, right, so I scanned about who we should buy and I picked Daisy and I bought some Daisy systems to do our project. So we did the first sort of computer laid out PC boards. You know--

Spicer: I think at this time it [the CAD marketplace] was called the DMV, [after the three leading ompanies]--Daisy, Mentor, Valid?

Rubinstein: That's right.

Spicer: Those were the three. Yeah.

Rubinstein: It was the three. That's exactly right.

Spicer: Yeah, yeah.

Rubinstein: So we did the first Daisy systems in HP. Picked that over Mentor and Valid, and then essentially, because the history goes forward and I had a lot to do with both Valid and Mentor going forward, but we chose Daisy that first time and the stuff worked great and we used that. I remember taking the *Introduction to VLSI Systems*, you know, the Conway-Mead book.

Spicer: Oh, yes, the VLSI...

Rubinstein: Right, so we had that, the VLSI book. I took that class at, you know, we had that class internally at HP and I built a chip that, you know, got fabbed over--

Spicer: at MOSIS...?

Rubinstein: Yeah, I forget where it got fabbed. It was, you know, it was probably out here in Santa Clara or something at the HP fab.

Spicer: Oh, yes.

Rubinstein: But, you know, I mean, that was all, again, you know, doing tape and stuff.

Spicer: Tape on Mylar.

Rubinstein: Exactly.

Spicer: I did some of that. Yeah. <laughs>

Rubinstein: Yeah, yeah, so, you know, but--

Spicer: Very slow going.

Rubinstein: --you know, I--

Spicer: After four layers it's--

Rubinstein: It's hard.

Spicer: It's pretty well, like, very difficult.

Rubinstein: But you learn, like, a lot of fundamentals, so later on when you're doing this stuff by computer and you're doing 10, you know, 8- to 10-layer PC boards, you know, you got the basics down in your head of how it all kind of works.

Spicer: I think people that do layout now are-- basically need PhDs because of the RF--

Rubinstein: Well, yeah, that's a whole different thing.

Spicer: Everything is--

Rubinstein: That's all analog at that point.

Spicer: It's all analog.

Rubinstein: It's all analog, yeah.

Spicer: Analog now, so...

Rubinstein: Yeah, yeah, yeah, it's--

Spicer: Really complicated.

Rubinstein: --complicated now, but so, yeah. So HP was a great environment. I learned a lot, and I just got frustrated because we just weren't moving fast enough, right, and I wanted to work in a smaller environment and, you know, so I start thinking about what to do next.

Spicer: We were at HP. You were looking around for things to do.

Rubinstein: Yeah, I started looking around what I want to do next, so, you know, I was sort of tangling with management because I didn't think they were managing the place right, and I was driving them nuts, they were driving me nuts, and so, you know, I was hanging out with the Motorola guys and we decided to start a company, right, and so we kind of got a group of guys from HP and a group of guys from Motorola and we started a company called Solbourne. Actually [it] was called CGC originally, which was Cool Guy Computer, right?

In parallel, I had been interviewing for other, I mean, I'd been out there looking for other jobs, because I want to do a startup, and I wanted to do an early-stage computer startup and so... But the primary effort, you know, we spent about, probably about six months. Doug McGregor, who was one of the chief architects on the 68020, had gone to Kyoto to go to school. His wife was Japanese, and so he went to get his PhD at Kyoto University, and he got to know the guys at Mitsubishi... Mitsubishi. Matsushita, sorry, at Matsushita really well, and so they wanted to big-time get in the computer business. So they invited me to come over and talk to them about helping them get in the computer business and, you know, I was like, "Okay." You know, I'd never been-- think I'd ever been to Japan. I'd never been to Japan before, so I fly over to Japan and go to Osaka and I meet with Matsushita and, you know, I meet with the senior people there and they take me through their, you know, 20-year computer plan and I'm like, "Oh, my God." I mean, because you can't have a 20-year computer plan, right?

<laughter>

Spicer: No.

Rubinstein: You know, and they have, like, baby steps to get going, and then eventually they're going to build a mainframe and then I'm like, "This is like so crazy."

Spicer: Ah, wow.

Rubinstein: And so--

Spicer: They're sort of recapitulating the history of computing.

Rubinstein: That's exactly what they were doing. I mean, that's how it happened, so that's how we're going to do and we're just going to recreate it, right, and so I went back to Doug's place in Kyoto and-- Doug's place in Kyoto, so the two guys who ran the 68020 was Dave Mothersole and Doug MacGregor. So I went back to Doug's place in Kyoto and we kind of brainstorm. We said, "Well, why don't we do our own company like when you graduate?" and he goes, "Awesome. Let's do that." So we cooked up this idea to basically we were going to clone the 68000 family, 68020 or, you know, further generation, and build a workstation on top of that, right, and we'd get Matsushita to fund us, and, you know, that's what we would do, right, and, you know, I was still interviewing for other jobs and Matsushita offered me a job, which I turned down, and I'd been interviewing out in Silicon Valley for jobs and stuff and so any case, we

assemble a core team. You know, we write the business plan. We go back to Matsushita. We go, "Look. I don't want to--" I tell them, "I don't want to work for you, but would you fund us?" and they went, surprisingly, went, "Yes," right, and because they liked Doug a lot and they liked me a lot and so they did, and so then I kind of assembled a group of people to go do this and we sort of did a vote and I wanted to move to California; everyone else wanted to stay in Colorado, right. The Texas people wanted to come to Colorado; the Colorado people want to stay in Colorado. So I decided to accept a job at Ardent, and it was about the time that, I mean, Matsushita sent the money, right, and I kind of disappeared out of it. So they continued on. They built the company. About three nanoseconds after the guys left Motorola, Motorola sued them. So they switched to SPARC, right. They got a license from Sun sort of. They built SPARC clones, and they built clones--

Spicer: Ross hyperSPARC?

Rubinstein: What?

Spicer: That thing?

Rubinstein: Yeah, I don't--

Spicer: Do you remember or...?

Rubinstein: I don't remember.

Spicer: Know that one?

Rubinstein: No, I didn't know that. But they basically built a chip, you know, they built a chip that was a SPARC processor [Panasonic KAP – stood for Kick Ass Processor] and then they built a workstation around it and they were selling workstations, and they were actually doing okay. They had a great team in Longmont, Colorado, and any time they'd get into, like, a real deal where there'd be a significant number of products, Scott McNealy would fly in and kill the deal, right, and would basically give away, you know, SPARC workstations, you know, Sun workstations, and so they never really got traction.

Spicer: This was Solbourne.

Rubinstein: This was Solbourne Computer, yeah.

Spicer: Yeah, we have one in the collection. Yeah.

Rubinstein: Yeah, you know, it was a great product.

Spicer: Amazing.

Rubinstein: And a really smart group of people who did it. I mean, I assembled the first 10 [people], but they really hired great people, and they were in Longmont, Colorado, and then they kind of did their thing. I decided I didn't want to do that, and it was disappointing because I liked the guys a lot and I liked our project and I would've loved to have started a company from scratch. I mean, I had started a company from scratch, right, but I wasn't going to stay, so I left, and I joined Ardent, which at the time was Dana Computer, right, and I came out for the interview and I interview with a bunch of people and they say, "Well, we'd really like to have you--" I mean, I was probably employee number 16 or something.

They go, "We'd really like to have you join the team," and they give me a written offer on the spot and they go, "You should take this," and then they roll in Gordon Bell, and I'm like, "Whoa, Gordon." I mean, because Gordon was, you know, a god of computer architecture. He'd written a book and, you know, ran DEC and, I mean, and here comes Gordon, right, and so that was the first time I met Gordon, right, and so he kind of, you know, told me all about why I should do this and why it's a great job and everything, right, and then the CEO Alan Michaels comes in and Alan was a character. He was this, you know, an old Intel sales guy, and he'd been CEO at Convergent Technologies and he was just a character, and he looks, he goes, "Let me see the offer they gave you," and he looks at the offer. He goes, "Ah, that's not enough," and he crosses out and puts in new numbers and stuff and, you know, "Okay. You should sign this now," and I'm like, "No, no, I'll sign it tomorrow," so-- but the next day I did sign it and joined them and I turned in my--

Spicer: By the way, do you think that whole thing was a set up?

Rubinstein: Course it was a set up. Nah, nah, it was Alan's shtick, but he had a great shtick. He had a bunch of those.

Spicer: So he did that on purpose.

Rubinstein: He did it on purpose, yeah, yeah.

Spicer: <laughs>

Rubinstein: That was his whole shtick, but, you know, I was-- I don't know, you know. I mean, I'm, you know, it was, you know, 1986. You know, I was 30 years, you know, not even 30 yet, right, when I joined, right. I turned--

Spicer: Still making your way. Yeah.

Rubinstein: Yeah, I was still trying to figure all this stuff out, and, you know, HP, I mean, HP was a pretty naïve place, you know, compared to other, you know, the rest of the world, right. So, I mean, we lived in a bubble, right, the HP bubble, and so this was a good education. So I join this crazy company, Dana Computer, and, you know, with a crazy CEO, a crazy head of engineering, Gordon wandering around, you know, and a bunch of really, really, really off-the-chart smart people, and we were building something that no one [had] ever done before.

Spicer: Who brought that company together?

Rubinstein: Alan did, Alan Michaels.

Spicer: Alan. Okay.

Rubinstein: Yeah, yeah, he left-- yeah, I think he kind of got booted out of Convergent. You know, they took the CEO spot away from him and, you know, and he--

Spicer: Oh, yeah, and did he hire Gordon and then Gordon hired the engineers or...?

Rubinstein: Ben basically hired all the engineers, Ben Wegbreit, and Ben had been at Convergent with him. Ben had been a professor at Harvard, I think, and yeah. If you want to hear good Ben stories ask Steve Blank about it. The first time I met Steve Blank was when I got there, and it was quite a cast of characters. It was quite a cast of characters, and, you know, we were building something that no one had done before, right, and--

Spicer: Which was a high-performance--

Rubinstein: A high-performance, high, you know, using the first generation of high-density CMOS gate arrays, I think. I think they were gate [arrays...]. I don't think they were ASICs yet, right?

Spicer: But I think it this what they called a graphic supercomputer?

Rubinstein: This was a graphic supercomputer.

Spicer: Which is a kind of a new product category--

Rubinstein: Was a whole new product category. It was combined, and so basically took, you know, a fraction of a Cray and a Silicon Graphics display terminal and put them together. All right. And there was two companies doing it, it turned out. There was us, Dana Computer at the time, and then there was Stellar, in Boston, which was a spinout of Apollo. I think it was the CEO of Apollo started it when he sold Apollo to HP. I don't remember, but at some point in time they started it over there, and so we had two teams, one here, one in Boston, doing basically the same product, different architectures.

Spicer: Different companies though, right?

Rubinstein: Different companies, different architectures, same product, right?

Spicer: Right.

Rubinstein: Started at, like, the same minute, right, and there's some history as to whether one stole the idea from the other or who stole the idea from who, whatever, but we had these two companies.

Spicer: Interesting.

Rubinstein: And I came in as, you know, as the CPU designer, and--

Spicer: Was there an enabling technology that--

Rubinstein: CMOS.

Spicer: --allowed this--

Rubinstein: High-density CMOS is what allowed it. This was--

Spicer: Okay. That allowed this new product category to come into fruition.

Rubinstein: To occur, absolutely right.

Spicer: Okay.

Rubinstein: So, you know, we were doing CMOS gate arrays. I did one ECL [Emitter Coupled Logic] gate array, but we were doing, you know, 10K, you know, LSI Logic's 10K family at the time, and that was like, you know, we were one of the first ones to do chips in that. We were the first to use Verilog. We were the first to use Synopsis. We had a lot of firsts. We were first to do parallelizing compilers. We were first to do some of the graphics libraries we did. DORE, I think it was called, was, you know, was-- and we had a group of really, really smart people. So I don't know. I was employee 16 or something like that, and, you know, and so I packed up and moved to-- drove straight to California, went right to work, right.

Spicer: And they were in Sunnyvale, I think?

Rubinstein: They were in Sunnyvale.

Spicer: Yeah. Right.

Rubinstein: Yeah, yeah, right next to where the Palm offices were, when I was at Palm, so it was kind of funny, but yeah, just down here in Sunnyvale, and that was a wild place, right.

Spicer: Yeah, tell us about that.

Rubinstein: Well, we worked 24/7, right. I mean, it was insane, and we were doing stuff that no one had ever done before and it was really cool, and we built really great products. Great products. We used the MIPS processor, so we were the first ones to use the MIPS processor outside of MIPS, and in the first-generation product we did not use the MIPS floating point processor, which we should've. On the

second-generation we did, but, you know, we built basically multi-quad vector engines and using the latest chips doing floating point and I forget who they were from but...

Spicer: And at this point CMOS has overtaken ECL and other bipolar technologies.

Rubinstein: Yeah, yeah, and all this stuff was enabled, so we were using, you know, I did an ASIC out of ECL for bus control that was done by the company that got bought by Brooktree, eventually [AMCC]. I forget the name of it but it was in San Diego. We did all the stuff here at, you know, at LSI.

Spicer: Gallium arsenide's completely--

Rubinstein: Yeah, no, not in the picture.

Spicer: <laughs> Way out of the picture, right?

Rubinstein: Not in the picture, yeah, yeah, and so, you know, I mean, the goal was something that was sort of refrigerator sized, a hundred thousand dollars, and, you know, had, you know, sort of a significant fraction of a Cray and the display capability, which was all done in software instead of having a special-purpose engine in the display. Just used a regular display and did all the software on the product, and it was a great product. It was really fun to design and build and, you know, we, you know, I did all the processes for how you design products and how you take them into production and, you know, because we had nothing when we got started, so we got to leverage off stuff I'd done at HP. We got to leverage off stuff from DEC and built the processes, built the tools. We wrote a lot of the tools ourselves.

Spicer: Machines were actually built here in Sunnyvale?

Rubinstein: Yeah.

Spicer: Physically built.

Rubinstein: Physically built, yeah.

Spicer: Yeah, not offshore.

Rubinstein: Yeah, nah, nah, all built here. PC boards were all done here.

Spicer: What would a typical-- who would a typical customer--

Rubinstein: Well, that was the problem. We didn't have any customers, right.

Spicer: Oh, oh.

<laughter>

Rubinstein: So, you know, I mean, look. We sold some to the government, right, for military kind of, you know, kind of CIA, doing satellite imaging. We sold some to medical research because you could do brain scans, you know, brain slices of scans and stuff like that. But, you know, I mean, what happened was we basically woke up SGI, right, and Forest Baskett had just joined them and interviewed with us first. We knew what we were doing and then he went over to SGI and, you know, and before you know it SGI came out with a competing product, and they had sort of account control, because all of our customers were using SGI terminals, right, you know, and displays, so they kind of kicked our butt, right, and both us and Stellar, and plus, we had Stellar and us both trying to get the business and so we're both undercutting each other and you could've sold more computers or made more money by standing on the corner of Palo Alto and giving these things away, right. So it was not a successful company, but the product was very forward thinking and, you know, multi-processor, multi-vector. Compilers that handle that all for you. You know, high-performance graphics subsystems. I mean, it was really, you know, big memory subsystems with lots, you know, error correction and all of that, high performance buses. I mean, we really pushed the envelope on a lot of stuff.

Spicer: There really were some supercomputing features to the architecture.

Rubinstein: Exactly. Yeah, yeah. It was a small-- it was a mini, you know, was a small, mini, you know, was a personal supercomputer, right, and I did an article in IEEE Spectrum called "Personal Supercomputing,"[1] right, and yeah, and

Spicer: But you mentioned 24/7 days.

Rubinstein: Oh, it was great.

Spicer: And I can see <laughs> that you mentioned Verilog and Synopsis and having to write compilers, and all of those things have huge learning curves.

Rubinstein: Oh, huge.

Spicer: And <laughs> like no wonder--

Rubinstein: We did all of it.

Spicer: No wonder you were, like, any one of those-- yeah, it's...

Rubinstein: We did all of it. You know, I mean, I was doing this ECL [gate array], you know, [it] was probably, I don't know, 3,000 gates or something, right, and it was a clever design. I have to pat myself on the back because it was a very clever design, and so, you know, I went to go run the tools on it to run test vectors and, you know, their test vector tools sucked, right, and so, you know, you got 80 percent coverage or something, right, so I just kind of rolled up my sleeves and spent three days sort of nonstop,

[1] [Interviewee's note] https://ieeexplore.ieee.org/document/4538.

you know, Coke and Wendy's chicken sandwiches and, you know, of the Sunnyvale Wendy's, right, and three days straight, manually doing vectors for this thing, right, until I got 98, you know, 99 percent fault coverage on it, right, and, mean, we did all kinds of stuff like that. It was nuts, right, but it was so much fun. Really enjoyed it.

Spicer: Just brute force.

Rubinstein: Just made it happen.

Spicer: Slogging through these. Wow.

Rubinstein: Yeah, yeah, and it was a great system, and our chips worked. You know, the simulation really worked and, I mean, we had some bugs but, you know, we worked around them and, you know, and the only problem is that we couldn't sell any.

Spicer: So tell me about starting at Ardent. They got together, didn't they, or sorry, Stellar and Ardent. Yeah.

Rubinstein: Well, yeah, I mean, Stellar and Ardent. We were killing each other, because we're both giving away products, and, you know, our system was better. You know, I'm biased, but our system was better. I think we did better, you know, we ran all impact benchmarks and all that kind of stuff and we did better and they were very different architectures, and so, you know, the two CEOs got together and decided to merge the two companies. Terrible idea, because you have two different cultures. We hated each other to start with. I mean, you know, every week we'd have a beer bust and Alan Michaels the CEO would come in and he'd put up a chart of last week [how many] the cars in the parking lots on nights and weekends at both companies, right, and they'd always be beating us. So we'd have to go, "We have to work harder." You know, "We got to work harder," right. Years later I asked Alan, I, like, "Alan, where'd you get the data for the cars in the parking lot or that--" he goes, "I just made it up."

<laughter>

Rubinstein: Was the funniest thing, so, you know--

Spicer: That's a well-known VC data source though, isn't it?

Rubinstein: Yeah.

Spicer: I think.

Rubinstein: That-- yeah.

Spicer: The cars in the parking lot at nine o'clock at night. See what does it look like?

Rubinstein: Yeah, exactly. Yeah, so he had charts and everything, so, you know, so we worked our hearts out and the CEOs decided that we'd be better off if we were together, so they merged the two companies, and that basically killed the companies.

Spicer: Oh, really?

Rubinstein: Yeah, because we hated each other, and we couldn't work together and, you know, but we chose our system over theirs to move forward.

Spicer: Ah, for the unified company.

Rubinstein: Yeah, for the unified company, and then, you know, I mean, Kubota was the manufacturer. Actually, no. We didn't manufacture them here. We manufactured them in Japan. Manufactured them at Kubota, outside of-- in Kofu, which is couple hours outside of Shinjuku on the train, and I spent months in Kofu [Yamanashi Prefecture], right, you know, getting productions lines and stuff up. This was another one where Kubota wanted to be in the computer business, right, and so they invested in Ardent and, you know, and built a manufacturing facility and lost their shirt basically. So they ended up owning the company in the end, right, and it turned into Kubota Computer, and they did some other products. I think they did mostly graphics products later on, but they kept going for a while after the, you know, after Stardent sort of ran its course.

Spicer: They make construction equipment.

Rubinstein: Yeah, they make construction equipment.

Spicer: Don't they?

Rubinstein: Yeah, they make really good Bobcat things, right, you know, yeah.

Spicer: Yeah, so it's unusual, but then, you know, Schlumberger is another example of a big [unrelated] company [that got into computers].

Rubinstein: Well, they had no business being in the computer business.

Spicer: Yeah, <laughs> right.

Rubinstein: No. They were not equipped for it and we spent a lot of time in Japan, more than enough time in Japan, and, you know, but it was a really fun experience. I mean, so they'd ship them over and we would do sort of final test here, and, you know, and-- but yeah. It was great though, but, you know, there's a lot of stuff there, right, it was advanced PC layout. We were doing PC, I mean, we're doing big PC boards, right, but they were multi, you know, beyond layers ever done, you know, ever done before. We're pushing the envelope on PC board routers. Matter of fact, the router we used to do the PC boards is now the router-- it's evolved, you know, for 20-something years, but is now the router that is used for

chips at, you know, for the chip development portion of Cadence. So Cadence's chip router is the router we originally used for PC boards. You know, they bought it. Yeah. [Cooper & Chyan Technologies]

Spicer: Oh, isn't that interesting. Wow.

Rubinstein: They bought it bunch of years later after, you know, after we went through all that.

Spicer: I didn't know you could translate from--

Rubinstein: It's basically the same problem.

Spicer: --PC board to-- I guess it is.

Rubinstein: It's the same problem, yeah.

Spicer: Yeah, right.

Rubinstein: So yeah. So it was a great experience. You know, I learned a lot about management, things to do and not to do. I mean, Alan was brilliant, crazy. You know, was an incredible manager, was the worst manager, and you know--

Spicer: Can you tell us one good story that epitomizes either--

Rubinstein: Well, I think the one about the cars in the parking lot is, you know--

Spicer: Okay, that is pretty good, yeah.

Rubinstein: --is a really good one.

Spicer: Okay. <laughs>

Rubinstein: You know, there were some, you know--

Spicer: Right.

Rubinstein: --Ben was brilliant and crazy.

Spicer: Ben, what's his last name?

Rubinstein: Ben Wegbreit.

Spicer: Okay.

Rubinstein: Yeah, ask Gordon about him. You know, Ben would go hollering through the hallways and scare all the engineers. He was happy, but he'd scare everybody, right, and yeah, and, you know, and I learned a lot about marketing from Steve Blank, I mean, so one of the big lessons, I mean, aside from massive technology infusion that we did in a very short period of time, that was, you know, very advanced, I got to learn a lot about marketing too, right, because I got to be very close friends with Steve Blank. You know, Steve's been involved in Museum from the beginning. He did that great video on the history of Silicon Valley. I assume you've seen that.

Spicer: Oh, yes.

Rubinstein: Yeah, yeah, yeah, yeah.

Spicer: Yeah, yeah.

Rubinstein: I think it's great, and so Steve became a very close friend, and I got to learn a lot about marketing from him, and the biggest lesson for me in all this, well, there were some management lessons, because you had a bunch of brilliant, brilliant people who couldn't work together, so it was extremely dysfunctional, and we had a company shrink, right, who'd come to meetings and help people communicate, because they couldn't communicate, right, and, you know, but the big part was the "build it and they will come" doesn't work, right, and up until then, most people took the philosophy of build it and they will come. Right, and that just doesn't work, I mean, you know, and I think that set the, you know, sort of planted the seeds for Steve's evolution of the, you know, Blank's evolution of the lean startup, right, and how you focus on the customer. You know, there's that whole movement now and there's all that book by Eric Ries and that all came out of Blank's teachings at Stanford and Berkeley and all that stuff, and I think that's where the seeds were planted, right, in the, you know, we were on a mission and we knew what we were doing and we didn't really, like, focus too much on what the customers really wanted, right, and about, you know, account control and all that kind of stuff and we got our butt kicked. So that was an interesting lesson. It was heartbreaking, right, because I invested four years of my life 24/7 doing it, right, and this was, you know, we were going to build a real company and it was going to be big, successful company and I was going to be able to be a real player in the company and it was my future, right, and then "phht," gone.

Spicer: Right, and that's quite common in engineering, isn't it?

Rubinstein: Very common, and very common in startups, right.

Spicer: How do you think people deal with that generally speaking? Like--

Rubinstein: It's hard. I mean, look, you know, I've interviewed lots of people over the years, and, I mean, I've seen people who've done 10 startups and never had 1 of them get traction. Right? And at some point in time, you start wondering, does that person-- is it them, or is it the startup? I mean, do they have bad judgement in choosing where they go? Right? And so when I interview people for jobs, I always explore why they chose-- not necessarily just about the companies they picked but why they picked those

companies and what was their thought process behind choosing to go to a different company. Right? And so it's not just random but there was actually a thought process behind it and if you look at someone who has gone to 10 companies that have failed, you kind of go, "Well, I'm not sure I want him joining my company because I might be 11." <laughs> So and it's-- look, I know lots of people have worked for years and years and years and have never had a success in that. I've been very lucky, very, very, lucky. I've had some failures, and the failures have actually been great because I've learned a lot from them. I wouldn't be who I am today, and I wouldn't have learned all the things that I learned today if it hadn't been for some of the companies that failed. Right? And I've also been fortunate, had lots of successes, and it's been great. And so it's been a-- it's been a good balance, I would say.

Spicer: And yes, I certainly know that that's a problem for a lot of engineers and that they can go through a whole career and essentially never have any...

Rubinstein: <laughs> They never have a hit.

Spicer: And <inaudible 01:31:16> have a shipping product so...

Rubinstein: Yeah, yeah. No, that's really frustrating.

Spicer: That's hard to...

Rubinstein: And then on the other side, you get the-- first of all, everyone has this sort of mis-interpretation that a lot of these companies are overnight successes. Right? And the reality is they're not, right? I mean, most companies take years to become successful. Even the ones that are overnight successes usually had their foundation in something else, and they got pivoted or something. That's a new word that everyone uses, but in the old days it was called something else but basically "pivoted." But it takes a lot of years to build a really successful company and it's tough if you've made your bet and it-- and it doesn't work out. But then other people just kind of hop around looking for a quick hit, and it's not like that. Sometimes it is, but it's-- mostly it's not.

Spicer: Let's jump ahead just a bit. I want to connect what you said about people, for example, not-- the "Field of Dreams" philosophy, build it and they will come. Did Steve and Apple apply that at all, or did they do market research?

Rubinstein: Apple did no market research.

Spicer: Interesting.

Rubinstein: None, but it wasn't, build it and they will come. We had a very good understanding of where things were going, right, and so everything we did was a sort of natural evolution of kind of what made sense. And so it was very sensible and, matter of fact, Apple very specifically doesn't do market research but I'd say they're an outlier.

Spicer: Is there a reason for that? They don't find it useful?

Rubinstein: Yeah, it's just not useful. So here's the tradeoff, right, is you can go out and ask customers what they want, but they can't really tell you what they want because they don't know what's possible. Like, if you're doing advanced technology stuff, so they're looking in the rearview mirror. So what you need to understand is what their needs are, right? Don't ask them what they want. Understand their needs, and if you can understand their needs, then you can build products that meet their needs. And then what you have to do is quickly iterate, based on the feedback you get on your products, right, and that's basically what Apples does. Right? I mean, we're-- the whole iPod run was what technologies enable what. What are we going to enable by technology that's coming, and how do we drive that as quickly as possible? And the basic idea of, do you do a music player, well, that's kind of obvious because everyone loves music, right? It's-- if you get the right price point, right, with the right set of capabilities, it's a natural home run, right, and you'll have an existence proof because you got Sony Walkman. I mean, they sold 300 million Walkmans. So you know portable music is a good market. You don't have to do a market study for that.

Spicer: Interesting though, because at the time-- this is just my own personal reflection, but I wonder, why would a computer company be getting into portable music players and-- or a phone later? I mean, we can talk about this.

Rubinstein: Well, we'll get back to that, yeah, because I think that's...

Spicer: But later-- but yeah.

Rubinstein: ...yeah, I think that's an interesting discussion.

Spicer: Yeah, because...

Rubinstein: It wasn't an accident.

Spicer: ...it's not intuitive.

Rubinstein: Yeah, it wasn't an accident, though. It was very well thought out.

Spicer: Like IBM...

Rubinstein: We'll get back to that.

Spicer: IBM didn't make iPods, for example.

Rubinstein: Compaq almost did.

Spicer: Oh, do they?

Rubinstein: Yeah, so the first iPod was actually designed by Compaq, right, and they never shipped it. Right? But the guys who worked on it we ended up hiring in our-- in the architecture team several years later, and they had nothing to do with iPod. But a few years later, they joined the architecture team working on the Mac stuff, and they pulled out-- they're like, "Here's our presentation from several years before the iPod came out...

Spicer: Oh, great.

Rubinstein: ...of doing the iPod." But it wasn't time yet.

Spicer: Yeah, right. Did they have...?

Rubinstein: But it wasn't time yet.

Spicer: Did they have the Microdrive in their...?

Rubinstein: No, it wasn't a Microdrive.

Spicer: Okay, so...

Rubinstein: See, that's the point is...

Spicer: So it can only store like...

Rubinstein: ...there's a convergence of technologies that has to occur to build a really great product, and it-- and that's the art part. Okay, the science is for now, what technologies. The art part is how you put those technologies together, and at what point in time are they capable enough and cost-effective enough to build a home run product. And I think that's something that we're really good at at Apple, right, when I was there, right, really good at that, and we did a lot of firsts. Right? I mean, iPod, the one I'm almost more proud of is Wi-Fi, Wi-Fi base stations, right?

Spicer: Oh, yes.

Rubinstein: And we created that, right? We didn't invent it, but we created it, right, and that's one of the things that, having learned about marketing and stuff from [Steve] Blank, right, I mean I could see market opportunities. Right? And that was such a clear market opportunity, and we were years ahead of everyone else.

Spicer: I think it was obvious the-- to anyone the first time they tried a wireless device, whether it was your mouse or your...

Rubinstein: It was...

Spicer: I was like, this is totally the way to go.

Rubinstein: It was like going from-- it's like "Wizard of Oz" going from black-and-white to color, right? I mean, just... <laughs>

Spicer: Yeah, that's right. Yeah.

Rubinstein: And so I think, in some ways...

Spicer: Oh, that's interesting.

Rubinstein: ...of all the things I've done, that one might be the biggest impact, right? It could be. I don't know. It's a tough tradeoff, whether Apple becoming a trillion-dollar company or the world using Wi-Fi, I mean, they're both pretty good, so I'm pretty happy about both of them. So any case, back to...

Spicer: That's wonderful.

Rubinstein: Back to Ardent.

Spicer: Okay, yeah. Let's wrap up Stellar, Ardent, Stardent.

Rubinstein: It was great though, because again, we got to develop processes around how to develop products, how to design chips, how to build products. How do you do software development, reliability, chip design? I mean, all these things, we were just pushing the envelope on all of them so it was unbelievable and we were going fast.

Spicer: Would you say-- what's the percentage of engineers in this company versus...?

Rubinstein: Almost all. Yeah, it was almost all.

Spicer: Like percent of engineers.

Rubinstein: Not 100 percent because there was a small marketing and sales team.

Spicer: So 90, 80?

Rubinstein: But it was-- it was brilliant people, and they all went on to do amazing things, right? I mean, and part of the reason-- I mean, went to NeXT after-- well, I mean part of me went to NeXT, but primarily part of the reason I went to Apple was something I learned from a guy named Rich Lowenthal. So Rich had been one of the senior engineering leaders at Convergent, had come as head of-- head of product development or whatever at Ardent, Dana-Ardent, had run afoul of Alan, had left, had come back. I was-- he was my boss when he left, and then when he came back, I was his boss and whatever. And Rich left kind of before the shit hit the fan at the company and joined this piece-of-shit company called StrataCom,

right, and we're all like, "Why would you go to StrataCom? It's failing." Right? And Rich took what he learned at Ardent, used that to completely turn StrataCom around, and then sold StrataCom for some ungodly amount of money to Cisco couple years later.

Spicer: And what were they making?

Rubinstein: It was network shit. I don't know. [WAN Switching Equipment]

Spicer: Okay, like parts and routers and...

Rubinstein: Routers, routers or-- I mean making routers or something. I don't know. Right? But it was a huge acquisition for Cisco. Those guys all made a ton of dough, and Rich was at Cisco for quite a few years. I mean, now he does VC stuff. I think he's-- he did Chargepoint, and he did a couple other companies, right? So he was mayor of Cupertino for a while, right? So I mean, I did a video for him like saying, "Rich is a good guy. You should vote for him." But what I learned from him was-- is, you don't need to do a startup to build a successful company, right, because in my mind, you want to build a successful company, you come up with an idea. You raise some money. You hire some people. You go build a company, right? And the idea of taking that shitty company and turning it around where you actually have a customer base and a market and products and revenue, and you may need to raise some more money, but whatever, that was like this lightbulb went off for me -- because it cuts like dramatic number of years out of the whole process.

Spicer: You've got all these systems already in place.

Rubinstein: Because you've got all this stuff in place and people and all that stuff and you may have to rejigger everything but, I mean-- and look, I mean you may need to fire a bunch of people. I mean, that's just what happens, right, but you go by "Star Trek" philosophy of the needs of the many...

Spicer: The needs of the many.

Rubinstein: ...outweigh the needs of the few or the one, right? <laughs> And it's terrible but it's something you have to do for the needs of the many, right, so-- but that set off a light bulb for me because it was really one of those aha moments about companies. Right? And it guided all my future path from there, so...

Spicer: So no more startups for you, is that the lesson, or is it...?

Rubinstein: Yeah, that was my last-- well, not quite, not quite my last startup, almost my last. I mean, I had a sort of startup but not really, right? So but yeah, basically there's no more startups, right? I mean, I advise startups and help out people and stuff but I'm not going to do the work myself, right, so it's too long a-- it's too tough a slog. So in any case, things got worse and worse at Ardent. The merger wasn't great, Stardent, at that point in time. The merger wasn't great. I didn't like my boss. He was-- he quit, and he was like, "Jeez." I'm like, "I'm upset with all this stuff." He goes, "Well, go home and kick the wife." I'm like,

"I'm not married." He says, "Go home and kick the dog." "I haven't got a dog. I got a cat." He goes, "Go home and kick the cat." I'm like, "That's not the right answer," right? So I started thinking about what I was going to do next, right, and I talked to Bill Worley at HP about coming and doing the next generation, not the spectrum but-- not HPPA, but the other one they did with Intel. But they were in the early stages of that.

Spicer: Itanium?

Rubinstein: Itanium, yes, right. So I talked to Bill about coming because Bill was back at HP by now.

Spicer: "Itanic," as Gordon Bell calls it.

Rubinstein: Exactly. Yeah, and I'm like, "What's changed at HP?" It's like, "Nothing." Like, I came and met the same group of people, and it's like nothing has changed. So I decided not to do that, and I talked to a couple other people. And then the phone rings one day, and it's an admin going, "Please hold for Steve Jobs." And I'm like, "Okay." I mean, and I knew who Steve was. I mean he wasn't like "Steve," right? He was-- well, he was Steve Jobs. I mean, he was...

Spicer: Had you met him before?

Rubinstein: No, never met him, and the funny thing was when I started looking for-- when I left HP, the guys at Motorola go, "Why don't you talk to NeXT?" And I'm like, "Great." I mean, I'll talk to anyone because I was talking to MIPS. I was talking to Ardent. I was-- to Dana. I was talking to a bunch of different companies, and so they said, "Well, we want to introduce you to Rich Page. He's at-- they're just starting NeXT, all right, and you guys should meet." I'm like, "Great," and then Rich never called me.

Right? I mean, they sent him a note saying, "You should call Jon," and I mean-- and he never did. So I knew about the company and I'd read about it and everything but I didn't really know very much about it. I knew who Steve was, but I'm not really a PC guy, right? I mean, I'm a workstation guy, right? I mean, I did workstations at HP. The personal computer division ended up doing terrible personal computers a few years later, all right? I'd left and gone to an engineering-- a personal supercomputing company, and it was-- but I knew who Steve was, right? So I'm like, "Okay. Hi, Steve." And Steve goes-- he goes, "I hear you're the best engineer in the Valley." I'm like, "Here we go," right, so Reality Distortion Field 101. So I'm like-- so we chatted for a while, and he goes, "I'm looking for someone to come and run Engineering." And it turned out actually that I'd be working for Rich Page, who was actually running engineering, but Steve was about to undermine Rich. Rich didn't know any of this at the time, and so Steve wanted a backup for when Rich quit, that he'd have someone to run engineering. So I went in to meet with Steve and we hit it off really, really well and then I met with the rest of the engineering team. We all hit it off and then I met with Rich and we had a heart-to-heart about, hey, your boss is going screw you and he goes, "Yeah, this is typical for Steve." And so we kind of had an agreement that I would keep him informed of whatever happened along the way and stuff.

Spicer: That's very good.

Rubinstein: But they were building really interesting products. I mean, they were building sort of this hybrid between PCs and workstations with the NeXT machine.

Spicer: So were you attracted to the product, the people, or-- yeah.

Rubinstein: Just everything. Well, I mean look, there's not that many places where you can build high-volume, innovative computers, right, personal computers or small computers. I mean, there's just not that many places, right, and if you build big machines, they take a long time. And one of the things I learned at Ardent was, you build one of these big machines, it takes a long time, and you can't do one of those every year.

Spicer: How long was that development cycle, about...

Rubinstein: Three years.

Spicer: ...three years? Yeah.

Rubinstein: It was long time, right, and that was typical when I was at HP, too. It would take us three, four years to build...

Spicer: Were there parts of the system that were no longer the latest thing by the time it had shipped?

Rubinstein: Yeah, of course. Yeah, I mean that's the problem, right? It's too long a cycle time, right, so one of the things I started getting in my head is, we want to do one-year cycles. Now, that leads to a problem in that it takes more than a year to do a chip, right? See, then you have to really have a pipeline of chips you're working on, and so you have to have enough resources to where you can put in place a roadmap with a pipeline of chips for both processors and control chips and all of that.

Spicer: Now, is this to make your own chips...

Rubinstein: Well, yeah.

Spicer: ...or to buy outside...?

Rubinstein: No, I'll-- you can buy stuff outside, but if you want to build a real system, you got to do your own chips.

Spicer: Even the microprocessor?

Rubinstein: No, no, you don’t have to build a microprocessor. You can buy that outside.

Spicer: Yeah, and I think it had a 56001 DSP in there, the NeXT?

Rubinstein: Well, it was a 68K-based and then it had the DSP in there but then the next generation...

Spicer: But it wasn't very...?

Rubinstein: I did the last slab, right, which was basically the cube done correctly, right, in a slab format because the cube was just silly. Right? And-- but I did the slab, right, but I really came there to do NRW -- which was NeXT RISC Workstation. So it was-- it was their PowerPC-based-- actually, it started off as Motorola 88000, right, and then when-- that product got killed when Apple and IBM merged the PowerPC efforts. So we had actually started off with 88000 and switched to PowerPC in the middle of the project, but I came in to run that project and do the chips with it and everything else. And so we developed new processes of how you do stuff in chip development and all that stuff that really had-- they hadn't really had in place at NeXT and...

Spicer: Part of that was what you did at Ardent, it sounds like, too, like building systems.

Rubinstein: Next-generation version of it, I pulled some of the people who helped me. We did everything in Verilog. It was done in Synopsys. We actually funded-- John Sanguinetti was my main CAD guy and we actually funded him to do another company, which was-- which did Verilog compilers or something, I forget what. And that ended up getting acquired by Synopsis or somebody. I think it was acquired by-- I forget who acquired it, but any case... [Chronologic acquired by Viewlogic in 1994]

Spicer: So Rich Page was your...

Rubinstein: Was my supervisor when I got there. He didn't last long.

Spicer: What was-- tell us about it. What was he like to work with and...?

Rubinstein: No, Rich was fine. I mean, Rich is a really good guy, right, and he was an Apple Fellow and-- but he wasn't-- in fairness, he wasn't the best liked manager of a big group and we had a big group. I mean, it was a lot of people. We had hundreds and hundreds of engineers.

Spicer: Hundreds of people.

Rubinstein: Yeah. I mean, it's hundreds of people, both in hardware, and then there's a couple hundred in software, run by Bud Tribble. So shortly after I kind of started running everything and Rich kind of moved up and then we got out of the hardware business and Rich-- well, Rich left. I kind of took over and then we basically split the company, right? So I mean, the NeXT NRW thing was a great product. It would have been a very successful product, but we never got a chance to come to market. We spent a lot of time with IBM, with Motorola, working with their design teams. It was really fine-tuning PowerPC. We built a great system around it. I got to know a lot of the IBM guys, which was great. My favorite IBM person is Nick Donofrio. He's kind of my-- he's one of my heroes.

Spicer: Former CEO, I think, right?

Rubinstein: Well, I don't think he was CEO. He ran engineering at IBM. Yeah, and...

Spicer: But I think he became CEO, actually.

Rubinstein: No, I don't think he...

Spicer: No?
Rubinstein: Nick never became CEO of IBM. [Executive Vice President Innovation and Technology and was also selected as an IBM Fellow]

Spicer: Nick Donofrio.

Rubinstein: No, he ran engineering. He ran the labs for a long time. I mean, Nick's great. He's retired now, but he's super. But I got a chance to meet Nick in that process, and it was impressive to me because, well, I'll fill this in later. I'll come back. Well, in any case, a few years later, I was struggling with what to do with our company because IBM had just screwed us and I sent Nick a note and I went, "Hey, you guys just screwed us. I don't know what to do with my company because..."

Spicer: How did-- how did they screw you?

Rubinstein: Well, they basically stopped doing PowerPC Workstations, right? We were doing sort of clones of IBM PowerPC Workstations at a future company we'll get to, and IBM just stopped doing it one day. And we were going to be the Compaq to their IBM, right, and all the sudden we were-- we were the leader in PowerPC-based workstations, which was not-- wasn't going to be viable just as a startup.

Spicer: It wasn't a question of them cutting off your supply of parts?

Rubinstein: No, no, it was-- well, but in the end, that's what it meant, right, because if they're not going to use their own products, right, I mean in high volume, it's never going to be competitive. Right? So it was-- it was a death knell for us, right, and then shortly thereafter, Microsoft pulled support for NT and I mean, it was-- it was going to be a cascading fall. And I'm like, so I sent him an email kind of going, "Dude, you screwed me," right, and I expected never to hear anything. And I got an email right back from him, going, "Really sorry. Please come and visit me at your convenience," and so contacted his assistant, I flew out there. He spent a couple hours with me and this is a guy who runs like a lot of IBM and I'm some stupid shit little startup with 120 people, right, and this was after NeXT. This wasn't NeXT, right, but boy, he treated me so well and I was like so blown away that it was such a life lesson in that sense. So always try to treat people respectfully and well, even when you're screwing them. Any case, so back to NeXT. So yes, I mean NeXT was a shitshow, right? <laughs> I mean, it was just total chaos. They couldn't sell anything. I mean, it was a great product, but it was never finished. Nothing was ever finished and-- because Steve was pushing stuff out the door before it was right.

Spicer: Is that on the hardware side or the...

Rubinstein: Everything, everything.

Spicer: ...or the software?

Rubinstein: The software wasn't ready. The hardware wasn't ready. Nothing was ready, and...

Spicer: Okay. Really? Who-- what was the major market? I know education was a part.

Rubinstein: Well, it was supposed to be. It was way too expensive for education.

Spicer: Right, right, and there were big discounts, I think, at some...

Rubinstein: Yeah. I mean, he gave them away, right? And we had this factory in Fremont that was-- that was the world's best factory building a single-sided board of this exact dimension, and if it was anything else, it was terrible factory, right? And..

Spicer: I'd love to pick your brain a bit about that because that was a real showpiece.

Rubinstein: Of course.

Spicer: It was...

Rubinstein: That was Steve's pride and joy.

Spicer: Yes.

Rubinstein: Yeah. It was terrible.

Spicer: And I think-- was some of that Japanophobia also...?

Rubinstein: Well, got to remember that NeXT was funded by Canon.

Spicer: Oh okay, so not Japanophobia, definitely not.

Rubinstein: Right? So it was-- no, no, no-- I mean, they were...

Spicer: Quite the opposite.

Rubinstein: ...partial owner of the company, and they played-- they played a reasonable role in not what was going on, because Steve-- I mean, Steve ran the place.

Spicer: Because-- yeah.

Rubinstein: Make no mistake about that.

Spicer: Because deploying that level of robotics is pretty unusual for that time outside of Japan. Right?

Rubinstein: Yeah, yeah.

Spicer: I mean...

Rubinstein: No, it was very impressive for a board this-- exactly this size, single-sided, which is not where the world was going. Right? And our second-generation products, I mean, just they weren't that size and they weren't single-sided and it was real problem. So-- but in any case, so yeah I mean, sales and marketing just-- it was too expensive a product. It was-- it was a product that was before its time. I mean, it was great.

Spicer: Why was it-- why was it too expensive?

Rubinstein: Because it cost too much.

Spicer: Just the...

Rubinstein: I mean, everything.

Spicer: ...the cost of goods...

Rubinstein: Everything, everything.

Spicer: ...in-- yeah.

Rubinstein: I mean, the manufacturing costs, the enclosure costs, the parts costs, the-- I mean, everything. It was expensive. Right? The chip, it was-- and we weren't doing high volume, right, because it was, they were-- they were low volume. I mean, every-- every now and then someone pushed a button, turn on the factory. It would spit out a bunch of these and then they'd turn off the button and that would be it for a while.

Spicer: But the intended audience was education or engineers or...?

Rubinstein: No, it was education. No, it wasn't engineers. These were...

Spicer: It was not considered a...

Rubinstein: These were personal-- these were high-end personal computers.

Spicer: Okay, so it's not a workstation per se.

Rubinstein: Well, but it really was a workstation. I mean, it was UNIX-based.

Spicer: Yeah, that's what I mean. Yeah.

Rubinstein: I mean, so it was neither fish nor fowl. That was-- that was the issue. Right?

Spicer: Right.

Rubinstein: And it was beautiful. I mean, it was beautiful-looking. The software was beautiful. It was-- the software was far more advanced than...

Spicer: I find even the board layouts are beautiful. I mean...

Rubinstein: ...anything out there. It was all beautiful, right, but no market for it, so I got there the second half of NeXT. So NeXT had already shipped the cube, and so I came in to sort of clean up engineering and get the NeXT RISC Workstation done and then take over all of engineering once that was done. That was the plan. And we never got to ship NRW, although you guys have one because I gave you one. I'm pretty sure. If I didn't give you one, I could give you one.

Spicer: Okay. We definitely want one. I'm going to go check afterwards.

Rubinstein: Yeah, yeah. I think I gave you one.

Spicer: Is that what it's called, NRW?

Rubinstein: NRW, yeah, NeXT RISC Workstation. NRW, yeah. If you don't have one, I got one I'll give to you.

Spicer: Wonderful. And that never shipped?

Rubinstein: Never shipped.

Spicer: And it was based on a [68]020?

Rubinstein: No, it was PowerPC.

Spicer: Oh, PPC. Okay.

Rubinstein: No, it was actually 88000, and in the end, well, I don't know if we ever actually switched it. It was 88000 based. Yeah. [88K to start then switched to PPC]

Spicer: How about manufacturing at NeXT? Was that basically just people lined up with soldering irons, or was it-- was there a degree of...?

Rubinstein: No, it was all automated over in the factory.

Spicer: Out in...

Rubinstein: In Fremont.

Spicer: ...Fremont?

Rubinstein: Yeah.

Spicer: That's-- all production happened over there?

Rubinstein: The whole thing happened in Fremont. Yeah, yeah, yeah. I don't know where the PC boards were made. I mean, I assume those are made in Japan or somewhere else so I don't really remember but the-- yeah, yeah.

Spicer: That was...

Rubinstein: Well, maybe it-- I don't remember. I don't remember.

Spicer: How did the hardware and software divisions work together? Were they sort of on friendly terms, or...?

Rubinstein: Yeah, it was sort of on friendly... [sic].

Spicer: More or less?

Rubinstein: Yeah. I mean-- yeah, I mean, we got along.

Spicer: Avie Tevanian and...

Rubinstein: Avie wasn't running software, Bud was. Right? Bud was running it. Mike DeMoney was in there. He did Java later on. Avie was there. There was a couple other guys there, too. I forget all the senior guys, but Bud was the-- was the head of software. Avie was sort of head of OS. Avie had been brought in from Carnegie-Mellon to do the Mach stuff underneath all of it, right, and had other guys doing the upper levels and stuff. But I mean look, it set the foundation for MacOS X, right, and so it's very important, what happened there. Right? And so eventually, I mean, we were running out of money, basically. Right? And so Steve called Canon and went, "If you don't deposit"-- I don't remember the exact number so I'm going to make this up a little bit but, basically, he called him. He said, "If you don't deposit a check for $10 million-- $20 million tomorrow, I'm going to shut the doors." Right? And they went, "Really?" And then he goes, "Yes." And obviously, there was a big kerfuffle in Japan, and Monday morning there was $20 million deposited, right? So we got to live another day, but it was-- clearly, things were like kind of heading downhill because we weren't selling. Right? I mean, we had some small niche

markets. We did have some universities, right, and we had financial guys. So some of the option-trader guys figured out they could write software an order of magnitude faster on top of NeXTSTEP than they could anywhere else. Right? And this, to them was, I mean, this is dollar signs, right, and so...

Spicer: Tim Berners-Lee on the...

Rubinstein: Yeah, exactly.

Spicer: ...the web was created on a NeXT.

Rubinstein: Exactly. Yeah, so there was pockets of places where people got it and where their budgets were such that they, he could-- Tim could afford to buy whatever he wanted to buy, right, because he's at CERN. Right? And the option traders in Chicago, they can buy whatever they want, right, so whatever makes them most productive. So we had a market and we were selling computers, but it wasn't a mass market, wasn't going to work, wasn't going to work. So it became evident it wasn't going to work. Steve had hired a president. That didn't work. The president tried to sell the company to Sun. They forgot to tell Steve about it. McNealy called Steve. I was in the room at the time, and McNealy goes, "Hey Steve, they just tried to sell me your company. What do you think?" And Steve kind of went crazy. Long story short is we weren't going anywhere, and so we decided to split the company.

And by then, the NeXTSTEP-on-Intel effort had been going on for about a year, so they had it running on PCs. So we were going to split the company into two, so there was going to be a software company where you had the NeXT OS running on top of standard hardware. And Canon, in the number-three Japanese company that wanted to be in the computer business-- we start with Matsushita.. We go to Kubota. Now, we're with Canon. Canon decided they wanted to be in the computer business. They were actually selling lots of computers, right? They had the Mac franchise in Japan, right? They had some mainframe. I forget which one they were selling in other countries. I mean, so they had-- Canon Sales knew how to sell computers and so they were proficient at the art and so-- but they wanted to be in the computer business. And I'm like, "Are you sure?" And they go, "Yes, we're sure." And I'm like, "Okay." So I was the bagman, basically. So my job was to make sure that the NeXT software company had sufficient money to continue on as an independent company, and to do that, we had to do a cramdown on Canon.

Spicer: Sorry. What's a "cramdown"?

Rubinstein: Basically make them take other stuff and so the money stayed with NeXT, right? So we basically sold Canon the hardware division in exchange for like a bulk of the software company, so they ended up owning a small piece of the software company. They got the entire hardware company, right, and...

Spicer: Which had a very finite lifespan, I would imagine.

Rubinstein: It wasn't long, and-- but they wanted to be in the hardware business. So the deal was, is we were going to do a joint company between the hardware employees of NeXT and Canon. Canon was

going to be majority owner. I was going to run the thing, and we took 100, give or take, people from NeXT. We took all the IP, all the hardware IP. Canon owned it, licensed it to us. Right? That includes processes, tools, the actual designs, everything. Right?

Spicer: I didn't know you could do that to processes. You can...

Rubinstein: Yeah, they took all the processes and...

Spicer: ...copyright them or...

Rubinstein: Well, no, no. They-- I mean...

Spicer: ...patent them or...?

Rubinstein: ...but they just got them, right? I mean the tools...

Spicer: Just ways of doing things.

Rubinstein: ...ways of doing things. They got all of that.

Spicer: Okay, I got it.

Rubinstein: And then they donated that. They-- that was part of their contribution and the funding. They funded us, right, and so we spun that out of NeXT. Right? And so I shut down the factory, basically got people to take pennies on the dollar for what we owed them. So we stiffed a whole bunch of people there and we moved a bunch of-- because NeXT had debt to Canon so we got rid of that. They got the hardware. They lost-- so basically, the software company got to go off. They had a bunch of cash from what NeXT had in the bank. They had no liabilities. Canon had a small ownership piece of it but not a lot, and Steve could then continue on as a software company. Right? And I took all the hardware, went to work for Canon, in effect, right,got-- kept all of our assets. They invested money in us, right? And we jettisoned the factory, and we could build anywhere we wanted. Right? And so that's how FirePOWER came about, which was kind of what we spun out when we spun out of NeXT. So I was the president. They sent over a Japanese CEO, very nice man who knew nothing about computers and didn't speak English, and we bought him-- we leased him a Cadillac and we bought him a golf membership at Green Hills here and he was happy. Right? And he'd go over to Fuki Sushi every night for dinner. That was his restaurant and he'd go there every night and he was happy.

Spicer: How effective could he be...

Rubinstein: He didn't do anything.

Spicer: ...without speaking the language?

Rubinstein: He didn't do anything, but they sent over a bunch of Japanese engineers, 20 or so engineers to learn how we did things. Right? And they were good engineers, right, and we just-- we trained them on all the tools and processes and everything else and they became part of the team. And we went and-- so what we were doing was basically going back. We basically took NRW, we redesigned it for PowerPC, a next-generation version of it. Right? And so we were building custom workstations, high-end workstations using Windows NT as our operating system instead of using NeXTSTEP. So we're using a standard operating system on top of custom hardware and this was part of-- we were basically doing IBM clones because Willy Shih, who is now a professor at Harvard, but Willy was running the personal systems division at IBM, which was PowerPC Personal Systems Division which was doing PowerPC workstations. Right? And we had a standard, sort of an architectural standard that was co-developed between us, Apple, and IBM, the PowerPC Personal Systems-- PowerPC Personal Systems Division. And so the three of us basically had this committee, architecture committee and we defined the architecture and the idea was we'd kind of be like a Compaq. Right? And Apple was doing their own thing. They were putting their own software on top of it. We were going to put Windows NT, as was IBM, and they were also going to put OS/2 on it.

Spicer: Did you use a CHRP, like a common...?

Rubinstein: That was CHRP.

Spicer: That-- okay.

Rubinstein: That's what CHRP was. That's what CHRP-- I mean, CHRP ended up because of that, right, the Common Hardware Reference Platform. Right? So that was how CHRP ended up, right, and it was basically the three of us, the three companies doing that. Right? So we built some products and then, in the middle of it all, Microsoft decided to no longer support NT, right, and-- well, first IBM-- the first step was IBM decides to not do PowerPC Personal Systems. Right? And Willy leaves IBM. He goes to Kodak or something. And so now we are the industry leaders of PowerPC personal computers, right, because Apples are different because they got their own OS. So when...

Spicer: This is PowerHouse Systems, right?

Rubinstein: This was PowerHouse, FirePOWER, PowerHouse Systems. Right.

Spicer: Sorry? It was-- it had two names?

Rubinstein: It had both names, yeah, yeah, yeah. We had to change the name because we couldn't get the copyright on PowerHouse so...

Spicer: So it was first PowerHouse. Then, it became...

Rubinstein: And then it became FirePOWER.

Spicer: Got it.

Rubinstein: Yeah, yeah. That's...

Spicer: Thank you.

Rubinstein: Yeah, exactly. And we had a great group of people, a really good group of people, and they all ended up going to do different things. I mean, our head of marketing was Phil Schiller, right, who I had hired from-- he wasn't at Apple. He was at-- not Adobe but the other one [MacroMedia], and Ron Okamoto was there. Right? And Ron is now head of-- at Apple is head of developer relations, right, and Ron was at Adobe. And I mean, great group of engineers, great group of engineers. And so we built these incredible systems. They were really good and they were-- they were slabs, sort of typical like what the PC looked like at the time, but they were dramatically faster based on PowerPC.

Spicer: What would the price point be...

Rubinstein: And they ran Windows NT.

Spicer: ...roughly, 10K?

Rubinstein: Two thousand bucks.

Spicer: Oh, two...

Rubinstein: No, no, it was like $2K. Yeah.

Spicer: Oh, really?

Rubinstein: Yeah, it was reasonable. Right? It was a little more expensive than a high-end Mac, or it was about the same price as a high-end Mac. Right? So-- but we weren't getting any traction, so I tried to sell the company to Apple. We were this close to selling the company to Apple because we-- there was a kid in Switzerland who had kind of ripped off the Apple ROM and figured out how to build a layer on top of CHRP that would allow you to run Mac OS. And we did that so we could demo-- we couldn't ship it, but we could demo Mac OS running on it. So we were this close to selling the company to Spindler, and-- because he needed high-end Macs because high-end Macs were terrible. Right? And unfortunately, he got fired in the middle of all that so that destroyed-- so then we tried to sell it to Groupe Bull and-- because they were doing PowerPC workstations, also. Right? And so we almost had a deal with Groupe Bull but that kind of fell through and, in the end, Motorola bought us, Motorola Personal Systems Division.

Spicer: Bull is one of the few companies that still does Itanium, I believe.

Rubinstein: Right. Well, it's because they're funded by government, and so they can waste as much money as they want. Right? <laughs> It's just ridiculous, so-- but yeah, I mean, so FirePOWER was really interesting. The people who did FirePOWER then-- there was this diaspora that went to a bunch of different companies, joined Bechtolsheim and did that networking startup that got sold to Cisco, ended up at Cisco doing that. A bunch of other people went to-- a bunch of them went to Apple. When the Motorola thing shut down, a bunch of them came to Apple with me. Matter of fact, the Motorola guys think I did it on purpose, right, that I sold them FirePOWER, right, that I went to Apple, that I had Steve cancel their MacOS license, right, so that they would shut down that group, and then we could hire that group. That was their thinking of what we actually did, but that's not what happened. So-- but that's the FirePOWER story. So great product, never shipped very many. We shipped a few, and Windows NT never really got finished was part of the problem. Microsoft never really finished it. Yeah, and then it turned into Windows whatever, whatever the next version of Windows was.

Spicer: So when NT came out, it was...

Rubinstein: Big deal.

Spicer: ...to my way of thinking, the first truly stable, somewhat robust version of Windows. Maybe I'm wrong, but...

Rubinstein: Yeah. No, no, that's right. That's right, but they never finished it and then it got rolled into whatever the following Windows was and it was the base underneath the rest of Windows.

Spicer: Yeah. There's apparently some VMS-esque legacy, DNA in there.

Rubinstein: I'm sure there is something in there, yeah.

Spicer: Yes. Same guy worked on them, anyway.

Rubinstein: Exactly, yeah. What's his name?

Spicer: Dave Cutler.

Rubinstein: Cutler, right. Yeah, so I-- I mean, I used to hang out with Cutler and we had kind of crafted this strategy on a bunch of stuff together.

Spicer: Oh, neat.

Rubinstein: Yeah, and Microsoft was very helpful in those days.

Spicer: Right. They actually...

Rubinstein: It was sort of my first interaction with Microsoft.

Spicer: Like, most people forgot for a while Microsoft was Apple's biggest software producer. Is that not true?

Rubinstein: Well, yeah. I mean, they made more money on Macs than we did. Right? I mean, seriously.

Spicer: Oh, really? Oh, my.

Rubinstein: Yeah, yeah. We'd sell a Mac. They'd make more money.

Spicer: Just from selling Word...

Rubinstein: Word...

Spicer: ...and Excel and...

Rubinstein: Word-- Office, basically Office, right?

Spicer: ...all that stuff. Yeah, so...

Rubinstein: So where did we leave off? Let's see.

Spicer: We left off...

Rubinstein: We were kind of ending the whole FirePOWER experience.

Spicer: Ending FirePOWER, moving to Apple, how does that happen?

Rubinstein: Yeah, so again, this is where IBM shuts down the PowerPC Personal Systems. I go visit Nick. Nick goes, "You should like-- you should go do something else because this isn't going to work." Right? And he was very-- he basically said, "Look, IBM is not going to help you. So I mean, we'll sell you parts and we'll be your partner but we're not going to help you do anything." Right? And...

Spicer: Meaning they'll sell you the microprocessor but not...

Rubinstein: Yeah, but we're not going to help create the market. We're not going to-- I mean, which made the whole thing untenable, so we went off to sell the company, ended up selling it to Motorola, and Canon was pretty unhappy. But too bad, that's how it works. Interestingly enough, the Canon guys, although they lost some money, they got a lot of benefits from this, and one of the benefits is their engineers got trained how to do chip development on the modern-- sort of using modern techniques. And so that team went back to Japan and became the core of Canon's chip group, which I think is still going, I mean last I heard. It's been a couple years since I talked to some of the guys over there because I still keep in touch with some of the people, but they set up a chip group. They put these guys in it to kind of lead it, and basically almost all the chips inside-- custom chips inside of Canon were done using the

processes that we had developed at FirePOWER-- NeXT then FirePOWER then-- and so there was that legacy. That was kind of one. In a funny way, the next Apple acquisition sort of-- I don't know how it actually happened, but we were kind of scrounging around for customers at FirePOWER. And Be was doing their workstation at the time and so...

Spicer: That was a 603-based-- PowerPC 603? [Firepower Systems, Inc. (formed as a partnership with Canon) offers the Powerized family of PReP 1.0 compliant systems. Currently available are 603, and 604-based uniprocessor systems (the Powerized ES line) and a 604-based multiprocessor (the Powerized MX line). A 603e-based system (also in the ES line) is expected in 2Q95. Also available are designs and motherboards. All systems run Windows NT. FirePower sells only to OEMs. The systems were announced in November 1994.]

Rubinstein: Yeah, yeah, it was-- I don't remember what it was based on but, in any case, their operating system was pretty good but they didn't really have the horsepower to do hardware. They didn't have enough juice, and so we had talked to them about them taking our hardware platform and putting their BeOS on it and selling it as their product. So instead of them doing hardware development, we could do the hardware development. They could OEM our product and-- which would have made a lot of sense.

Spicer: "We" being FirePOWER?

Rubinstein: FirePOWER, yeah. Yeah, so the Be would use FirePOWER's hardware. They could do their own OS. We would continue with NT, whatever, or we'd switch to who knows what. But there was some opportunity to do a deal and so I got to know Sakoman through that process. Right? Sakoman was running engineering.

Spicer: This is Bob?

Rubinstein: You can't do that on a camera to me.

Spicer: Okay. It's okay. Yeah.

Rubinstein: Yeah, Sakoman, Sakoman, Sakoman. Now you're making me Google it.

Spicer: I'm sorry.

Rubinstein: My memory is shit for this kind of stuff. Sakoman. Steve.

Spicer: Steve, okay.

Rubinstein: Yeah, right?

Spicer: Thank you.

Rubinstein: Steve had been at Apple, went to Be, was the-- sort of ran the product development at Be or whatever, and then he ended up back at Apple and did not get to run the OS group. He was supposed to be running the OS group after Avie, but he didn't get-- he didn't get the tap on the shoulder. Any case, Sakoman and I were talking and stuff and, as well as some of the other engineers there, and I picked up the rumor through all of this that Apple was about to acquire Be. And I'm like, "Whoa," like, "That's wrong." Right? That doesn't make any sense at all. And we were in acquisition talks with Apple around that time, as well, or before that, right? And this is when Spindler was running things and then he got the boot and then Gil took over. Right? So through all this, there's a lot of commotion going on around Apple, around Be, around us, around IBM, NT. I mean, there's a lot of turmoil in this whole space. So I hear this rumor that Be is about to be acquired by Apple, and I called Steve. And I said, "Steve, I don't know what's going on. I don't know anything about it, but here's the rumor. That's stupid because NeXTSTEP is-- NeXT OS is so much better than BeOS that you ought to get-- you ought to get in there and sell them NeXT. Right? And so this was kind of October of '96, something like that. And I kind of-- and Steve went, "Okay. Well"-- Steve and I would talk every couple of months and we...

Spicer: Just on the-- on the phone or...?

Rubinstein: Yeah, we'd just talk on the phone. We'd get together and go for walks sometimes. I'd see him on a regular basis, wasn't weekly but a fairly regular basis during the couple years after I left NeXT and was running FirePOWER because I did that for like three years. So we would chat occasionally.

Spicer: I want to ask you what it was like to work with him, but we can do that later.

Rubinstein: It's-- and so yeah, and I had worked for Rich at NeXT, but then I'd work for Steve directly for half the time, maybe. And so I'd gotten to know Steve really well through the NeXT period and we worked very closely together at NeXT and so we kept in touch. And I didn't really get any kind of reaction out of him. It was like, "Okay. Well, thank you for the information," was kind of it, and that was the last I thought about him. Right? So we closed the deal with Motorola, and it was funny because we were, I don't know, 120 people. Motorola sends in almost that many people to do due diligence. <laughs> I remember one of the big fights during the acquisition was the fact that they wanted all of us to take drug tests, right, and our software team was like, <makes noise>. Right? So we cut a deal where the...

Spicer: What are you implying? Nothing. <laughs>

Rubinstein: Well, we cut a deal where we grandfathered in all the current employees, so anyone new we were going to hire had to take a drug test. Right? And Motorola finally agreed to that, so everyone in the interview process, we're like, "Dude, you got-- you're going to take a drug test, so be cool." Right? The first hire fails his drug test. It was unbelievable. So through that whole process, in any case, we closed the deal. I get-- I'm not part of the deal so I am a consultant to Motorola for the next six months, for the computer group for the next six months, and Glen Miranker, who was kind of my number two at FirePOWER, takes over the Motorola Group. He goes to work for Motorola and they go off to build notebooks for Motorola, Mac notebooks basically, because Motorola had a Mac license at the time.

Right? So they were building Mac-compatible products, and their first products were notebooks. So they went off to go do that and I kind of sailed off in the sunset for the next six months and...

Spicer: You must have been pretty tired just...

Rubinstein: I was pretty tired.

Spicer: ...at this point.

Rubinstein: So I needed a break and so I kept trying to help Motorola but they didn't really-- I mean, it was a, you're on the payroll but we don't really want to hear from you. Right? And I'm like, "Okay, whatever." I tried to set up meetings to go down to Phoenix, which is where they were headquartered, and I'd go occasionally but they weren't really interested. So I said, "Okay, I'm going on vacation." And I went on vacation and I took a couple months off and I went wandering around Europe. And in-- I'm on the Isle of Skye, which is off the coast of Scotland. It's where Talisker comes from, if you're a Scotch drinker. And I'm sitting around Christmas afternoon, Christmas Eve, afternoon before Christmas, and I'm reading the-- I don't know-- it was FT [Financial Times] or something. And I open the paper up, and it says, "NeXT is about to be acquired by Apple." So I go call my voicemail and my home-- sorry, my voicemail-- I call my home number in the US and I listen to my answering machine and it's got a call from a couple reporters who want information on background about Apple. And so I spent Christmas afternoon talking to reporters-- or Christmas Eve afternoon talking to reporters from Scotland about the coming acquisition [Peter Burrows for example] and...

Spicer: But this is before you had even been...

Rubinstein: No, no, I had nothing to do with any of this.

Spicer: ...told about the acquisition.

Rubinstein: I didn't know anything about it. I just read about it in the FT.

Spicer: It's kind of like athletes learning they've been traded by the-- in the papers, I suppose.

Rubinstein: Except I didn't work at NeXT, so I wasn't employed or anything. I just-- so I called Mike Slade. Mike Slade had been head of marketing at NeXT and had left and gone and done Starwave and got bought by ESPN. And that's now what like all that online stuff for ESPN is the-- is what Starwave turned into. But Mike's the only guy who worked for the three big-- the three big heavyweights, right, Jobs, Gates, and...

Spicer: Ellison?

Rubinstein: No, Gates's partner.

Spicer: Paul Allen?

Rubinstein: Paul Allen, yeah, because Paul Allen funded Starwave, so it was-- so any case, so I call Slade. I go, "What's going on?" And he goes-- and he kept pretty close in touch with Steve, and he goes, "Yeah, they're getting acquired." So I'm like, "Great." Right? So that-- that's interesting. Well, I'm glad that happened. That was-- I may have planted a seed, I might not have. Who knows, right? But it's a good thing that happened and I'm a stockholder at NeXT so that's good for me from a personal point of view and it's good for Apple because NeXT is a great company. It's got great software, and it would be a good future. And then I kind of forgot about it, and then a couple days later, I get a message saying, "Call Steve." Right? So I call Steve, and he goes, "Hey, Apple is reorganizing and they're looking for someone to run engineering and you should call the head of HR." And I'm like, "Okay." So I called the head of HR, and she told me, "Hey, we're looking for-- we're going to reorganize and we're looking for someone and you should come back and interview for the job." So I'm like, "Okay." So I flew back. It was right before Macworld. So I...

Spicer: Where-- where were you flying from?

Rubinstein: Scotland.

Spicer: Oh, the Isle of Skye?

Rubinstein: I'm up in Scotland.

Spicer: Okay, got it.

Rubinstein: Yeah, yeah. No, I'm hanging in northern Scotland.

Spicer: You're still there?

Rubinstein: Yeah, yeah, yeah. I mean, I had no place to be. Right?

Spicer: Right.

Rubinstein: It was Christmas, right, so no, this gets into early January and they go, "You need to come back." I'm like, "Okay, I'll come back." So I flew back from London, and they start recruiting me to come and run-- to come and run product development. So kind of what was going on was NeXT was being acquired and the whole NeXT team. That was going to close in early February. They've had McKinsey in there for six months, I think, looking to reorganize the company, right, because it was divisionalized at the time. So it had five major divisions, low-end, high-end, portables, servers, and something else [Printers]. I don't remember.

The company was in shambles, absolute shambles, and Gil was the-- Gil had just been appointed the CEO some months before. Fred Anderson had been hired as CFO from ADP and there was all these

division managers and stuff that were running the place and it was chaos. So McKinsey's proposal was to restructure it functionally, right, collapse all the divisions, make it singular functions, hardware engineering, software engineering, marketing, more like a traditional, smaller company because I think what had happened is Apple had really grown. They had divisionalized, but the reality was-- is the business wasn't strong enough to support the divisionalization. There was-- everyone was doing this-- they were duplicating everything, same boot ROMs, I mean, duplicate boot ROMs in each group and duplicate every chips, chip development. I mean, it was all-- it was crazy. So yeah, so I went in and I met with some of the people there. I met with the HR head-- multiple times, and again, I came back to that lesson. I talked to some of my friends, and they go, "Are you crazy?" I mean, Apple is going out of business because I mean the common wisdom at the time was Apple was going to go out of business, right? It was going to go bankrupt. It was done, right, and Fred was doing Herculean efforts to save the company but that likely it was going to go out.

Spicer: I remember the quarter before he came back, before Steve returned, they had lost...

Rubinstein: Well, Steve isn't back yet.

Spicer: No, but before he came back, I think it was a $740 million [loss] in the preceding quarter, so they had maybe one 1 quarter left...

Rubinstein: Yeah, we had one quarter left when I got there.

Spicer: ...I think.

Rubinstein: Yeah, I think the company's valuation was like $2 billion when I got there. I mean, it's a trillion today. It was $2 billion. Right? And it was out of money and it was a quarter away from bankruptcy, basically. It was in terrible, terrible shape, and all my friends go, "That's crazy. It doesn't make any sense." At the same time, I was interviewing at a couple other places, like Juniper Networks, to go run Engineering there-- they were just kind of getting started at the time-- and a couple other places. But I went to Macworld in January, and I'm like, "Wow, there's girls here." Right? I mean, I'm used to going to supercomputer conferences. Right? <laughs> And I'm like, "This is really interesting." I'm, "This piece-- this personal computer stuff might"-- because I'd always been kind of on the workstation side of things-- "This personal computer stuff might actually be pretty interesting." <laughs> So-- but the lesson I'd learned from Rich Lowenthal and his StrataCom experience kind of like really resonated in my head, is that if you could turn Apple around, it had an incredibly loyal customer base. It had a large installed base. It had a lot of things really going for it, and it just needed to be like dramatically cleaned up. I mean, this wasn't going to be a minor, we'll fix a couple things. This was going to be a reset on the company, but you had an awful lot of structure in place that allowed you room-- now, I didn't know how close to bankruptcy we were, to be honest. I figured I had a year, year and a half to kind of get stuff sorted out. I didn't realize like in three months we were going to be out of business, right? So-- but I thought about it and I met Gil once before I took the job and I-- what the hell, right? I mean, there's no downside. If we pull this off, it will be the miracle of miracles.

Spicer: Did you have confidence in Gil to lead the turnaround?

Rubinstein: No, I didn't know Gil at all, and...

Spicer: Okay, but you still joined?

Rubinstein: Yeah, yeah, yeah, because I figured this was all going to get worked out somehow.

Spicer: There's enough good people here.

Rubinstein: There's enough good people. We'll figure all this out. And they were getting rid of all the division managers, right, and it was going to me. Avie was going to be running software although they had the woman from IBM at the time also involved in running software, but I figured she'd move into a strategy senior position and Avie would actually do the day-to-day work. And so I-- and then I knew I could work with Avie and I liked Fred a lot. Guerrino De Luca, at the time, was head of marketing, and Guerrino was a really good guy and I could work with-- I felt like I could work with him. And I started-- I talked to him about maybe bringing Phil back, right, to help, to run product marketing because I needed a partner in product marketing, and so the pieces were all there. It just needed to get blown up and rebuilt. So I said, "Okay, I'll do it." Right? And so I showed up at Apple.

Spicer: And I'm sorry, this is before Jobs-- any inkling that Jobs was...

Rubinstein: No, no. I talked to him. He wasn't going. He wasn't. I mean, he was an advisor, right?

Spicer: Oh, he was affirmatively not coming back.

Rubinstein: Not coming back, yeah. No, no, not coming back.

Spicer: Okay. Wow.

Rubinstein: And that bullshit that Larry spun, Ellison spun at his eulogy-- at his funeral and stuff was nonsense.

Spicer: I didn't-- I wasn't there.

Rubinstein: Yeah, but basically, I mean, Larry has been quoted as saying, "No, no, no. Steve had this strategy of how he was going to do this, and he was going to get back to take over the company." That is certainly not what I saw. Now, it may be that Steve kept it secret from me. Anything is possible, but we were pretty close at the time. Right? And I know Laurene [Powell Jobs, Steve's wife] didn't want him to go back, right, because it meant he would disappear. Right?

Spicer: Right, and a lot of stress too, probably.

Rubinstein: Lot of stress and so yeah, so Steve was just an advisor. Woz was an advisor. Woz was hanging around, right, and I mean, they had that disastrous Macworld. I mean, I went to the Macworld and it was great because there was lots of women but the keynote was like the worst thing I've ever seen. It ran-- you should go look it up.

Spicer: Who-- who was it, or...?

Rubinstein: It was Gil running it.

Spicer: Oh, Gil.

Rubinstein: But it ran for an hour over. They had all kinds of Apple Masters, Mohammed Ali or whatever, stand up and, I mean, it was-- it had nothing to do with what the business was. It was silly. The whole thing was silly, right? But the big high note was Steve and Woz got on stage with Gil, and that was a really big deal, right, and probably the first time they'd been together in a long time. So I said, "Yes, I'll do it." Right? And so I showed up. I think it was February 3rd of '97. Interestingly enough, the Apple-- the NeXT-Apple deal closed the same day so I was checking in and I ran into Nancy Heinen, who was chief legal counsel at NeXT at the time, in the parking-- or at the check-in desk at City Tower or whatever it was called, City Center. And she says, "Yeah, we're closing the deal today." I'm like, "Cool." So basically, Avie and I start. She wasn't joining at the time. She was just-- she was the NeXT chief legal counsel. She was going to wind down NeXT and get everything done. So Avie and I started the same day, and we went to-- they kept us. They kept me, in particular, hidden for three days because I was going to replace like five division managers, right, because we were going to collapse all these divisions. Right? And so, I mean, there was a lot of people that were going to go away, and they did. <laughs> Right? And fortunately, I didn't actually have to fire them because, I mean, they didn't work for me, so HR took care of it.

Spicer: It's not really fair to ask the new guy to do that.

Rubinstein: Yeah, but it wouldn't have surprised me if they had. Right? So I hide out for three days, and then they announced they were doing this major restructuring and that I was going to being running hardware. Software was kind of divvied up between Ellen Hancock and Avie. I-- was it Ellen? Ellen Hancock, right? Yeah, I think Ellen Hancock and Avie and various other groups and stuff. And so we went to the first executive staff meeting and I listened to what was going on and I look at Avie. And I'm like, "Oh my God, what did we get ourselves into?" I mean, this is a disaster.

Spicer: What-- anything specific then?

Rubinstein: Well, I mean, everything. It's like nobody is running the place. It's chaos in the exec staff meeting. The-- I mean, the ideas everyone has are nuts. Fred is doing the best he can to keep the company financially solvent, but we're about to go bankrupt. I mean, I had-- from the outside, in the interview process, you would never have known how bad it was. It was so awful. It was unbelievable, and I mean, Fred is the-- partly the hero of this story because he pulled off a miracle, buying the time for us to turn that company around. Any case, the marching orders were, let's whack the company in half, and Avie

and I set out to cut engineering in half, basically. And it took a couple of iterations to get there, but we got there. We canceled lots of projects, and most of the projects had been actually cancelled before Steve came back because Steve didn't actually come back. I mean, history has been rewritten a bit, but Steve didn't come back until like after 4th of July that-- or actually, maybe it was, yeah, it was probably after 4th of July. I forget [July 6th, 1997]. Whenever Gil got fired, that year, I mean, that's when Steve came back, right, and then Fred was actually interim. Nobody remembers that at all, but Steve didn't come back. He was just advising. Fred stepped into the interim CEO position for quite a few months. We interviewed a dozen people to be CEO, and Steve didn't like any of them, right, and so...

Spicer: What is Steve's role? Is he chairman?

Rubinstein: No, he's advisor. No, no, no. He's just an advisor.

Spicer: Oh, he's just-- oh, okay, but his word is enough to...

Rubinstein: So Ed Wollard and Fred, Ed Woolard was chairman of the board, right, and Ed fired Gil Amelio, right, and worked with Fred on managing the company, basically. And Fred was interim CEO and Steve agreed to be like a fulltime advisor, right, so he went from a part-time advisor to-- occasionally showing up to whatever-- to a fulltime advisor. So now Steve is sort of settling into the saddle of running things, although Fred is actually at the helm. Right? And so Step One is, let's find a new CEO. Right? So we start the process of interviewing people to be CEO of the company. In parallel, we continue the process of downsizing the company and fine-tuning or continuing to downsize the product roadmap. And I mean, it was about this time where I killed the high-end Mac, so I had already killed the low-end stuff. The performance stuff, I killed right out of the chute because it was terrible. It was done in Singapore. There's a big group in Singapore. I flushed that group.

Spicer: What was bad about it?

Rubinstein: It was unreliable. It was crappy product. It was-- everybody hated it. It failed continually in the field. I mean, failure rate was enormous. It was just a bad experience, and it was-- and it was poor quality. I mean, it was bad. It was a bad product like on every dimension, so we killed that. I shut down that whole division in Singapore, so that's-- I mean, I had to whack out-- we were, I don't know, 1,400, 1,500 people. I had to whack out seven-plus hundred [sic] people, right? I mean, it was really painful. Right? So we took out that. I had a big group in France that was doing address books and other stuff. I don't know all the things they were doing and it was in Paris and I loved going to Paris but it just wasn't. So they were gone and we had a printer division which was, I mean, Apple kind of was a very early success in printers but it lost its way. It was the first ones to do digital cameras but never really made a success of that, so they had this big printer division that had a billion dollars in inventory. It was a billion-dollar business with a billion dollars in inventory sitting out in Sacramento in a warehouse. I mean, it looked like "Raiders of the Lost Ark," that scene where-- that warehouse scene.

Spicer: Yeah. Why did they build up so much inventory?

Rubinstein: Who knows? It was mismanagement, right?

Spicer: Wow.

Rubinstein: But it was enormous amount of inventory and so I shut down the whole printer division, right, because it wasn't-- it wasn't the core focus.

Spicer: It wasn't carrying its weight.

Rubinstein: Wasn't carrying its weight. It wasn't the core focus, so...

Spicer: Right. Is this the time that you-- I think Steve announced this...?

Rubinstein: That was a little bit later.

Spicer: The two-by-two thing?

Rubinstein: Yeah, we figured that out later.

Spicer: Okay, but it is essentially, it's ratifying what you're doing now?

Rubinstein: We're heading that way. We haven't gotten there yet, but we're heading that way.

Spicer: Okay, got it.

Rubinstein: Right? And when Steve comes back, we formalize that way. Right? But I had already gotten rid of-- jettisoned a whole bunch of stuff before he came back, right, and the four quadrants, I mean, that had the iMac in it, right, and the iMac hadn't really been started yet. I was working on-- I forget what it was called, but it was the desktop one based on PowerPC. I forget the name of the product, but it was a really nice product. It was a slab product [G3 Desktop]. I killed the high-end tower product after Steve came back because it was never going to get finished. It just-- like, the teams could never deliver the product. I mean, I looked at it and I-- there's graphics chips that were huge and they were never going to get those right. I mean, it was just bad all the way around.

Spicer: So when you-- when you assess-- this would be really useful for people to know. When you assess the state of a project like you're doing now multiple times across a company, what are some of the red flags that you look for?

Rubinstein: Well, so I look at the team first and how capable is the team and kind of what's the history of the development process so far. I look at the bug rate, fix/find rates, right? How many turns of silicon have they done, right? How much simulation have they done, and what do the simulations looks like? What process have they followed to do it? How long has the product been in development? I mean, a good example was the Twentieth Anniversary Mac. This was Gil's pet project. It had been going for three-plus

years, right, and I'm like, "We should kill this product." And Gil goes, "No." Right? And I get told by someone else [Marco Landi] that [it's a] career-limiting move if you kill Gil's pet project, right, so we shipped it. By the time we shipped it, a reasonable number of the parts inside the Twentieth Anniversary Mac were obsolete, right, and no longer or about to become no longer in manufacturing. So we had to do lifetime buys on all the parts that were about to go out of production, right, which I mean, that says you got a bad product, aside from the fact that it was expensive and hard to build and, I mean, there's a whole list of other things. So that only got killed after Gil left, and I could kill it, right, because it was a stupid product. It was really a stupid product, but...

Spicer: There was essentially a laptop motherboard, I think, flipped up. Was it? No?

Rubinstein: No, it was a whole new thing from scratch.

Spicer: Oh, was it?

Rubinstein: Yeah, and it had this big display. It was an education product, right? No, that's not-- that wasn't it.

Spicer: And it...

Rubinstein: It was a different product. No, no, it was-- you're right, and it had...

Spicer: ...had a Bose sound system, right?

Rubinstein: Had Bose sound system with it, yeah.

Spicer: Like a big...

Rubinstein: I'm confusing that with the education product.

Spicer: ...subwoofer, I think.

Rubinstein: Yeah, yeah, yeah. That was it. Yeah. It was terrible. It was terrible. So any case, we killed lots of products. Steve came back. We started refining what products we were doing. He was advising at this point. Started refining it. We kill the high-end Mac and through this, Fred is going, "Wait a minute. We don't have an entry [-level] product anymore," because I had killed Performa and that was the entry product. And Fred keeps going, "We don't have an entry product." And we start working on a network computer, right, because Ellison was big into the network computer and him and Steve were best friends and...

Spicer: That was the era.

Rubinstein: ...that was the era of network computers. We have to do a network computer, so we start building this network computer. And I keep going, "I-- the NeXT machine with no hard drive didn't work out well. This isn't going to work well because it doesn't have the"-- we talked about balance before. "The networks aren't fast enough yet to have the kind of balance you need, and this isn't-- this isn't going to work well." But Steve kept pushing forward with it, and Fred kept going, "Wait a minute, we need an entry roadmap." So finally, we had sort of a knock-down-drag-out one day and we decide that we're going to switch the network computer to becoming the iMac and we grow the enclosure a little bit and we stick a hard drive in it. Right? It had the motherboard that came from the-- from the other desktop product [G3 Desktop]. We basically just took that and put it inside of it, right, and did a fast-track, 11- month, 12-month. I mean, normal product development at Apple took three years, and I'm like, "We got to get to one-year cycles."

Spicer: Now, it was very close towards the introduction of the internet and the web, was it not? It was like, I seem to remember the iMac. This is the...

Rubinstein: The round sort of gumdrop one.

Spicer: In the pretty colors.

Rubinstein: Pretty colors, right.

Spicer: I mean, wasn't it "Rip. Mix. Burn," the idea?

Rubinstein: That was later, but yeah.

Spicer: Okay, but I mean, it was...

Rubinstein: "Rip. Mix. Burn," was actually around the tower initially, but we'll get to that.

Spicer: Okay, but the iMac was basically, "i" is "internet." Right?

Rubinstein: Right.

Spicer: And this is how everyone-- this is how you're going to get on the internet, to novices, novice buyers.

Rubinstein: This was kind of-- this product was the one that basically put Apple back on the map, right? I mean, before that, we had our desktop. It was successful. It was a great product, and it was G3 desktop, right? It was the slab. It was a very successful product and-- but it went to Mac aficionados, right? It went to the Mac installed base army. It wasn't going to get any new customers, right, and the PC was going gangbusters at the time. Right? So any case, so we finally convinced Steve to-- we switched the NC to an iMac. Jony redoes the-- makes the enclosure a little bit bigger. We stick a drive inside. We put a slot-load CD in the front of it, and I'm going to get back to slot-load in a minute. And we-- and I'm like, "We're going

to do this product in a year." Right? It was probably like 14 months, but our goal is to get it done in year. And everyone goes, "That's impossible." Right? And I said, "No, no, no. We're going to redo all of our processes at the same time," and we started building out sort of Apple new product development process at the same that we're doing this product.

Spicer: Did...

Rubinstein: It was kind of a SkunkWorks.

Spicer: Were these from your own past experience...

Rubinstein: Yeah, yeah, yeah.

Spicer: ...that you developed these processes?

Rubinstein: Yeah, absolutely. I brought in people to do the processes and it's still the processes they basically use today but I brought people in to help with the process and stuff. We hired a few people, some people from FirePOWER, some people from NeXT who had been there at NeXT, and...

Spicer: Is it about a project management focus here?

Rubinstein: It's all of it.

Spicer: It's just...

Rubinstein: It's all of it. It's about concurrent engineering, and it's product-- it's a multistage process with gates and milestones and checklists and interdisciplinary. So like we shipped a display about the time-- like right after I got there, we shipped this display, LG display. It starts having epidemic failure in the field, right? And I'm like, "Oh, my God. We have a 50 percent-- 40, 50 percent failure rate. This is a crisis." So I'm like, "Epidemic. Get LG. They got to replace all this stuff. I mean, we got to move quickly." And the lawyers kind of go-- very sheepishly go, "Well, the problem is we haven't finished our agreement yet." And my eyes get about that big, right, and I go, "What do you mean you haven't finished the agreement?" "Well, we just didn't get around to it." And I'm like, "You can't ship a product until you get the agreements,"

So I mean, that's one part of the development process, right? You get your legal shit done before you ship the product. You get your patents done. I mean, it's-- you get design for manufacturing in at the very beginning, right, so you start off with the manufacturing team in the front. You don't just throw something over the wall to them, right? It's-- so it's very cross-functional, very disciplinary-- very interdisciplinary. We got that-- so I used the iMac as kind of the pipe cleaner, right, to clean out the pipe and to institute all-new processes around how we're going to do stuff at Apple. So I mean, it was 14, 16 months for the iMac total, from really start to finish, but...

Spicer: Who came up with the translucent, transparent...

Rubinstein: Jony did.

Spicer: ...concept?

Rubinstein: That was a Jony thing. Yeah.

Spicer: And what was the rationale behind that, any idea? It's pretty unusual.

Rubinstein: Yeah, I mean, what was inside was cool-looking. Right? I mean, it was cool.

Spicer: I mean, who does that? No one else did that.

Rubinstein: No, no, but Jony was-- Jony is very creative.

Spicer: It's great.

Rubinstein: Jony's-- I mean, since the ID team was working for me at the time, for the first four, five-- four or five years, Jony worked for me, and he had just gotten promoted when I got there, so the guy who had been running ID just quit. And about the time Steve came back, Jony is quitting and I'm like, I talk him out of quitting and then Steve helps talk him out of quitting. And I mean, it was very-- it was a very volatile time, I mean, because you just laid off 500, 600 people, hundred or two hundred had quit. This is just on my side. Avie did the same thing on the other side, right, so dramatic downsize of the company, like whole divisions gone. Right? I mean, server division, gone. Right? Low-end division, gone. Right? And we pulled all of it into a very functional team, so there was a central boot ROM team, right, and interesting, still working sort of on the CHRP, follow-on from the CHRP stuff. And we had a notebook team and we had a high-end desktop team and then, eventually, the iMac team, low-end team, and we centralized sort of the technology team. So there was a hard drive team. There was a display team. There was an audio team. There was a power supply team. There was-- I mean, all the different sort of core technologies, networking team, et cetera, et cetera, those all got pulled together into core technology groups and...

Spicer: And so during a project, you have people from each of these teams...

Rubinstein: Yeah, you're pulling-- you're pulling cross-functionally across all the teams.

Spicer: ...contributing to the project. Right?

Rubinstein: So-- and we used the iMac as kind of the first proof of concept.

Spicer: To test your new process.

Rubinstein: Yeah, and so I mean, people just worked their hearts out to get that first iMac out. The ID team, I mean they were in South Korea. The thing was built in Korea and-- because LG was in Korea, right? So they were in Kumi (or Gumi) or something, which is-- I never took the train. I took a helicopter

when I went, the one time I went down there, but normally everyone else took a train down. Right? And it was a long train ride and it's cold down there and the hotels are not nice. But I mean, the first iMacs for the launch-- we built three of them for the launch or whatever-- I mean, the ID guys were sitting in bathtubs hand-adjusting the enclosures and stuff. I mean, these things were handcrafted.

Spicer: Wow.

Rubinstein: Yeah, so-- but it was good because it drove a lot of technology, so we got rid of ADB. I picked USB to switch to because, I mean, ADB was just crap at the time, right?

Spicer: Well, tell us-- tell us about USB. Now, that's a huge decision.

Rubinstein: It was a huge decision. Yeah, yeah.

Spicer: What made you choose that?

Rubinstein: Well, I mean it was clearly the new standard, right? It had the performance we needed. There were not peripherals out yet, right, but they were going to come, eventually. I mean, a million PCs had shipped with USB. They just-- no one used it, and...

Spicer: Are computers still shipping with serial and parallel ports at this...

Rubinstein: Yeah.

Spicer: ...at this time?

Rubinstein: They all had serial and parallel ports, and they had floppy drives. Right? And I mean, we got rid of all that, right? And so I looked at USB and USB was a good technology and Intel had done a good job on it and I knew some of the guys who had done it. I'd worked with one at HP before, so I had a connection into the team.

Spicer: Was there a competing standard that was...?

Rubinstein: Was-- we had FireWire but that was a higher-end thing and that was expensive and really meant for high-end cameras and video cameras and stuff. So it was too-- it was too high-end for a low-end product. This had to be a cost-effective product so FireWire wouldn't work for that and I needed a basic BUS to talk to like lots of peripherals, right, and FireWire wasn't that.

Spicer: So one of the things that you've said in an interview, which I brought up a while ago, too, is that Apple was-- when you came back and Steve came back, was very much concerned with ecosystem thinking.

Rubinstein: That's me, yeah.

Spicer: Oh, that's you?

Rubinstein: That's me.

Spicer: That's you. So tell us, because you're talking about peripherals and them all plugging into something central, it seems like a good time to talk about that, maybe. Can you talk a bit about that?

Rubinstein: Well, yeah. I mean, you can't do everything yourself, right, and so you need to build an ecosystem. Right? And so there's two ways to do it. You can go through a standards committee, IEEE, blah, blah, blah, and build a standard and then try to get everyone to adopt it and, I mean, it takes forever. And that's basically what I-- what we were doing at HP with HPPA and the cross-functional architectural committees and stuff, or you can grab a technology that's almost ready, right, and just go make it happen. Right? And if you can move quickly enough on the technology, you can-- that can become the standard, and it was clear to me that USB had that potential. It was very clear. I mean, Intel was behind us. They were investing a lot in it. There were a lot of machines shipping with it. The PC-- the printer industry and all those guys hadn't come around yet, but they were going to come around eventually. It was obvious, right?

Spicer: And its purpose was to replace the kind of unwieldly parallel cables?

Rubinstein: Yeah, we had parallel ports. We had serial ports, and you had like all...

Spicer: Just come up with literally something more "universal."

Rubinstein: Just something plug-and-play, right?

Spicer: Yeah, for...

Rubinstein: And so it actually led to a couple things. So I decided we were going to use USB. I sold it to Steve. He said, "Fine." Steve was-- usually trusted me around technology decisions, right, not always but usually trusted me on it, and so I picked USB. We did a-- I said, "We're getting rid of the floppy," and that caused a big debate but everyone came around.

Spicer: That was viewed...

Rubinstein: That was huge.

Spicer: ...as a shot across the bow, really...

Rubinstein: No, it was huge.

Spicer: ...really in the whole industry.

Rubinstein: Yeah, yeah, and we did the CD.

Spicer: And I think it was Steve who [at the time] said, "Well, when was the last time you used a floppy?"

Rubinstein: Yeah, right. I mean...

Spicer: And people kind of, "Yeah, I think you're right."

Rubinstein: Yeah, exactly. Right?

Spicer: It was the time.

Rubinstein: So we switched that, which-- but we needed to do a mouse. We needed to do a keyboard. I needed printers, right? Now, I had the advantage of I was just shutting down a billion-dollar printer business, right? And it's interesting because Wall Street never gave us credit for this but I shut down a billion-dollar printer business and our computer business never missed a beat. So that billion dollars of revenue got recreated on the computer side because we had good products, right, for first time in a while.

And so I called Epson and I called up HP and I went, "Dudes, I got a billion-dollar printer business. Anyone want it?" And they both went-- I called up all the printer guys. HP and Epson really jumped on it, and I said, "I need USB printers, and here's what I need to them to be." And both HP and Epson jumped on it. HP actually-- I mean, Epson actually built products that looked like the iMac, right, which was kind of cool, right? I remember they had the printers that kind of had the same colors and stuff and matchy-matchy, and VJ, this is when I first met VJ at HP. He was running the printer division. [Vyomesh Joshi]

Spicer: I'm sorry. I don't know him. Sorry.

Rubinstein: Yeah, he ran the printer division at the time, and-- or he was the number-two guy at the printer division. VJ goes, "Sign us up," and so we did these. Yeah, so we actually had the first USB printers, right, on the market to go along with the iMac, so-- and we worked with Harman Kardon to do audio. Steve almost fired me over that.

Spicer: Fired you?

Rubinstein: Yes, because...

Spicer: Oh, why was that?

Rubinstein: Because I took Jony's team and I had them do the ID for Harman Kardon because Harman Kardon's IDs were terrible and I wanted something to go with the iMac that was going to be really cool-looking. Right?

Spicer: Yeah, didn't bring the product down.

Rubinstein: Yeah, yeah, so I had Jony's team design something and gave the design basically to Harman Kardon. Steve went crazy and almost fired me for that, but yeah, so we built a billion-- multi-billion-dollar ecosystem around the iMac of peripherals.

Spicer: What happened to that billion dollars in inventory in printers? Did you...?

Rubinstein: It just got-- it got blown. I mean, Tim Cook took care of it at some point, right?

Spicer: Sold it at a...?

Rubinstein: Yeah, it got sold off or whatever.

Spicer: Auctioned it or something.

Rubinstein: Yeah. I don't know, but that was one of-- when Tim first came in, that was one of his first things was to clean up a lot of that inventory shit and so it got gotten rid of. Right? And...

Spicer: Got sent to a farm upstate or something? <laughs>

Rubinstein: Who knows? Buried in the bay someplace. I don't know. I mean, bring in a front-loader. I just-- I don't know. I don't want to know, but in any case, so yeah, I mean it was a really big deal. So we did the launch, that first iMac launch, and we're in rehearsals for the iMac launch and I'm in meeting with the CEO of, I think it was Quanta, Barry Lam. And the phone-- or Steve's admin comes in and goes, "Steve, on the phone is ringing." I'm busy in a meeting, right, and Steve's admin comes in and Steve wants to talk to me. I pick up the phone, and there is this insane person on the other end of the phone yelling at me. And I'm like, "What's going on?" Right? And Steve's just screaming at me and then slams the phone down, and I'm like, "WTF? I mean, what's that about?" Right? And then two nanoseconds later, Phil Schiller calls me. He goes, "You better get down here quick. Steve is having a meltdown."

So I go running down to the-- I forget. I think we were in the De Anza Auditorium, and Steve goes, "What's this?" And I'm like, "That's the Tray-load-- I mean that's the CD-ROM drive." He goes, "But what's this tray that comes out?" I'm like, "That's how they work, right? I mean, that's what all computers have." He goes, "Well, I want it to be like my car where you just-- you have slot-load." And I'm like, "Well, they don't make those." Right? And he goes, "Well, this destroys the product." Right? And so the next couple days I talk him down off the cliff because he was impossible, right? They were just coming out with some slot-loads, but they were in the full-size form factor. We were using the product that came out in portables, right, and the tray loads out of portables. So he calmed down. We did the launch. It was a home run. I mean, if you can watch that launch, it was great, right, the iMac launch, and...

Spicer: That was in Cupertino?

Rubinstein: That was-- yeah, that was at De Anza Auditorium, and I think it was-- yeah, I'm sure it was De Anza [Flint Center at DeAnza]. And it was a great launch and it was a great product and the iMac really took off and that's what turned Apple around, that product. Right? And so...

Spicer: I remember, just on a personal level, when it came out I thought-- I kind of went, "Finally, there's some"-- because I had wanted to buy Macs. It's not about me but I wanted to buy Macs for my Mom and Dad and the product space was so confusing, I didn't know what to buy.

Rubinstein: You didn't know what to buy. No one knew what to buy.

Spicer: Was it a Centris, a Performa?

Rubinstein: Yeah, it was terrible.

Spicer: There was another model. You just had no way, and all these weird numbers. Anyway...

Rubinstein: Yeah, so as soon as we're kind of in the midst of developing the iMac-- we had sort of addressed that problem organically by killing a lot of stuff, but then Steve really formalized from a marketing point of view, okay, we have our two-by-two. And when we started working on iBook and we'd already been doing PowerBook and PowerMac and we started doing iMac and then we started the iBook, the toilet-seat one, and-- which was a really special product and really an important product.

Spicer: Tell us-- tell us about that.

Rubinstein: Yeah, we'll get to that in a second, but-- so that's when we really formalized the two-by-two product matrix and started thinking about the product line that way and making it simple for everyone to buy stuff.

Spicer: How powerful was that, both internally and for your customers?

Rubinstein: Enormously, because you walk into a store, you knew exactly what to buy, right? Now, it's a little bit of a marketing gimmick, right, because in each quadrant we had sort of entry-level, medium, and high-end, right, because you could buy configurations of each. So from a product development point of view, we actually had a lot more work to do but, I mean, at any particular point in time, I had 30, 35 projects going, right, displays, keyboards, mice, multiple versions of each. I had three generations. I had the last generation, the current generation, and the next generation of every product, right, that was sort of in the queue. Right? So we were really busy as an engineering team, and we bottomed out at about 750 people. We grew back up to 1,200 - 1,400 during the next couple years and-- as the company got more successful. So-- and the iMac was a great product. I mean, it was the first generation. We just leveraged the G3 desktop board and put that in, and it came with a separate module. So LG built the display in Korea and then they got shipped to Singapore and in Singapore, we did the motherboard at the Apple factory. And that got then-- or maybe they went to Seoul and the motherboard got shifted in its enclosure from Singapore and they got integrated together there. Then, they got shipped to the US, some

combination like that, but we'd leveraged a lot. I mean, the one thing that was crappy about it was the mouse. That round mouse was terrible. Yeah, that was a bad product, right, and that was industrial design sort of...

Spicer: Trumping human factors.

Rubinstein: ...trumping human factors. Exactly. That's a nice way to put it, and we had several examples of that over the years. But that product is really the one that turned the company around, right, and got us going again and really getting back to high volume, and, look, at the end of the day, Fred deserves a lot of credit because he's the one who kept going, "We need to have an entry-level product. We need to have a low-end product." And that product took off in education. It took off-- I mean, it took off in the consumer space, and all of the sudden our market share and consumer space, which had dropped below 2 percent, was heading back up to 8-percent kind of range, right, so it was-- not in the overall PC business. That was-- we were still at 2 percent, but in the consumer space, it made a really big difference. It was a great product. People loved it, and we started the process of turning it. We did the next-generation version where the board was integrated directly into it. It was a new board designed specifically for that product and it was optimized and cost reduced and we made it much easier to manufacture. We went to different colors and patterns and we-- and in parallel, we started working with the iBook which would be kind of the sister product for the iMac. Right? And the big thing there was, now we're getting heavy into education and everything. We wanted to add networking that could be used in education, and the problem is that schools and homes but particularly-- homes are hard to rewire, and schools are impossible rewire because of asbestos. A lot of the schools were old, had a lot of asbestos, so you can't go digging in the walls. So we spent a lot of time looking at powerline, at wireless, at phone line, all the different kinds of networking. We evaluated them all and the conclusion we came to was wireless was the way to go and there were several choices. Right? And Intel was doing HomeRF, which was sort of the sort of more popular standard at the time. I mean, no one shipped it yet, but it had a lot of momentum going behind it. And the other one was Wi-Fi, which was mostly used for industrial control at the time. We did lots of research around what made sense and we decided wireless was the right way to go and, even though Intel was pushing HomeRF in the standards committees, we decided to do Wi-Fi. We thought it was a better standard, and there's technical issues between the two that we felt strongly that Wi-Fi was the right way to go. And I had a big argument with Pat Gelsinger, who was CTO of Intel at the time. Actually, we had an argument about three things. Firewire verses USB 2, he won that one, but then he had some control over it because he took FireWire out of their chips. And Rambus versus RDRAM, I won on that one on the RDRAM side. And Wi-Fi versus HomeRF, and I won the Wi-Fi. So I got two out of three. Steve tried to charge Intel to use FireWire and as-- for a license fee and Intel wasn't going to pay a license fee and so they just dropped it out of their chips and that was kind of the end of that.

Spicer: Did that doom FireWire for-- as a standard?

Rubinstein: Basically. Basically that doomed FireWire.

Spicer: And no other vendor was making the chips or...?

Rubinstein: Well, we-- I mean, we had suppliers for the chips. Intel wasn't making chips. They were going to incorporate it in their core-- into their core chipset for-- they were going to add it to PCs, right, because we had it in our higher-end Macs, and if you're going to do video editing or anything like that, you needed it.

Spicer: Oh, so FireWire could have been on PCs at some point at...

Rubinstein: It was. I mean, it was plug-in but, yes, it could have been standard in high-end PCs, actually in all PCs eventually if we hadn't gotten in a pissing contest with Intel. It was the first of several pissing contests, but any case, we picked-- we picked Wi-Fi, decide-- had to go figure out where we were going to get the technology from, did a-- sort of scoured the earth. And we found a small group up in the Netherlands that had been, I think, part of NCR and then sold to AT&T as part of the merger and then it had been spun out to Lucent and they were kind of this little group up near Amsterdam. They were outside of Amsterdam someplace and they were kind of doing their own thing and they were doing Wi-Fi for industrial control. And a Wi-Fi card cost a couple thousand bucks and a base station cost around $10 grand and they were happy doing their thing. And the standard was-- it wasn't-- I mean, there wasn't an IEEE standard yet. It was evolving still. It hadn't been declared yet, and so we found them and we decided that was what we were going to use for the base foundation of our technology. And Lucent was doing a second-generation version of it with the chips that they were doing and stuff and so we made a big decision that we were going to adopt that. Tim Cook did a great job negotiating a deal with them. I mean, he really-- we spent a lot of time together over there working on this, and he really convinced them to drop their drawers and give us pricing that was unbelievable so that we could do basically $100 plug-in cards and couple-hundred-dollar base stations, which was dramatically different pricing than where it had started, which is what it would have taken to enable.

So we made a decision that we were going to put it in the iBook first because that was a portable product that was meant for education, right? And so while we were developing the iBook, we said, "Okay iBook team, you now have to add antennas." And they went crazy, right, because first of all, it was a big cost hit, right? I mean, they had to add connectors for you to plug in the card and they had to add antennas into the product and-- but because it was all-plastic product, it was convenient to add antennas to. And so we did that.

Spicer: Did you have to hire people, the RF specialist team?

Rubinstein: We had some already, right, because ATG had been doing work on this for a while, on just wireless in general, not specifically Wi-Fi, right, and we tuned them down to Wi-Fi, but we did hire some people. Yeah, we hired some people, and we had some interesting people go through our Wi-Fi group over time. The guy who did Ubiquity, he was an intern in our group and on the weekends, he was doing point-to-point Wifi base stations in his living room and he spun that out as a business and now they have a multibillion-dollar business doing Wi-Fi stuff. So but yeah, we hired some people in, and-- but we had a core team that was already doing wireless from the old ATG days and so we got them and we built it into the first iBook. I think one of the finest launches we did-- the finest moments, was when Phil Schiller jumped off the-- at Javits Center, jumped off the top of the scaffolding. So the schtick-- we wanted to have

a schtick, right, and so we had two things to do for the introduction. One was we had this big scaffolding. It was way up in the air, and then there was one of those bags down below that you use in the movies, right, to land on.

Spicer: Like a pit, sort of.

Rubinstein: Well, it was those airbags that you land on, right?

Spicer: Oh, yeah. Right.

Rubinstein: So you-- so it blocks your fall.

Spicer: Oh, my gosh.

Rubinstein: So we took an iBook, we put an accelerometer on it, right? We put Phil Schiller on top of it, and we threw him off of it to land on the airbag and then wirelessly we broadcast the data from the accelerometer on the screen. So you could see the-- him jumping and landing and everything, right?

Spicer: Was he holding the computer?

Rubinstein: He was holding the computer this way, right?

Spicer: Okay. Thank you. Yeah.

Rubinstein: But so we come up with this idea, and Schiller, I mean the running joke around Apple at the time was Steve would say, "Jump," and Phil Schiller would go, "How high?" <laughs> And let me tell you, this was high, so we actually bought a-- we brought a professional stuntman in, right, to teach Phil how to jump off. You got to kick your legs and then you got to roll your back and so you got to land right and he had to hold the iMac-- the iBook in a certain way and it was a big drama to get this. So-- but it was a great demo. The morning of the show, we're rehearsing this, right, and the chief legal-- the CEO or whatever or the Javits Center was there watching us do this. And he sees Phil or-- Schiller jump off this thing, and he goes, "Stop the show. You can't do that." Right? And so Nancy Heinen, who was there, got with their chief legal counsel and on the back of her business card wrote a liability release for Javits for Phil to jump off of it. Any case, Phil jumps off of it-- I mean, no one had ever seen anything like this before-- and wirelessly broadcast the data. And then, every fourth or fifth seat in the audience, we put an iBook below it. Right? And so then Steve goes, "Okay. Everyone reach below." And we had Apple employees in the audience, right, and everyone pulled out their iBooks and started surfing the internet wirelessly in the audience. I mean, it was...

Spicer: Wow.

Rubinstein: It was unbelievable. [https://www.youtube.com/watch?v=1MR4R5LdrJw]

Spicer: That is...

Rubinstein: It was so cool.

Spicer: ...spectacular.

Rubinstein: And that's the beginning of Wi-Fi, right, of commercial and...

Spicer: Really?

Rubinstein: ...consumerized, commercial, consumer Wi-Fi. Yeah, three years ahead of Dell. Dell claimed, "We're the first with Wi-Fi," three years later, right, but we'd been shipping it. And we put the antennas and the connectors and stuff eventually in all of the products, but the iBook was first, right, and then eventually we just built it in. We started working with Broadcom, with Ed Frank at Broadcom, and Ed did chips for us. So we could integrate it in, and eventually, those integrated with Bluetooth and continual integration. But yeah, so that was sort of how Wi-Fi got going, and we shipped $20 million worth of antennas and connectors before Wi-Fi really got any real-- that's a lot of connectors and a lot of antennas, before it got any real traction.

Spicer: And then, so could you relate that maybe to Bluetooth and the different purposes they serve and when...

Rubinstein: Well, yeah. I mean, from our perspective...

Spicer: ...when Bluetooth came on board?

Rubinstein: Yeah, I mean, Wi-Fi was for networking and, in the beginning, the Bluetooth guys wanted it to be for networking and we kept telling them, "No, you're peripheral connect." But they had delusions of grandeur so we had to keep beating them down, right, and eventually I think they finally embraced their role in society, right, of being a peripheral connection instead of a network, although I think they still occasionally get delusions of grandeur but...

Spicer: Because it's not obvious to me why you would need another network just for short range if you've already got...

Rubinstein: Massive power difference.

Spicer: ...wire-- Wi-Fi.

Rubinstein: No, but it's a massive power difference, right? Bluetooth is low power to real low power, depending on how you use it, right, whereas Wi-Fi takes a lot of power. Right? And so-- and you don't need Wi-Fi for-- I mean, you don't need all the stack and all that, networking stack and stuff for and interconnect for peripherals. You don't want that. It's too much overhead, right, so it-- Bluetooth is much

simpler. It's much lower power. Frankly, we need something that's even lower than Bluetooth and there's Zigbee and a whole bunch of other things that people are working on but nothing has really caught-- gotten traction and stuff. I mean, I looked at a bunch of this when we first did the iPod stuff with Nike and talking from your iPod to your shoe because we used to have a little module in the shoe. You've got one of those here in the museum. I gave you a pair of sneakers for the museum that-- the first pair that had the NikePlus but you need different interconnects for different purposes, right, and...

Spicer: But has Bluetooth-- like why would you need one slower than Bluetooth, do you think?

Rubinstein: Lower power.

Spicer: Oh, even...

Rubinstein: Bluetooths use a lot of power.

Spicer: Even lower power.

Rubinstein: Yeah, even lower power. Yeah, you want to run it off like a battery that lasts 10 years, right? I mean, Bluetooth, the battery lasts a day, right, or a couple of days. Right? You need something where the battery lasts 10 years, right, and so you need really low-power communication stuff and you-- typically, that's very low bandwidth, too, so those go together. So-- but it's all about convergence of the right technology to go with the right purpose and when those all come together. In any case, we start shipping this Wi-Fi thing. It's like magic, right, and it starts getting some real momentum and we've got these base stations and it's part of the Mac ecosystem so it's why people would buy Macs, not PCs. But I'm like, the PC industry, at some point in time, shifts to Wi-Fi because we've-- the IEEE Committee finishes the Wi-Fi standard and you start getting PCI cards with Wi-Fi on them for PCs. And they start putting them in them and then you got a couple of companies started building base stations and...

Spicer: So Apple would have been on the relevant committees, right, at...

Rubinstein: Yeah, yeah, we were on all the committees and everything. Yeah, we did all that stuff.

Spicer: Yeah, and did your de facto work influence, like sort of...

Rubinstein: Yeah, yeah, yeah.

Spicer: ... push things in your direction already?

Rubinstein: No, absolutely. Yeah. Well, interestingly enough, so HomeRF, the HomeRF guys wanted to change the FCC standards to make it better for HomeRF versus not as good for Wi-Fi versus how they were currently. And so I spent a bunch of time in D.C. at the FCC and at the House Telecommunications Commission talking to people about why they shouldn't change the standard and why Wi-Fi was the right way to go and why you shouldn't let Intel change things, right?

Spicer: Is that the Part 15 thing?

Rubinstein: I don't...

Spicer: The one with interference with your TV and all that?

Rubinstein: No, no, no. This is specifics around the standard of the unlicensed band, right? So there's a bunch of requirements around the unlicensed band, and Intel wanted to change a few of those license-- a few things around the unlicensed band to make HomeRF work better because HomeRF [uses] spread spectrum and-- or frequency hopping. And we're channel-oriented, and so there were some things around that that Intel wanted to change. So I spent a bunch of time with Powell, who was running the FCC at the time, and the other FCC commissioners and the CTO of the FCC, who ended up at Cisco a few years later, really smart guy [Robert Pepper]. I forget his name, and then some of the people on the House-- any case, we head them off at the pass. Wi-Fi became sort of the de facto standard and I'm looking at this and I'm going, "This is a big business." Right? Our base stations could be used because we're just a PCI card, right, so we could take our PCI card that goes in our Mac, plug it into a PC. We could take our base station. We're missing one thing, and that's the application that runs on a PC to configure the base station. It's not a big deal. We weren't using browser-based stuff at the time. Right? These were all custom apps, right, so we had a custom app on the Mac. So I go to Steve, and I said, "Look, I need three, four people. I'm going to port our custom app on the Mac over to a PC version, so we can enter the base station business on the PC." Steve goes, "Over my dead body." I said, "But Steve, it's like three, four people. I mean, we already have it running. We just need to productize." "No." All right. So I'm like, "All right." "No." I mean, I had lots of other things to do, so...

Spicer: Did he give you any reason or...?

Rubinstein: He just-- he thought that was part of the Mac ecosystem and didn't want to...

Spicer: Oh, it was-- it was unique to...

Rubinstein: It was unique to the Mac ecosystem.

Spicer: A value proposition.

Rubinstein: Value proposition. Our base stations were better than anyone else's. They were. They had lots of features no one else had. We had mesh. No one else had mesh. Until Eero came out recently, no one else really did mesh. We had that. We had easy configuration. There was no SSID, right? I mean, it was the name of a network. I mean, it was Mac-like, right? Everything was simple. Right? I mean, you had a simple name, password. I mean, it wasn't-- it wasn't this bizarre shit you got on the PC side of things, so I wanted to build a multibillion-- I mean I said, "This is going to be a multibillion-- I want to build a multibillion-dollar networking business." Right? And Steve went, "No way. We're not doing that." I said, "All right, so we're not doing that." So we kind of put that aside, right, and-- which then came when we did the iPod later one. I dug my heels in, and we'll get to that in a couple of minutes.

But so that was sort of Wi-Fi. I'm like super, super proud of what we did there. I mean, it was like so special and, I mean, think about the-- we never figured-- we knew it would do really well in homes and in schools. But we named it AirPort Base Station but that wasn't because we thought it was going to actually be in airports. Right? I mean, that was never in our thinking. Starbucks, McDonalds, I mean, we never thought about it that way. Right? And anyone who says we did isn't-- is fibbing, right, because we didn't think that big. Right? This was, how do we sell more Macs? I mean, that was our goal here, right, is we had such a small market share, we wanted to sell more Macs and we were searching for any way we can to get people to buy more Macs and to love the Mac even more. Right? And so this was one of the ways to get more into education, to get more in the consumer space so...

Spicer: So within the Apple ecosystem or the Mac ecosystem, could basically every device talk to-- was every device Wi-Fi enabled?

Rubinstein: Eventually.

Spicer: Eventually.

Rubinstein: I mean, we went around the quadrants, right, and we started with the iBook and then we went to the PowerMac, then the PowerBook, and then the iMac. Right? So we just kind of worked our way around. As we were doing future product releases, kind of in the order of product release, we were adding it, and so we'd have to add-- initially, we added a PCI slot and an antenna into the product. And then eventually, we just integrated it in completely, and look, this led to issues. Right? I mean, iPhone AntennaGate has a long history behind it, right, because we did the first-- the first metal iBook was the Titanium iBook-- I mean PowerBook. Right? The first PowerBook with Wi-Fi was the Titanium PowerBook, and its antenna performance sucked because it was a metal enclosure. And I said, "We need a slot this big to get the antenna performance," and Jony and Steve didn't want a slot that big because it didn't look good. So we had a smaller lot, shitty antenna performance, right, and that gets repeated over and over in history of-- and culminates in AntennaGate, right, so on the iPhone. So but no, we ran it around all the products, so within-- I don't remember how long it took us, but within a year or two years, whatever, year and a half, all of our products were Wi-Fi ready. And then, we just started building it in, right, into products where it just came in like as default in the product.

Spicer: So I want to pick up on something you just said which is the-- you want a strip this big, but it really needs to be that, so big, whatever. Can you describe how the ID team [ph?] and the engineers would have worked together? Like, the engineers just look at-- or is it, maybe it's just you and Jony sit...

Rubinstein: No, no, no. It was the engineers on both sides.

Spicer: Okay, but the sort of...

Rubinstein: But then it would bounce up to me and Jony.

Spicer: Okay, so they would look at the proposed antenna topology, and the engineers would just go...

Rubinstein: "We need a slot like this," and...

Spicer: ..."This is not going to work."

Rubinstein: ...ID would go, "No." Yeah.

Spicer: And the design guys would go, "I don't like the way it looks," so...

Rubinstein: Well, they would do an ID. We would do a design. Right? I mean, the ID team and the engineering team, the-- Jony's team would do an ID. The engineering team would be doing design at the same time, and then we put them together, right, and sometimes stuff didn't work.

Spicer: And this is where the tradeoffs have to...?

Rubinstein: And that's where the tradeoffs happen. Yeah.

Spicer: The horse trading. Right, yeah.

Rubinstein: And so I'd fight with Steve all the time about those tradeoffs, right, and sometimes I'd win. Sometimes, I'd lose. Right? And so that was what I lost and we paid the price for it because the performance-- antenna performance in Titanium PowerBooks was shitty. It's too bad.

Spicer: By the way, just out of my personal curiosity, is it [the] antenna that was coming out the back on its own...?

Rubinstein: No, no, no. It was built into the enclosure.

Spicer: No, no. I know, but sometimes-- and I think you said initially they were cards with an external...

Rubinstein: No, no, but it didn't have an external antenna.

Spicer: Oh, you did not?

Rubinstein: We always built the antenna in, right, so if you look at an iBook, original toilet-seat iBook, right, you could see the antenna wires up against the plastic around the corners of the top of the display. Behind the display, right, you could see the wires and then it came down and then it had a little RF plug that would plug on to the-- into the card but that was all inside. We never put anything outside. Let me-- I mean there was-- there were some versions of the AirPort base station that we sold an external antenna for where you could plug an antenna in and stick it up on top of a shelf kind of thing. That was just an accessory.

Spicer: I was curious how an internal antenna compares to a separate-- I shouldn't stick that in there-- separate, freestanding, rubber antenna this high or something. I mean, is it...?

Rubinstein: Depends how good the antenna engineers are.

Spicer: I guess so, yeah.

Rubinstein: Right? If they're good enough, it shouldn't make a difference.

Spicer: Oh, interesting. So like with AntennaGate, since you brought that up, is that-- I mean, the solution was really to hold--sort of modify the user behavior, I think, to...

Rubinstein: Well, that's not really a good solution.

Spicer: ...to hold it differently. I mean...

Rubinstein: Yeah. I mean, that was the initial answer.

Spicer: That was the initial answer.

Rubinstein: But that's not the good-- that's not a good answer. A good answer is to design the product so that the antenna works.

Spicer: Right, so did they...?

Rubinstein: I wasn't there at the time, so I don't know. Right?

Spicer: Okay. I was just curious.

Rubinstein: But it's-- there's a long history behind these tradeoffs and not always getting made in the right direction. So that's kind of the Wi-Fi story, and it's-- it was, again, we did it to sell more Macs, right, to-- and we had no idea it was going to become such a thing. And it's great because everywhere I go, I'm connected now. It's awesome.

Spicer: It's so interesting how the pieces come together, and in a way, the smartphone has kind of integrated everything. Anyway, is it time for the iPod yet?

Rubinstein: Well, we did lots of products, right?

Spicer: What did you do between...?

Rubinstein: I mean, we did...

Spicer: After the...

Rubinstein: We did the G5 PowerMac which was a really high-end product, which was a great product. That was a real slog with IBM, who did the processors, G5 processor for-- it was an amazing product. We did lots of PowerBooks, so kind of in the middle of all this, we start brainstorming, Steve and I and Phil and a few other people start brainstorming about it. Okay. We have our quadrants. How do we get people to adopt the Mac? How do we create an ecosystem that people adopt the Mac for, and what peripherals do we have to have to make the Mac special? And Sina Tamaddon, who no one has ever heard of, right, but Sina is-- basically, I ran product development. Avie ran the operating system. Sina ran all the applications, so all those applications you love, the guy who did them is Sina.

Spicer: Could you spell their name?

Rubinstein: Sina, S-N-I-- S-I-N-A. Sina Tamaddon...

Spicer: Thank you.

Rubinstein: ...right, T-A-M-A-D-D-O-N. Right? and Sina had been with us at NeXT. Sina had been at Sun originally and was like sales support or something at Sun and then joined NeXT in sales support and-- but Sina is a natural product guy. Right? And he loves audio, video, all that stuff, just loves it and has a very good sense of products. He's a very quiet guy, and so when-- shortly after NeXT was acquired, he wasn't part of the original group, but then Steve brought him on to kind of help out with stuff, same thing with Nancy Heinen, joined later as well. And-- but so Sina took over the applications, right? There weren't any, really, in the beginning, right?

And so Sina started-- I mean, I think the first one was iMovie, I think, right, I think, was the first one. Right, and that was, we take FireWire-- Sony cameras have-- had FireWire. You can plug it into a PowerMac, which has FireWire, and we basically bought-- there was an application that had been developed at SuperMac in-- under Steve Blank's reign. It had been sold off to Macromedia, and then we bought it. Sina bought it from Macromedia, right, or got the team or some variation and they basically re-did it all and that's what became iMovie. Right? And so we were doing the movie editing and stuff like that on the Mac and I think it came about the guys who everyone was using at the time-- it was a company in Boston [AVID]. I forget the name, but they were going PC because they were-- they had given up on the Mac. And so we decided we'll have to do this stuff ourselves, so we started doing a lot of the apps ourselves.

So the first one was iMovie, then iDVD, right, and any case, we need to do music. HP caught us with our pants down, right, and with the "Rip. Mix. Burn." stuff. Right? I mean, they put CD burning in their high-end towers for the PC group, and we didn't have-- we didn't have that yet. So we did a quick scramble, and we bought this small company that had been ex-Apple guys who had been doing a music app [SoundJam]. And Sina bought them and that's what became iTunes, right, and we retooled it for iTunes. And we took it into the PowerMac first because the only CD-burning drives were full height, and the only product we had-- because everything tried to get miniaturized, the only full-height product we had was the tower. So it went into the tower first. I think it was probably the G4 tower, but I don't remember. You can look all that up [G4 Tower was first Mac with CD-RW]. And so it goes in the tower and we start doing this

video editing stuff, right, and music collection. Right? And so we had the "Rip. Mix. Burn." thing, and through that development, we start playing with the portable music players.

So we looked at video cameras. We looked at still cameras. We looked at cellphones. We looked at pocket organizers and music players and maybe one or two other things, and the idea was that the Mac was the center of your digital universe, right? And that the Mac made that device that much better because the software on the Mac enhanced the experience of using that device. So that's basically what iMovie did with the Sony cameras. I mean, it used to be you could take a video camera, as much as you want, and then what did you do with it? It sat on a tape in a drawer someplace, right, but the ability to download that into a computer and then actually edit it and create your own movie from it was dramatic improvement in value to having that camera. Same thing with still cameras, right? And eventually, that ended up being iPhoto, right, which Sina did, as well. So the music thing, so we're doing this music thing. We know we're going to roll CD burning into all of our products, eventually. I'm busy working on a CD-burning version for the iMac. It took a long time because it had to be slot load. Steve had twisted my arm into doing the next generation of iMac with a slot load drive instead of the tray load. That was-- we had a big fight, and he finally put his arm around me and said, "We're best friends. Do this for me as a personal favor." And it wasn't the wrong thing to do, but it wasn't the right thing to do. And so I go, "Okay Steve, we'll do it," but that meant that it took us longer to get the-- to get CD burning into the iMac but we got it into the bigger products first and then eventually it-- and into the portable products because they used tray load and the earlier ones used tray load. But so we're all playing with these music players, and they just suck. Right? There's little, tiny ones from Nike and from Philips.

Spicer: Sorry. At this time, were you thinking of accommodating other people's peripherals or making your own?

Rubinstein: Yeah, we were thinking about everything.

Spicer: Or making your own, as well?

Rubinstein: Well, we were. We were accommodating other people's cameras, other people's video <inaudible 00:26:16>.

Spicer: Right, but their...

Rubinstein: But we wanted to find something that we could do ourselves that we could build an experience that would blow everybody away, right?

Spicer: So you weren't just trying to accommodate everyone else's mp3 players. You eventually decided...

Rubinstein: Well, we started off as, is how do we make everyone else's mp3 players much better, and then we realized they all suck. We better do it ourselves, right, and so I put together a team just to investigate. Mike Culbert, who was CTO, who is unfortunately gone now, but Mike is probably one of the

smartest technology guys I've ever met. He was on the Newton team. He did like all the power management for the Intel versions of the Macs. I mean, he did like such dramatic, important work, so he helped out with that. I had Stan Ng, who was the marketing guy. I mean, it was a group-- small, core group of people who-- and I worked on it-- core group of people kind of worked on the concept and what we do. And so there was little, shitty products, Philips and Nike, and then there was these really big products, Creative Labs and other people, and they were disk-drive-based, USB 1-based so they were really slow. It would take you 10 hours to load the content, and they were big and heavy. Right? And you couldn't run with them. You couldn't-- I mean, because they had to sit on a tabletop because they were not portable, really. So we had all these products and they were terrible so we kind of said, "Okay, let's look at doing it."

And the first look we took was in late '99 probably, because I'm thinking we released in 2001. No, so it would have been late 2000, mid-2000. I'm losing track of time, but it took us a little over a year to do the first one, came out in 2001. So it would have been 2000. Yeah, so late '99, we started looking at this stuff and playing with it, and we couldn't find something that really worked. Yeah, it was probably mid-2000, couldn't find something that really worked.

Spicer: Would you say the storage issue was the main bottleneck?

Rubinstein: Yeah. I mean, there was a bunch of different things, but the storage issue was the big one and we had FireWire, right, so we had the solution. And almost of our products-- not the lowest-end ones but almost all of the products had FireWire in them, right, and maybe even the lowest-end ones had it. I forget, but we had FireWire, right, which means you could load the content really quickly.

We needed a small, cheap display. We needed a small, cheap battery. We needed a processor, right, and we needed storage and so I started scrounging around for all this stuff and trying to put the pieces together. And I was hanging out at Almaden at IBM Research because I was friends with Nick Donofrio and Nick said, "Come on by. Take a look at our technology. See if there's anything you want to use." So I took a look and I saw the Microdrive when it was under development and I reached out to the Microdrive Group and said, "Hey, I need five gigabytes and this price." And they laughed at me. Right? "Never going to happen." I'm like, "All right," and so I said, "Okay, good. No problem."

And so I kept looking and eventually I was in Japan and found the Toshiba drive and they weren't really sure what to do with it because it wasn't-- it didn't have enough capacity to really go in a PC. Right? And I was there and they were taking us through their roadmap for all of our other products, and at the end of the meeting, they go, "We have this other thing. Would you like to take a look at it?" I'm like, "Yeah, sure. I'll take a look at it." So we looked at it, and like it's obvious, right? This is how to make an iPod, right? And Jeff Williams is there with me, and I'm like, "Jeff, we need to get all of these." So Jeff goes, "Yeah, we think we have an idea. We can use this. How many of them can you make, and can we get exclusive?" And he started the whole exclusive conversation, so I-- Steve was in Tokyo, so I said, "Steve"-- and I've told this story lots of times but, "I need a $10 million check to go do development on this." And Steve goes, "No problem, I'll write you the check."

So then I talk to Fred to make sure the check won't bounce because Steve-- Fred was the guy who actually wrote the check, not Steve, and Fred goes, "Go ahead. The check won't bounce." And so Jeff's negotiating exclusive on the drive, while we had been over there, we had found batteries and displays, so-- because the cellphone industry had really started taking off with-- remember, cellphones used to have single-line displays, and it had just been recent at that point in time that the bigger displays, black and white-- they were not color, they were black and white-- displays had started becoming available, same thing with battery technology. Right? The lithium ion battery technology had just started getting incorporated in cellphones, so there was this convergent of great technologies. Right? And the form-factor was self-evident. It was going to be about the size of a pack of cards because if you took the display in the battery and the circuit board and the hard drive and the connectors you needed on either side, that defined the form factor. Right? And so we had a basic design. We had to find a processor. We had to assemble a team to actually go do the work. Jony and his team started working on our ID, and we'd get together and brainstorm about-- with Steve and Jony and Phil and I and a couple other people would brainstorm about, how does it all go together. And Phil Schiller is the one who came up with the scroll wheel. He had a B&O phone, an old B&O phone that had the scroll wheel, right, and they didn't have acceleration in those days. But-- so we grabbed that idea. We patented it right away, and we actually ended up licensing that patent back to B&O. I don't think they really knew that we'd lifted it from them, but that validated our patent, which was really good. And I started looking for-- assembling a team and I started pulling resources from various parts of the group, although the iPod team was going to leverage all the other teams as far as the disk drive group and the display group and the power supply group and the interface group and the various kinds of I/O. And we needed to put a core team together to do the processor for it and then a software team to do the low-level software.

Sina's team was going to do the user interface for it, but we needed to put sort of an operating system and a-- the basic underpinnings of the middleware that would support the GUI. And so Sina's team started working on a GUI for it, and we started working on the low-level software. So I needed someone to manage the team, and so I started going through my-- there wasn't anyone at Apple I wanted to do it because all the really good people I had at Apple, I couldn't pull off of what they were working on, right? I mean, it was too important that they get the quadrants, the AirPort base station, the displays. All that stuff needed to get out. We were in a very critical time in the company, and so I decided to go outside and take a look outside. So I called Ali Alasti, who is one of the managers at-- who had worked for me at NeXT and Ali is a great engineering manager and he was at Sun at the time. Actually, he was at some company that was getting acquired by Sun or had just been acquired by Sun or something or other. And I think Ali had been at Go or at one of those other companies around doing Newton kind of stuff, right? And Ali goes, "I can't come. I'm busy doing it but I know this guy, Tony, and he might be interested." So I call Tony up and Tony was on the ski slopes skiing. And Tony has re-spun the whole story that he came up with the idea of the iPod and that Steve called him and, I mean, that's all nonsense.

Spicer: This is Tony Fadell you're talking about?

Rubinstein: This is Tony Fadell. Yeah, so I drag Tony in. I convince Tony to act-- he didn't want-- I wasn't sure we were going to actually do this yet. So I didn't want to hire someone. I wanted a consultant, so I brought him in as a consultant to start the research around doing the product and so we assembled a few

people around him, some people from the CTO group, Stan from the marketing group, a couple others and a couple EEs. And they started doing the basic work around which processor would we use, what middleware would we go get, or where would we get it from, what OS would we use, all that type of stuff. And so we got to the point where we had selected all the pieces we need. We had found PortalPlayer. They-- there was five or six solutions on the market or coming to the market. PortalPlayer had the best one. They had a low-level OS we could modify and do what we need. We found some middleware at another Apple spinoff that was doing middleware for cellphones and we could leverage what they did. We ended up-- we started licensing it up, and we ended up buying it from them and we had all the pieces and...

Spicer: Sorry. What was the processor you chose?

Rubinstein: PortalPlayer.

Spicer: The processor?

Rubinstein: PortalPlayer.

Spicer: Oh, is that a chip?

Rubinstein: That is a chip. They make processors.

Spicer: Oh, I'm sorry. I thought it was software.

Rubinstein: No, no. Yeah, I forget the name of the software company [PIXO], but they did middleware. I mean, PortalPlayer had a low-level OS which we then modified and then we bought the middleware and then Sina's team did the GUI on top of it. And so like, "Okay, here's a real budget. Here's a real schedule. We have the beginnings of an industrial design. Tony, I need you to lead the team." Tony goes, "Nah, I don't-- I'm going to go off and do my own thing." It sounds like, from what I've read since then, he was thinking about going and then, at that point, doing his own iPod, kind of ripping us off for what we-- the development team had done, but I twisted his arm really hard and he finally agreed to lead the team.

So I put him in as team leader, and we built a cross-functional team. In the beginning, it was 20, 25 people to do the first iPod, and we did it in 11 months. So we really started, and we really got going in February. It could have even been March, right, and we launched it in-- basically the week I got-- the week after I got married, or we had to postpone the launch for my wedding, right, and-- because I had set my wedding date. And Steve goes, "Okay, we're going to announce this date." And I'm like, "No Steve, I'm getting married then, so a week later we can do it." So we postpone the launch for a week. In October of 2001, I got married October 13th. It was a week or so later [Oct 23rd] and then we actually started shipping in November for Christmas. And so it was the first product we'd really ever done in less than a year, and we really humped on getting that done. It was-- and it really stressed all the systems, but it came out great. It was a great product.

Spicer: Did that set a pace for Apple that's been...

Rubinstein: Yeah, yeah. We kept turning-- I kept turning up the crank, right? I mean, it's my fault if everyone just like complains about working too hard at Apple because every product we do, I would accelerate the next one, right, and so the pace of innovation kept increasing. Right? And frankly, I was shit terrified, right? I mean, for the iPod, I mean, Sony should have killed us, right? They owned this space, right? They'd sold 300 million Walkmans, all right? They owned the content. I mean, they had Sony Music, right, so there was no reason why Sony shouldn't have owned this space. So I figured, hey, it's just a matter of time. Sony will wake up, and they're going to kill us because they got great-- they were great engineers. It wasn't like we were better. We were very good engineers, but they had very good engineers, too. Right? And I mean, Sony builds great products. Matter of fact, Steve was always in awe of Sony's products. That was sort of-- I mean, he sort of used Sony as the, you got to build products like Sony, right, at least in the early days. I mean now, it's a different-- no, they're coming back again. They're-- I mean, the new TVs are pretty good. There was a period of time where it was not so good, right, but the new stuff is pretty good. But they were the company that Steve always held up to go, "This is what we need to surpass."

Spicer: Now, that's a shift in mindset, though, towards a-- more of a consumer electronics competitor.

Rubinstein: Well now, so this is interesting because...the company, at this point in time, is about to make a transition from being a computer company to a consumer company, not just in the iPod but the computers, too. Right? I mean, there were almost no enterprise products.

Spicer: So tell us about that.

Rubinstein: Well, I mean so Steve hated enterprise. When we did the G5 tower, I'm like, "I can do really great products for the enterprise for content creation." So Steve went, "Okay. Go ahead and take a look at that." So I went to New York. I went to visit a whole bunch of studios. They were doing advertising, movies, all that stuff. They were using Macs and SGI and Cray computers. I mean, they had it all, right? I mean, there was massive compute to do video editing and to do content creation and content management and all of that stuff, massive storage, massive compute, all of that. So I talked to a bunch of their CIOs, and I created from that like the Mac version of what a server and a RAID drive would be. So we created the Xserve and the Xserve RAID, right, and we took the G5 tower.

Spicer: Those were-- those were lovely.

Rubinstein: Great product.

Spicer: ...beautifully done.

Rubinstein: Loved those products, right, and so they were home run products from a design point of view and people loved them but Apple was not an enterprise company. Steve didn't like having to talk to customers, and in the enterprise, they're going to buy 100 Xserves and Xserve RAIDs, they want to talk to

the CEO. And I mean, there was one event where there was, I don't know, 500 CIO's in a room in Vegas or something, and Steve was supposed to fly there and talk to them, and he didn't get on the plane, and he left the poor guy who was in charge of enterprise sales kind of high and dry to do the dance, so in any case, great products, really interesting, but Apple was not the company to sell them at the time. It's too bad, too, because they were really good, so that was kind of a detour we took on our product development roadmap, and eventually they shut all that stuff down because it just wasn't our customer base, so we brainstormed a lot about what do we want to be when we grow up and what kind of company we want to be, and clearly the answer is you wanted to be a consumer company, still build computers but build consumer computers, which is why Apple's not really successful in the enterprise and probably, unless they've changed something dramatic in their DNA, will never be because they can't do the kind of things that are necessary, basic security stuff. You want to get enterprise-class security monitoring on a Mac. You can't do it. I've worked at hedge funds for years. I advise at hedge funds. It's hard to use Macs at hedge funds because you can't monitor all the systems, and in a hedge fund you need to monitor every computer in the place, so there's lots of software that military people have left the CIA and NSA and all those places and built up really cool software that monitors a whole network of what's going on and monitors what's going on on the computer and all that, and you can't run any of that shit on a Mac because it just doesn't work, so it's coming but it's not their focus, and this dates back to history. At one point in time Gateway tried to acquire us. When we did that big downturn, I think it was around 2000. The shit hit the fan, and our sales dropped off a cliff. This was before Thanksgiving. Dropped off a cliff. And everyone else in the PC industry is going, "No, no, everything's fine. It's just Apple," or saying "We're all good," and Kodak falls off a cliff, and the consumer companies start going over this cliff, and eventually everyone goes over the cliff, and so at that point in time before Gateway had gone off the cliff but we had, Gateway came in and tried to acquire us.

Spicer: And this is 2000, when the dot com--

Rubinstein: Yeah, during the whole dot com explosion, yeah, yeah, yeah.

Spicer: --thing is about to plummet.

Rubinstein: '99, 2000, something like that.

Spicer: Okay.

Rubinstein: Sometime in that time frame. I don't remember exactly when, but it was that Thanksgiving, I remember, things went to hell. The world just died, and it's interesting because it's in that period of time from then to when the company started going up again, there was like a year and a half, two years, we ran at a loss, which Wall Street hated. Our stock went to shit again, but we invested in R&D unbelievably, so Mac OS X got developed, massive development during that time, iPod, a lot of the products. We were just cranking during that time period, and Fred was running the company basically at a slight loss to break even, right in that range, and it was very carefully controlled because we wanted to invest everything we could in R&D, so when the market turned around, we exploded, and that's the beginning of the big uplift on stuff, so, yeah, it's been phenomenal since then, so we did a huge investment during that time and--

Spicer: What kind of things were you investing in?

Rubinstein: Mac OS X, iPods, the product lines, all of that got invested during that time.

Spicer: Well, let's talk about the software at some point. <laughs>

Rubinstein: So, in any case, so we did the first generation iPod. Walt Mossberg decreed it was too expensive and it would never be successful. It was successful, but it wasn't a rocket ship or anything.

Spicer: Did you come out with the thousand songs in your pocket thing right away?

Rubinstein: Yeah, yeah, yeah, yeah, yeah.

Spicer: And do you know who came up with that or...?

Rubinstein: Yes. Steve would say he did, but probably the ad agency.

Spicer: Marketing or ad agency.

Rubinstein: It was the ad agency. He worked very closely with the ad agency, and they came up with iMac name, and they did all that stuff. I mean Phil, bless his heart, is fabulous, but he was product marketing in those days. He didn't have the other parts of marketing. Steve ran the rest of marketing, and so direct pipeline in the advertising agency, marcom, all that stuff came through Steve. Steve did all of that.

Spicer: So the public perception of the company is controlled by Steve.

Rubinstein: Steve. It's all Steve. Yeah, yeah, absolutely, and, look, he did a great job on all of it. He assembled a group of people around him that were phenomenal.

Spicer: Amazing, incredible group.

Rubinstein: And the advertising they did and the product naming and all that stuff was remarkable.

Spicer: What was your closest competitor at this time? Probably there weren't any, right?

Rubinstein: At iPod? None. There was nobody. We caught everybody flatfooted. There was nobody, but the product did well, not great. Look, it was a small market. When we did iTunes, we initially just did ripped music, but we wanted to start selling music for the store. We convinced the music companies, Steve convinced the music companies that, "Look, this is a great experiment because at most we've got 2% market share. At most we've got 2% market share, so you do not have to worry about 98% of your market, and so it's a great way to experiment," and so they went "Okay." And frankly at the time we were going to stay Mac only. We didn't have this idea we were going to expand to the PC.

Spicer: Again, it's another thing that makes the Mac unique.

Rubinstein: It makes people buy more Macs, and that was the whole point of the iPod, was to sell more Macs, but the lesson from AirPort just sort of sat on my shoulders and sat on Phil Schiller's shoulders, and we started hammering Steve. "We got to take this stuff to the PC. We got to take it to the PC," and we just kept haranguing him, and finally he goes, "Fuck you guys. I don't want to talk about this anymore. You do whatever you want." So we went out, and we found a software company. I think they were in L.A. I forget what they were called, but we basically hired them to take their PC software and hook it up to the iPod. Music Match is what it was called. The original software that was bought to make iTunes was called SoundJam. It was the original product, and those were a bunch of Apple guys who did that.

This was a different group down in L.A. They'd done a product that was sort of a half-assed version of iTunes, and it wasn't very good, but it worked on a PC, and it worked with portable players, and so we just modified it to work with the iPod, and then we gave them a very strict roadmap, and we said, "Look, here's the roadmap we want, and this thing's going to put you guys on the map, so here's what we need." And Phil and I managed them very closely and managed their roadmap and the iPod on the PC. By the way, we also did the Mini at this point in time, which Steve tried to cancel. I got a panicked phone call one day. "You better get to this meeting. Steve just cancelled the Mini." And I'm like, "Ahhhhhh," so I come running down there, and Steve's just leaving the room, and everyone goes, "What do we do?" I said, "Just keep going." Because the Mini is really the product that caused the iPod to take off because of the price point, and it was the anodized aluminum, the colors, [the] price point. It had enough storage but not too much.

Spicer: Sorry, you're talking about, I got a little confused, the iPod mini?

Rubinstein: iPod mini.

Spicer: Not the Mac mini.

Rubinstein: Not the Mac mini. No, I'm talking about iPod mini. Yeah, yeah, yeah. That product just really took off, and we brought out the PC stuff about the same time, so--

Spicer: This thing about, "Oh, it's only 2% of the market," doesn't work anymore, so how did they convince the music industry to blindly open up and--

Rubinstein: The thing had taken off. Clearly it was the wave of the future, and Steve's very persuasive, and he kind of played them off against each other. If they had colluded with each other, which fortunately they hated each other so much that they couldn't... There's a couple guys who've written books that were on the other side of this, and they hated Steve, just hated Steve. I forget the names of the people, but you can go read about them. Like the guy at Sony Music or whatever just hated Steve, but Steve basically played them off against each other, and he got them to drop like dominoes. And once he got enough critical mass, the guys were feeling left out, they had to jump in too, and he finally got them all, which was amazing. And now it's something that only Steve could do.

Spicer: As soon as you get the first guy, they're probably all going to-- Like, if you get Universal--

Rubinstein: We almost bought Universal.

Spicer: --the people at Sony are going to--

Rubinstein: Steve wanted to buy Universal, and Fred looked at the financials and had a heart attack, but Steve still wanted to do it.

Spicer: It's a money-losing company, is it?

Rubinstein: Yeah, yeah. It was terrible. The financials were terrible, but Steve wanted their library, which was very smart, but also was a problem because our point to him was, "Look. If we buy Universal, everyone else is going to shut us out, and Universal doesn't have all the music we need. They have some of the music, so we're better off not buying it." Now, it would have been a good investment, financial investment, but it might have screwed up the iPod brand, and I think as a company we were better off not owning the content and having the products really ramp versus the other way around.

So I don't remember the exact timeline, what came first, the music store or the PC. I think the PC came first, then the music store. I don't remember, but we just sort of hit this tipping point where between--. We had the second generation iPod, we had iPod mini, we had the music store, we were running on PCs with Music Match, and we just had critical mass, and this thing just took off like a rocket, the [iPod] Mini in particular but all the iPods, and we were turning the crank as fast as we could, a year or less product cycles because I was terrified that Sony was going to kill us. It was just a matter of time until Sony came out with a better product. They had a lot longer to work on it because we were on this really fast cycle time.

Spicer: I remember you saying in a talk somewhere that to be successful, a company has to eat its young.

Rubinstein: Right. Exactly.

Spicer: And basically every year you need to kill off the previous--

Rubinstein: So we were on like, "What's the next technology?" "What are we driving?" The Mini was an interesting one because we had a company from Colorado [Cornice]. It was a spinout of one of the other disk drive companies [Maxtor], I forget which one. So they come in, and they show us a microdrive. The Toshiba drive is 1.8 inch. This was 1 inch, kind of like the IBM Microdrive, and they showed it to us, and we went, "Great. We love it. When's it going to be done?" "Well, nine months to a year." I'm like, "Okay. We'll take all of it. We want exclusive." They go, "Well, we don't really want to do exclusive." I'm like, "You really want to do exclusive." "We don't want to do it." They're like, "It's not going to build the kind of company we want to build." I'm like, "You know. That's really dumb." So we went back and forth, and finally I went, "Okay, that's fine." So by this time the IBM Disk Drive group had been sold to Hitachi, and

the guy who used to run it for IBM was still running it for Hitachi. Or? It was, yeah, Hitachi. They're the big drive manufacturer.

Spicer: Oh yeah.

Rubinstein: Yeah, yeah, yeah, yeah, yeah. So IBM sold their drive division to Hitachi, so I call this guy, and I said, "Hey, it's me again," and he goes, "Whatever it is you want, we'll do it." <laughs> And so for the mini we used the now-Hitachi Microdrive.

Spicer: And they're 1-inch drives?

Rubinstein: 1-inch drives, yeah, yeah. And they're 5 gig by this point in time, and they took a very deep breath <takes a deep breath>, and they sucked up the price, and--

Spicer: Are these in a compact flash format, these disks, were they in some other connector system?

Rubinstein: Yeah, I don't remember.

Spicer: Because they were also used in cameras, right?

Rubinstein: Yeah, yeah, yeah, yeah. They had a different form factor for that but yeah, yeah, and so we went, "Hey, how many can you make, and we want exclusive for this space," and they went, "No problem," and that was the Mini. That's what created the Mini. The thing took off like a rocket, and the PC side went crazy. And it was a good product, not a great product on a PC, so now Steve's finally come around, and he goes, "Look. If we're going to do this, they have to have an Apple experience, and it will give people a taste of the Mac so it will make them want to come to Mac for all the rest of their stuff, so let's take iTunes and really port it to the PC, so Sina Tamaddon [Senior VP, Applications]'s team took iTunes, ported it to the PC, and we had our first Apple application on top of the PC. It took a lot of kicking and screaming to get there, but we got there.

Spicer: There's also this fact that the iPod itself became kind of a status symbol.

Rubinstein: Oh yeah.

Spicer: Do you want to comment on that a bit?

Rubinstein: You saw it everywhere, right? And the advertising was fabulous with the earbuds. I remember in the U.K. there was an article in one of the U.K. rags or whatever, and it had whichever Spice it was and the football guy. I'm not a sports guy, right, but you know who I'm talking about. David Beckham.

Spicer: Beckham and Posh Spice or something. <laughs>

Rubinstein: And Posh Spice, right, and there's a photograph of the two of them walking through Heathrow with their iPod headphones in, right? Our sales in the U.K. just exploded after that.

Spicer: Oh really.

Rubinstein: You couldn't have better marketing. It was unbelievable, and basically we just went worldwide with it, and the marketing was great, the word of mouth, the buzz, all of that was great, and people started using iTunes on the PC, and then they started buying Macs because they realized, "Oh my God. This is so much of a better experience," so it really helped Mac sales on the consumer side, and it really transitioned Apple from being a computer company to a consumer company, and through all of this Apple actually changed its name. Remember, it used to be called Apple Computer, and in the midst of all this, Steve told Nancy, "Go change the name. It's just going to be Apple." And we became Apple, but it was the start of the company becoming a consumer company, and the rest is kind of history.

Spicer: It's such an exciting story even just to hear you talk about it--

Rubinstein: Oh, it was so hard.

Spicer: --because of the impact.

Rubinstein: It was so hard, but it was so much fun. And we did multiple products. We just kept turning the crank, and we built the iPod team to a bigger and bigger team. We spun it off as a division. I was running kind of all the product development. I spun out the iPod division. I took over the iPod division. I hired someone else to run the Mac division, so now we're starting to divisionalize, and eventually Jony [Ive] went to work for Steve in all this transition, and I just focused on iPods and iPod follow-ons. So we were cranking out Micro and Nano and all those different products, iPod 2, 3, 4. We cranked out so many products.

Spicer: As a company, what fraction of revenues was iPod generating for you?

Rubinstein: Well, it started off really small, but it got bigger and bigger.

Spicer: And in some ways it tided the company over in some cases, didn't it?

Rubinstein: Yeah, I don't remember the exact numbers, but it became a substantial portion of-- including the growth was explosive. That was the thing is the growth was explosive, and it set us on the path for the iPhone. There's a couple of things that set us on the path for the iPhone. So the guy I hired to run Mac products was a guy named Tim Bucher, and Tim had been with us at NeXT and had gone off to do a game company, 3DO or something, and he'd gone to a couple of other places, and so I hired him to run the Mac thing. He didn't work out. Kind of the antibodies kicked in, and he got pushed out and stuff, but when he came in he was very hot on tablets, so we started thinking deeply about tablets. So we're thinking about keyboards on tablets and multi-touch, and we were thinking also about multi-touch on the PowerBooks.

Spicer: Would this be on a touch screen on the PowerBook, multi-touch?

Rubinstein: No, this was on the--

Spicer: Oh, the Trackpad.

Rubinstein: On the Trackpad.

Spicer: Okay, got it.

Rubinstein: Multi-touch on the Trackpad is where we started thinking, and then we started thinking about a touchscreen version of what would become an iPad but a Mac or iPod or whatever but a big one that you could read your news on and that you could do email on, and it wasn't for content creation but content consumption, so that was the concept. And Tim was driving this hard.

Microsoft about that time came out with the first version of, I guess, I don't what it was called then, but now it's the Surface <inaudible>, and that was kind of a failure, but there was a lot of stuff going on around tablets, and people were thinking about it. So we decided we needed to get multi-touch capability, and so we went and bought a company that was a spinoff of CMU. So all of this stuff that Steve goes on and on about in his keynotes later on about how we own multi-touch and that we created it all and we've patented it all, it's all nonsense, right?

We acquired a bunch of patents on it, but we bought this company [Fingerworks]. We partnered with Broadcom. They did the chips for it. There's a whole blog at Microsoft about the history of multi-touch that's really interesting, so as much as I'd love to take credit for having created the first idea around multi-touch, that's nonsense[2].It was a technology that just wasn't capable enough yet, but we started playing around with it. The problem with the tablet was is you couldn't do it yet. There wasn't enough performance in the processors to drive the displays of that size, so the logical thing to do was-- we were kicking around a phone.

Steve had gotten a memo from somebody I forget about becoming an MVNO [Mobile Virtual Network Operator] so becoming our own carrier basically, and I had been trying to put wireless, not Wi-Fi but cellular wireless, in the PowerBooks, and I was working a deal. It was the first time I met Paul Jacobs from Qualcomm, so I was trying to work a deal between Qualcomm, us, and Verizon, and Paul and I were in because this had to be subsidized. This was way, way expensive. And we were in, Qualcomm was willing to subsidize, Apple was willing to subsidize much like we subsidized Wi-Fi in the earlier days, and we couldn't get Verizon over the hump. They just wouldn't do it because their service was very expensive for the data, and they just wouldn't do it, which was dumb, I thought, but otherwise today every notebook would have cellular built in, but that just didn't happen, but that's how I met Paul Jacobs in the beginning of this process.

[2] [Interviewee's note] http://www.billbuxton.com/multitouchOverview.html

So, in any case, we're looking at all of this for the tablet, and it's kind of a no-go because the technology is just not ready yet for a tablet, but we keep iterating, and even after I leave they keep iterating until the iPad comes out. We're doing iPods one after another, and we're starting to think about that the software in the iPod's too simple because we're starting to add stuff. So we added video. We added color. We started adding more and more capabilities to the iPod. We switch it from FireWire to USB 2 because now USB 2's out. We're increasing drive size. We do a solid-state version. So we're bifurcating or adding lots of variations on the product. I did the shuffle. I'm a runner, so I would run along Embarcadero, and I would see everyone schlepping these big devices, earphones or these tiny ones, and we started doing the shoulder things, the armbands with Nike and other companies so you could run with your iPod, but it's not a good experience. So I said, "Look, we got to do a shuffle," so we did that.

Spicer: And that's the one you just clip on?

Rubinstein: Yeah, the little, tiny one.

Spicer: The tiny, 1-inch square?

Rubinstein: Well, now you clip on. In the old days it was a little thing that you could do anything with it. You just stuck it on your belt or whatever, but that was for runners. So when we had a whole roadmap of these things--

Spicer: Would that have existed, by the way, if you weren't a runner?

Rubinstein: Might not.

Spicer: Would someone else have come up with it?

Rubinstein: Yeah, might, might not. Who knows?

Spicer: It's kind of interesting.

Rubinstein: I don't know. I don't know. And it's funny because I don't listen to music when I run, but it's really important--

Spicer: For a lot of people, yeah.

Rubinstein: --it's really important for a lot of people, and we worked with Nike to do training stuff. I remember we had them do the very first sort of podcast that we put on an iPod for running, and we had Nike do it, and Steve listens to it, and he goes, "This guy's terrible. He doesn't know anything about running," and I'm like, "Oh my God," because this was done by Alberto Salazar, who's like one of the gods of running, but Steve knew everything, right. He knew better.

But we did a lot of fun stuff around that. We did the Nike + iPod, so we built a whole ecosystem around the iPod about the connector. We licensed the connector to third parties so we could build this multibillion dollar iPod ecosystem. There were really sort of three legs of the iPod stool. There was the iPod itself, there was the iTunes music store and the music you'd buy, and then there was the peripherals you'd buy, and those three kind of locked you into the iPod family indefinitely because once you had those it was really hard to switch, and that was the idea is we wanted you to just keep buying the next generation iPod, and we'd keep cranking them out, and you'd keep buying more, and the numbers kept growing and growing and growing, and it was great. We started looking at doing more advanced iPods. The iPod operating system wasn't going to work. The PortalPlayer guys were starting to get itchy about that they wanted to add other customers because we were their only customer, so we were squeezing them really hard. So they wanted to expand. They got a new CEO. They were a public company. They went public.

Spicer: Probably based on the success--

Rubinstein: No, it was all based, not probably.

Spicer: --because of you.

Rubinstein: It was all based on us.

Spicer: On Apple.

Rubinstein: It was the same thing with Synaptics, right, the touch guys. They were the same thing. Our business was huge, and they got difficult to work with, so in any case PortalPlayer tried to do a power move, and I said, "Screw that." And so we went to Samsung, and we worked out a deal with Samsung where they were going to do multiyear, multi-family processors for us basically to our specifications, and they went and did that, and we got rid of PortalPlayer. They crashed and burned. Jensen at NVIDIA bought them. Jensen's the chairman of NVIDIA. In the small world department the first chip I did with LSI Logic, I had a world-class apps engineer from LSI Logic, and we did these amazing chips together. It was the first time they'd done anything of this density. We were using all new tools and everything, and my apps engineer was Jen-Hsun Huang, and Jen-Hsun and I started a long-term, very close friendship on that day forward. In any case, so Jen-Hsun bought PortalPlayer, and it didn't go anywhere. We did this deal with Samsung. They built processors, and I think they built all the processors for Apple until Apple started using their own basically.

Spicer: And those are the ones they got from Pacific Semi?

Rubinstein: They bought P.A. Semi, Palo Alto Semi.

Spicer: Or Palo Alto Semi I should say.

Rubinstein: I don't think they got the chips, but they got the core design, and they developed on top of it, but for many years we used a Samsung roadmap, a multiyear roadmap and stuff. Yeah, so we cranked

out iPods. We were busy working on the next generation stuff. Clearly the software evolved past-- it was getting too sophisticated to do-- what we had was basically a small operating system that wasn't up to capacity, so we looked at two approaches. Interestingly enough, Steve Sakoman was back at Apple at this point in time. He had been on the Mac OS X team. He came over and joined us on the iPod team, and he started at looking at basically we take the Linux, the mobile Linux OS at the bottom, and we'd stick some middle layer of stuff from Mac OS X, and build apps on top of that, and that was kind of our concept, and the Mac OS X guys wanted to use Mac OS X all the way up and down the stack.

And so I started this development, and we got partway into it. We got some demos and stuff, and we started looking at phone stuff because this was for phones and tablets and things like that going forward, and we started playing with phones, and we decided to do the iPhone. Tony was running the project. I helped him choose the suppliers, build up the team. We picked Infineon, which is now Intel, now getting sold to Apple, so it's kind of funny. I negotiated the deal with Qualcomm, IP licenses and stuff like that. I did all the sort of founding work around the iPhone, and then I kind of got tired.

Spicer: Can I ask why Apple decided to build an iPhone? Was it continuation of that strategy?

Rubinstein: Yeah, I think it was the continuation of that strategy. It was the logical thing that came next. There was no point in doing personal organizers because those are going to get subsumed by the phone. The phone was going to probably subsume the music player. You couldn't build an iPad yet because the processing power wasn't there, but you could build an iPhone because the screen's smaller, so you need a lot less processing power because moving those bits around is a really big deal, and we had been looking at doing this MVNO thing, and that really didn't make sense. We tried this deal with Motorola on doing the music player on top of the Motorola cellular phone. That was a disaster because their product was crap.

Spicer: Is that the ROKR?

Rubinstein: Yeah, the ROKR. It was a terrible product.

Spicer: Was it?

Rubinstein: The Motorola people kind of go, "Well, Apple screwed us because they were really working on the iPhone and they just did this to learn from us or whatever," and that's nonsense. If that product had been great, things might have come out different, but the product was shit. We thought about home phones, we thought about mobile phones, we thought about Wi-Fi phones, and we thought about a lot of different things and decided to do the iPhone. And around that time I decided that I needed a break, and so I told Steve I wanted to take a leave of absence, and we agreed to that. I wasn't in a hurry, so we agreed to 18 months I would take my leave of absence, and I had to finish the solid-state iPod, the nano, the video, and a bunch of products and keep working on the foundations for the iPhone and help out with whatever they needed to do for the tablet and all of that and keep all that stuff moving forward and then help train Tony to take over the iPod division.

Spicer: That strategy explicitly suggests that the iPhone sort of connects to the Mac in some way, but in a way it's also stand-alone, wouldn't you say? The iPhone.

Rubinstein: Well, it started off as being a peripheral. Steve and I used to always fight about iTunes being the sort of center of the Mac connection to peripherals. I'm like, "That makes no sense. We should have an application that talks to all these devices, and then you have a bunch of content applications that manage the content, stores, whatever, and you interface to them that way," and Steve went, "No, no, no, we're not going to do it that way." I'm like, "Alright." And then years later that's kind of how--

Spicer: That's what I was getting at is--

Rubinstein: That's how it ended up.

Spicer: --the App Store. That's a brilliant idea.

Rubinstein: Yeah, but it used to be part of iTunes, so it took a long time for them to separate it out. Look, we did the software auto-update. That was originally done for USB. We used to have a server under Mike Bell's desk because Mike Bell was doing the Boot ROM stuff and drivers and things.

Spicer: How many millions of users did that have to serve?

Rubinstein: Oh, a lot, but the way we designed USB is you plug in a device. The biggest problem on PCs is where the hell is the driver, so we put it in, you plug in a device. It goes and looks. Does it have the driver already in the OS? If no, because we know what device it is because the device code comes back over USB. If not, we got to Apple's server, we'd find the right driver, we'd install it, and then all of a sudden your printer, your whatever would start working, and that software evolved into what is now a software update on the Mac, for all the software, but it started off being USB device drivers, which was a huge service headache, a huge service headache, because people would never install the driver first.

Spicer: And a very bad user experience, too. Terrible.

Rubinstein: So, in any case, we had a lot of irons in the fire going. So Avie and Scott Forstall [were] on the team and really wanted to use Mac OS X. I wanted to use Linux because I could get drivers from everybody because all the chip guys were using Linux, so I could build a low-level operating system and then support all the Mac OS stuff on top of that, but we'd have a real-time, multitasking, low-level operating system running underneath that everybody supported, every chip guy supported, and so Sakoman was working on that. It wasn't going to get traction. That was clear because Steve really wanted what-- Scott said, "We'll get it done. Don't worry." I'm like, "Okay."

And so Sakoman quit and moved to Northern California where he still is today hiding out. I took my leave. I gave them 18 months notice. Six months before I was going to leave it was time to announce to Wall Street because we had to tell Wall Street I was leaving and make filings and all that kind of stuff, so about six months before, Steve and I sat down and had a heart to heart. He goes, "You know. You

should just go, and maybe you'll come back someday. Who knows? And we'll see, and I'm like, "Okay. Whatever you want," but I think he was trying to call my bluff to see if I'd go, "No, no, no, no, I really want to stay at Apple," and I went, "Alright, whatever," and so we announced six months before I left. I spent six months doing the handoff. We got a lot of the iPhone stuff going hardcore before that, and a lot of other things got put in the pipeline during that time period, and we kept shipping lots more iPods, and I left, and that was kind of the end of an era for me.

I was there nine years. I'm incredibly proud of what we accomplished, not just from a product point of view because we created an incredible stream of successful products. If I look back I think the only product we did that wasn't successful was the Cube. That was the only one, which is an amazing track record given the number of products we did, and I would argue the Cube was successful in a lot of ways. It just was not a commercial success, because we learned how to do clear plastics. We learned how to do cooling with no fans. There was like so many things we learned from the Cube, and all that learning went into the future products, and you wouldn't have a fanless iMac if you hadn't done that, and you wouldn't have had clear plastics on a variety of products if you hadn't done that. There were so many things that we got out of that, so commercial failure, successful product.

Next question would be, well, why did the Cube fail? Steve and I were at loggerheads over the target for the product. I started it off as a pro product, so the observation was that people bought towers but never putting cards in them, so they were buying a huge power supply, they were buying all these slots, and they were going for high performance but not actually using any of the slots. They had a graphics card because we put a graphics card in, but none of the other slots were used. So I'm like, "Why do that? Why not sell them a small product that had the performance capability and that had an expansion chassis that if you wanted to add cards the small percentage of people that did could plug in cards in the expansion chassis, but your graphics and your core compute and all of that would be in your main product."

So Jony and his team came up with the Cube format. Mechanical team went to work on cooling it because it was a chimney design, so it sucked air in from underneath. The heat sinks were in the middle of the product instead of on the outside. They came through a core chimney. The heat accelerated through it, and it would cool the product that way. We had a touch switch on it. We had a lot of really cool stuff. And we developed this very high-end serial bus. There was sort of super FireWire that would connect it to another box, which we never got to develop, that would have been the companion chassis for storage and all that stuff with its own power supply and everything else. So the main Cube had just what you needed. You could do a high-end or low-end version of it and high-end or low-end graphics, and it was a stand-alone product, and then you could plug in this expansion chassis. That was the concept, and that's what we went to go design. We got partway into it. Steve goes, "No, no, no, this is a consumer product." I'm like, "Steve, it's too expensive to be a consumer product." And so we went back and forth, but it ended up being a consumer product that was too expensive, and so it crashed and burned.

Spicer: Very beautiful

Rubinstein: Beautiful. It's in the Museum of Modern Art.

Spicer: I was just going to say, yeah.

Rubinstein: No, no, no, Jony and his guys did a fabulous job on it, and the mechanical engineering team did amazing work, the electrical team. It's a work of art in every dimension. And I'll tell you, the serial expansion chassis thing, which now is used by lots of people doing-- there's been lots of standards since then that have come up since then that people use, but it was a really good idea, and I think it would have been a very successful high-end product, I think, but we learned a lot from it, and so that made it worth all the effort. I was there nine years, a pretty amazing track record.

Spicer: I think there's a saying in Latin on the passing of an emperor, and it goes, "if you seek a monument to them, look around you." That fits you.

Rubinstein: Well, I don't know. I don't know.

Spicer: It does, Jon. It really does. You've touched almost every person on Earth's life with your technology.

Rubinstein: Yeah, I have. From that perspective I have.

Spicer: That's pretty unusual.

Rubinstein: But it wasn't the motivation. The motivation was always "build great stuff for people and save Apple." That was the other part of it. Apple was dying when we got there, and it was save Apple and build great products. We didn't need to do market studies or anything like that. We knew what the next product was. It was self-evident, and the technology was evolving so quickly, and we had a variety of technology teams, so we knew what to incorporate next. We missed CD burning, and I feel stupid about that. We knew it was coming, but we didn't know how fast it was going to come, so that was the only technology we missed along the way. Everything else we were there right at the front of it. We always picked the right set of technologies.

This is something I spent an enormous amount of time on was focusing on what technologies to choose going forward and making sure we had the right mix at the right time because it's all about that convergence of technologies and balance to your system architecture because the system expands into the ecosystem. It's not just about the single product anymore, but it's about the entire ecosystem, so if you had iTunes store and it took an hour to download a song, useless, so it all has to kind of work together, so I think we did a remarkable job.

We revamped all the processes by how Apple did products. We redid the whole team. We bought companies, we hired people, and they're basically the guys driving the company now, and it was a great run. People ask me, "Am I sorry I left?" Look, I miss the team, I miss some of the stuff we did, but I was

exhausted. I worked for Steve on and off for 16 years, and that was shattering, and I just needed a break.

Spicer: I'm sure those were basically 80-to-100-hour weeks for--

Rubinstein: Oh, yeah, yeah, yeah. Christmas Eve.

Spicer: --for 20 years.

Rubinstein: So, Thanksgiving Day, Christmas Day, Steve and I are busy yelling at each other on the phone. Our wives are standing on either side tapping their feet going, "Hey, it's time to get going to Christmas dinner," and Steve and I are busy yelling at each other. This was constant, and we had this love-hate thing going. I loved Steve, and I hated Steve, and Steve loved me and hated me because I made his life difficult because I didn't always do what I was told, and he liked people who did what they were told, but we did amazing work together, amazing work, and I'm very proud of what we accomplished together. In some ways I'm a little sorry about how things ended up because Steve got mad at me when I went to Palm. We'll get into that some more, but a lot of people got sick at Apple.

Spicer: From burnout.

Rubinstein: Yeah, it's interesting because I never really thought about it, and when Yukari Kane, who was the Wall Street Journal reporter who was writing that book that turned out about Tim Cook, it wasn't supposed to be. The book was supposed to be about the Apple turnaround, so I spent a huge amount of time with Yukari, and she's got great material by the way, but I spent a ton of time talking with her about it because she was writing this other book, and then the publisher made her switch to writing the Tim Cook book, which I don't think was a very good-- it was right, but it was wrong.

It was right but 10 years ahead of its time, so it was wrong, but Yukari said to me, she goes, "It's really weird how many people at Apple got sick and in some cases died, more than just Steve. Mike Culbert. The list goes on and on of people who got terminally ill or really ill, and I wasn't feeling good. I wasn't sick, but I was just tired, and I wasn't feeling good, and I worried that if I stayed I'd end up damaging myself, and my health was frankly more important. And if I look at the team now, those guys are all gray and fat, and I didn't want to end up gray and fat, and I didn't want to get burned out.

There's long histories of Steve burning people out and them doing weird things afterwards, and I won't go into any of that, but you guys know all the stories about some of the things that happened in the history of all this, so I didn't want to end up like that. I wanted it to have been a really positive experience, and I learned a lot. I did really well from a personal point of view. I built a great team, I loved the people who were there, and it was just time to take a break. It was April 1 of 2006. Avie left on the same day. That was a fluke, by the way. Fred had left six months before or something like that. He was annoyed, but I left on pretty good terms with Steve. I think I left the company in pretty good hands.

We had gotten a group of people to really step up to run both the Mac division and the iPod division, and I felt pretty good about it, and it was kind of time for the next generation, and I was going to go take a break. I had bought a piece of property down in Mexico a couple years earlier on the beach and decided to build a house, and so I was excited about doing that. We had started construction already, but I wanted to go down there and sort of supervise the main part of the construction, and so my wife and I packed up, and she had fortunately sold her company shortly prior to that to one of the private equity guys, and so she got freed up. So we packed up and moved to a one-bedroom apartment in a fishing village on the coast of Mexico, which was pretty fun, me, and my wife, and two Labradors in this tiny, little apartment, and I spent the next year finishing up a sort of two-and-a-half year construction project and finished the house, and we moved in.

It was great, and I had very little to do with technology that year. I sort of checked out. I just wanted to take a breather, focus on the house and focus on running and biking and doing other stuff. During the week I'd go to the office every day. I'd go over to the construction site and watch them build stuff, and we did a bunch of traveling, and it was great. It was a great year. We finished the house, and just about the time the house was done I'm literally laying in my hammock in front of the house on the ocean, and the cell phone rings, and it's Fred Anderson. And Fred goes, "We got this deal we're working on, and we want you to help." And I'm like, "Fred, I'm busy." He goes, "No, no, no. Let me get Roger on the phone."

So Fred Anderson had left Apple. He'd hooked up with Roger McNamee with Bono and started Elevation Partners, and so Roger and Fred start doing the arm twist of, "We just need you to come and look at the deal, so come on up and take a look at the deal." So I said, "Okay, okay. I'll come up and take a look at the deal." So I came up, and it was Palm, and Palm had been a great company in its heyday, and it had gone through several cycles of success and failure, and it was kind of on the downside. It was a lot like Apple when I joined Apple except much smaller, and it didn't quite have the loyal customer base, but it had built some great products and had a lot of loyalty and had a good brand name, and the products just weren't good enough.

And so their concept was to either take it private or do a recapitalization, and they asked me to be the executive chairman and kind of drive the next generation in product development. Ed Colligan was the CEO, and he would stay on as CEO, and he'd run day-to-day. I'd only have to work halftime, and I could stay in Mexico part of the time, so they kind of twisted my arm and talked me into. Look, I owe Fred an enormous debt of gratitude because Fred was so instrumental in saving Apple. Without Fred we would never have had the chance to build all those great products, and Roger's great. He's kind of wacky, but he's great, and so I went, "Yes."

So we kind of worked out a deal, and the deal was I was halftime. I'd be executive chairman. I'd drive future product development. I would not have to be the CEO. If we sold the company, I wouldn't have to go with it, and there were a few other items but none of which worked out. So I come up from Mexico. Actually Ed comes down and spends a couple days with me in Mexico, and we kind of talk about the company, about him, and about me, and we kind of work things out, how to work together, and then I came up. I was living in San Francisco at the time, and I took the train down the first day, and I get to the train station, and the Palm shuttle bus isn't there, and I'm like, "This is not good."

We're off to a terrible start. If the shuttle bus driver can't get here, I can't imagine how screwed up the rest of the company is, and it was pretty screwed up. So I basically start working fulltime and trying to sort it all out, and we followed a very similar recipe. We fired a bunch of people. We killed some of the products they were working on. We invested more heavily in others, and then we set our sights on a long-term plan of a whole new OS. And they'd been sort of dabbling in it, but they hadn't really put a stake in the ground as "This is what we're going to go do." And so we started working on the Palm Pre and webOS, and webOS was sort of the really big effort.

Spicer: Was there anyone on webOS team that had a lot of experience developing a mobile operating system?

Rubinstein: Oh yeah, absolutely. We had a bunch of guys. Yeah, no, we had a bunch of guys.

Spicer: Could you say where they came from or...?

Rubinstein: Apple. <laughs>

Spicer: Oh, okay.

Rubinstein: Right. Some of the guys from the old Mac team, pre Mac OS X, I forget what it was all called, but the old classic Mac.

Spicer: OS 9?

Rubinstein: OS 9, and then also Mac was working on a next-generation operating system they never shipped that failed that they never got out the door. In any case, yeah, we had people who'd worked on that, we had people from some other places, and then we brought lots of other people in. We hired some really great people, really great people, and then there were some great people there, and we let go of some people, so we kind of mixed it up.

So, the day before the public announcement that we're going to do this, that Elevation's going to recapitalize the company, then I'm going to take over as executive chairman, I sent Steve an email. I said, "Hey Steve. There's going to be an announcement. I just want to let you know, give you a heads up. I can't give you the details, but it involves me and Palm." Two nanoseconds later I get an email back from him going, "I hope you're not doing anything to compete with Apple." So we got on the phone, and I'm like, "Dude, I want to work together." Right? They had just sort of launched the iPhone, and I'm like, "Look, we can build an ecosystem around all this, and there's a lot of stuff we can do." And I got, "Not interested and not interested in talking to you, and don't hire any of our people."

So, of course we were hiring people from Apple, and we're hiring people from elsewhere too. I didn't want to build just an Apple culture. I wanted to build a mixed culture, but we hired some Apple people, we hired some people from other places, and then Steve got really mad and threatened to sue us and sent us a nasty letter, and we sent him a letter back, and he responded to that letter, and the letter he

responded with was kind of the key letter they used in the no-poaching-- there was this government investigation about no poaching and collusion between CEO's about no poaching and everything, so that was one of the key pieces of evidence in it, so it was a big mess. So Steve got mad at me and stopped talking to me for a while, but, yeah, we assembled a team.

We set out to build webOS. We had a very clear picture about what we wanted to do, that we wanted to base it on WebKit and that it was web native, that long term the OS could reside on the device, in the cloud, whatever, and that it basically had a bus in it that was flexible and you could run it in any portion anywhere, that it automatically software updated. It was multitasking. It had a user interface. Basically it looks like iPhone X, and if you look at iPhone X today, that looks just like-- all the notifications that you see in Android and in iPhone now all came from that. Of course it was the same people because when we shut down Palm they all left and went to basically-- but we did a lot of really profound work. Matías Duarte was our user interface guy. He's phenomenal. He's now at Android doing all the Android stuff, but we hired him. He was at Danger at the time. We hired him to come in. We had some ID guys from Apple, from other places. We had a really good ID team. We assembled a really world-class team, and we made a couple mistakes. So they'd been working on sort of a tablet companion to a cell phone, so instead of it being in an iPad that was sort of stand-alone. You had to have it work with your phone, which kind of made no sense, so it got announced before we got there, but then we kind of killed it, and we were doing stuff with Microsoft, and I'm like, "We should kill the stuff with Microsoft and just focus." And they're like, "No, no, no. We're going to get revenue from it, so that will help tide us over to when we ship webOS in a couple years."

The typical operating system effort takes three or four years. We did the first generation in less than two or a little over two maybe, but it was really fast track, but, "It's revenue to tide us over," and I'm like, "Okay, whatever." Well, that was a big mistake. That was the first mistake I made is we should have killed the Windows product immediately because our product was so much better than anyone else's for a variety of reasons, and nobody cared. Samsung's was five bucks cheaper, so they sold Samsungs. We did the same stuff we did with loading drivers. The big issue with Windows Mobile or Windows phones was people had to load the driver first. We had it where you plugged in USB, it just automatically loaded the driver, and off you'd go, right? And we had to get in a big fight with Microsoft because interestingly, the only way Microsoft could get people to sign the legal agreement of their licensing terms was by opening the CD you needed to use to put the driver in, but that screwed up your packaging because you have to have a CD-sized package, right?

You have to load the CD before you plugged your phone into your computer. None of it made any sense. So we just kind of went, "We're not doing any of that." And they got mad, but they got over it, and we changed how that's all done, and now that's how Windows Mobile does everything, too. But I think we did a lot of really advanced stuff in webOS. The fact that so much of your stuff was in the cloud and you could switch devices and it would automatically update the new device to match the old device. Our hardware wasn't good enough, and it took us a long time to build the machine at Apple, right, because we did some of the hardware, but the guys in Asia did a lot of the hardware. We had Ray Chen at Compal. We had Uncle Terry at Foxconn. That's Terry Guo. We had half a dozen companies we worked closely

with, and we built a relationship over time, and we built the engineering teams so that their side could work with our side and really understood what it was about building great products.

If you look today, probably the best PC notebooks are from ASUS, and that's because ASUS had bought a company called Alphatop. They got handed off a few times, but they all ended up at ASUS eventually, and that company's the one that did some of the iBooks with us in the early days, and that same engineering team took that DNA and instilled it into the rest of their notebook team. In any case, it takes a while to build up that kind of relationship, the symbiotic relationship that it takes to build great products, and Palm didn't have that, and so we needed to rebuild that, and we didn't have the time, but I think we built a great OS.

And we built good hardware products, not great hardware products. I did, my fault, I did a shitty job with the carriers, so Ed did a deal with Sprint, couldn't get a deal done with Verizon. You can't be successful with just Sprint. Once we announced on Sprint, Verizon wanted to do a deal. We did a deal with Verizon. Then Verizon screwed us. AT&T was kind of in the mix around all of this. It was a mess, and the carriers, they're just difficult to work with. And Motorola Handset Group, which got spun out-- Sanjay Jha took that over. So Sanjay was at Qualcomm. We opened our kimono because we worked very closely with Qualcomm. All of our products were based on Qualcomm processors. We worked very closely, and Sanjay was running all that stuff, and so we opened kimono on everything to Sanjay about webOS and everything we do and about our launch and all that, and then like a week later he ends up being CEO of Motorola Mobility. But one thing he did a better job on was he parked himself at Verizon, and he got that Verizon-Google-Android deal done with the Droid thing, and we couldn't get that done. I spent my time focused on the product development. He didn't have to do that because Google was doing all that for him although they copied a bunch of things we did for the Motorola-specific things, so I don't know. It was a trade-off, right?

And if we'd been six months earlier, we would have gotten what became the Droid deal, and we would have basically been, like, the Verizon product for that season, so we were basically six months late, and it's because we got started six months too late. We did an incredible job of developing a whole new OS from scratch, which by the way had a lot of similarities to the stuff I was trying to do at Apple. This was a Linux base, right, and then we built the middleware. We used WebKit and all that for all the UI stuff, and we used a lot of open source pieces and pulled it all together, so it was a great OS. It was a great OS, and we never really had time to finish it. We never really had time to ship enough products to really get it-- we shipped millions of products, but that wasn't enough to--

Spicer: Where were they assembled?

Rubinstein: In China. Yeah, China, China in Shenzhen, north of Shanghai. Yeah, we started with Inventec Appliance, some of the same guys who did one of the first iPods, so it's sort of round up the usual suspects because there's a handful of people that are capable of building these kind of products, and it's Foxconn, and it's Quanta and Compal and Inventec and a handful of others, right? So we were building the kind of design relationship we needed, but we couldn't get there in time, and we never really

got a chance to get going. A couple things happened in the industry that just really hurt us from a timing point of view.

The Motorola Android thing with Verizon really hurt us. The economy went south, and so Europe deals were not to be had, so we just never got a chance to really finish. We had plenty of money. We raised a lot of money on Wall Street, and so money wasn't an issue. We had half a billion dollars in the bank. No, we had probably 18 months to a 2-year runway, so we could have kept going for another 18 months and 2 years. My worry was what happened after the 18 months, that we wouldn't make it through and that we'd come out the other side with nothing, and we knew that Google, Motorola, Apple, they were all going to invest huge amounts of money, billions of dollars in this. We knew that RIM was going to die, BlackBerry or whatever, right? They were going to die. We knew that. We knew Nokia was toast. And if those guys are toast and they were industry darlings, right, we had a real uphill battle.

Spicer: What made you think they were declining? Just news reports?

Rubinstein: Their products were crappy. No, no, no. Their products were crap, right? The iPhone was going to kill them. When Android and us got to the level of where we had really reliable products, we were going to kill them, and there was no way they were going to catch up because they didn't get it. Alright. They didn't get it. Yeah, so we built great products. We had a great team. The realization hit that we just didn't have the horsepower because of our size, and Verizon did a deal that they didn't live up to and stuck us with a huge amount of inventory, $100 million worth of inventory or something. Yeah, it was horrible. There's ways to dump all that. Various places in the world and stuff, you can go dump it all, but it really put a hurt to us, so we decided it was time to sell the company.

So I went out, and we hired some bankers. We hired Goldman Sachs, Nick Giovanni, who was great, and we hired Frank Quattrone. He had just sort of gotten back in the business, having gotten his legal troubles over with Jim Comey, and those two guys helped me sell the company when I sort of rounded up the usual suspects. Talked to HP, talked to BlackBerry RIM, talked to Apple. Steve and I talked about it because he really wanted the IP because he didn't want anyone else to get the IP, and we had a lot of really good IP, both on the webOS side and on the original Palm side. We had a lot of really good IP.

Spicer: What would have kept Apple from buying it?

Rubinstein: Nothing except that he wanted the IP. He didn't want the whole company, alright. So he's like, "Well, give us a nonexclusive license to the IP and sell the company to someone else." I'm like, "Well that values our IP at zero basically, so that's a nonstarter," but we talked a bunch about it over time, and there's a couple of other companies we talked to, and in the end it came down to RIM and HP. HP wanted us less so for the phones and more to build a tablet because they saw the iPad as really hurting them. Now, we built webOS to be scalable so it could go from anything from a tiny phone to a TV set and definitely to a tablet. It wasn't product-ready, but the concept and the architecture was scalable. It was all scalable.

So, HP wanted to build a tablet, and frankly RIM needed a new OS, and they were sort of crashing around with they'd bought some other OS, and they were trying to incorporate that, and it was terrible, so we kind of got down to the end. It was those two guys. HTC wanted to buy us. We had a bunch of people thinking about buying us, and it came down to RIM and HP, and actually I wanted to sell it to RIM. I thought the RIM guys with webOS could do something spectacular. They needed a new OS. We needed high-volume hardware. We needed deep pockets. They hadn't sort of failed yet. They had deep pockets, and I thought there was a really interesting opportunity for the two companies, and then at the last minute Jim [Basilie] kind of got squirrely. He was the co-CEO. It was Jim and Mike, and Mike was the technology guy, and we got along okay, and they understood the technology, and they understood the value, and they understood the IP, and they liked how our stuff looked, how webOS looked and how you interacted with it and stuff, so they got all of that.

And so I thought we were going to have a deal, and then at the last minute they tried to change the terms of the deal, and I'm like, "Guys, I got HP right behind you, and their deal's a clean deal. The board is going to make me take the other deal if you don't not do this." And they went, "No, no, no. This is our deal," and I'm like, "Alright." We were this close to announcing a deal with RIM. We were a day away. I was in Florida for their developer conference, in Orlando or wherever the hell it was. I was there for their-- it was about to announce it, and it kind of blew up at the last minute, which taught me a lesson about deals aren't done until they're signed, and I flew back, and it took us another day to get the deal done with HP, and then we announced that a day later. So, we basically did the deal with Mark Hurd, who was the CEO, and Todd Bradley, who ran the PC division, and I had a long conversation with Mark about the resources. This was a multibillion dollar investment, and this really required relationships with carriers and that it was really going to be tough and that Apple and Google and these other companies are investing massive amounts of money and that HP is going to have to invest that, and he assured me that he had downsized the company and taken a lot of the innovation out of it to get the financials right, and now the financials were good and the company was growing again, and he wanted to really invest in innovation, and they needed a tablet. They needed phones. They needed all that stuff and he thought that they could make the deals with the carriers and that we could do a great tablet, and it all sounded really good, and thank God we closed the deal because a month later he got fired.

Spicer: Mark Hurd?

Rubinstein: Mark Hurd, yeah, yeah, and so Todd and I took it and tried to do the best we could, and we went into the tablet, but HP's PC sales were cratering, and so they wanted the tablet to kind of fill in, and there was no way. And we went through a couple of CEO's. Léo Apotheker was the CEO, the last CEO, and he's like, "You got to ship right away," and we're like, "We're not ready to ship," and I said, "Look. We'll ship, but here's the downsides of shipping because we're not really ready." RIM basically copied our UI on the tablet they brought out. I got a chance to see it backstage at one of the AllThingsD Mobile conferences or whatever, and I'm looking and I'm going, "Mike, this looks just like webOS. What did you guys do?" And he just turned his head and walked away, but that never made it anywhere. That crashed and burned. Tough business, right?

So we had the webOS team working overtime with the HP hardware team, and we kind of comingled the teams. Their mobile team and our team became the Palm division of HP, and the Touchpad was a great product. It was kind of half a generation behind, and it was too expensive, and when HP decided to get out of the business, without my knowing about it, they dropped the price on it, and that thing took off like a rocket, so at the right price point there was clearly a really good market for it, and my point to them was, "Look. You're going to have to invest a couple billion to subsidize this marketplace to get into it because you're not in it, so drop the price, invest in it, let's get another year or two under our belt of webOS to where it's mature," because we're running kind of neck and neck with Android, which wasn't that great at the time, but we're a couple years behind Apple. "Give us a year or two to catch up with the maturity. We'll mature. We'll have a couple more generations of hardware, which were all in the pipeline, and we just need some time, so get the right price point, give us time to do it." And a couple things happened. Google bought Motorola Mobility, so they bet $10 billion. Apple goes we bet $10 billion. And Léo and the board were busy buying--

Spicer: Autonomy.

Rubinstein: --Autonomy, and they didn't have $10 billion. Their chip pile had gone over here.

Spicer: They spent $11 billion on Autonomy. <laughs>

Rubinstein: Which was crazy. That company was built on accounting--

Spicer: BS.

Rubinstein: --accounting shenanigans.

Spicer: They're still dealing with the aftermath.

Rubinstein: And I had this conversation with Ray Lane because I got it from a hedge fund guy who said, "You got to look at their financials, and they're using the difference in accounting rules in the U.S. and U.K. to kind of boost how the company looks," but whatever. Look, I'm not an accountant. Supposedly those guys knew what they were doing, so they bought Autonomy. They didn't have $10 billion to invest, and frankly they didn't want to because they thought of themselves as an enterprise company. Mark understood he needed to be a consumer company. After Mark was gone, everyone wanted to be enterprise. Of course, if you ask them about it, they probably went, "Ahhh. Rubinstein screwed it all up, and so we shut it down," but that's not my perspective. I think we had a pretty good shot. We sold several million touchpads. We had a reasonable installed base of webOS for a short period of time, and they were good products. They just weren't done. Nothing was finished. We never got a chance to finish <inaudible>.

Spicer: Absolutely. I think, just my own opinion, that there would have been a market beneath the premium Apple-priced products and maybe the Android people who want something in between.

Rubinstein: Yeah, that was what we were going for. That's exactly what we were going for, and we just never got a chance to get there, and it's too bad because a lot of people worked really hard, and we created good stuff.

Spicer: The technology sounds--

Rubinstein: The technology was phenomenal.

Spicer: --amazing.

Rubinstein: Yeah, it was phenomenal, and we had a great relationship with Qualcomm, so we were using the latest and greatest Qualcomm chips. Paul and I continued developing our relationship at that point in time, and we had a really good relationship, and we got a great deal from those guys. They really helped us. They didn't invest money in us, but they invested a lot of time and effort. Well, they did invest money because they gave us the chips for a good price, and they were really helpful. We had great relationships with our manufacturers. Uncle Terry was great.

Spicer: By the way, after HP took you over, did the manufacturing stay with the same outfits it was at?

Rubinstein: Yeah, it's the same guys.

Spicer: Same. Everything stayed--

Rubinstein: It changed because I no longer managed the manufacturing. That went over to the HP guys, but we didn't change factories.

Spicer: The same factories.

Rubinstein: It's the same factories. It's just the management structure changed, and I was told I wasn't allowed to talk to the guys in Asia anymore, which I thought was stupid, but they had chain of command, and they didn't want me interfering in the chain of command even though I had a many-many-year relationship with all these guys, having been at Apple for nine years, and Palm for four years. And I'd been through with all these guys through their own development. Foxconn was a connector company when we started working with them. They did enclosures and connectors. They couldn't build a laptop. We worked through all that with them. We worked with them building computers. We did the migration from Taiwan to China with them, not just them but with all the guys, Compal and Quanta and Inventec, all those guys. But, yeah, it's sort of round up the usual suspects, but they were all very supportive. Yeah, so really good products. Just ran out of time. It's too bad because they were really good. They were really good.

Spicer: Who made the decision ultimately at HP? Was it Léo?

Rubinstein: I have no idea. I didn't know. They didn't ask me. I read about it in the press.

Spicer: That's pretty--

Rubinstein: And then Léo gets fired because he took the fall for the Autonomy deal, so I stuck around for a bit. I'm like Todd, "I'm going to go." "No, no, no. We're going to keep going."

Spicer: Sorry. Who's Todd?

Rubinstein: Todd Bradley. He ran the PC division, so I was working for Todd. So Todd's like, "Stick around." And so then I tried to help him with PC's for a while, just sort of technology in PCs and building better PCs and helping him with sort of what makes a great product, and we did a couple good PC products. I can't use PCs personally. I tried. When we got acquired by HP, I'm like, "Okay. I should really be using a PC, not a Mac." It's just only right, and so for about three weeks I tried to use a PC. I couldn't do it, and I'm like, "Nah, I'm going back to my Mac," and I switched back to Mac and haven't tried it again since. That's not true. Whenever I want to program my Lutron lighting system, I dust off my HP laptop because Lutron software only runs on PC's, so I have to dust it off, I got to update all the software, and then I can reprogram my Lutron lighting system. I enjoy watching the blue screen of death appear in society at large, for example like on airplane--Yeah, in the airport.

Spicer: --airplane screens.

Rubinstein: Yeah, it's ridiculous.

Spicer: There's even actually an Internet of Things sink they have with a display on it, and that display was running Windows, and it had the BSoD on it just to wash your hands.

Rubinstein: Yeah, it's ridiculous.

Spicer: A little overkill maybe.

Rubinstein: Yeah, ridiculous.

Spicer: So HP has sort of--

Rubinstein: Yeah, yeah, yeah. So I tried to quit, and Todd goes, "No, I want you to stick around and help me with just general PC stuff," because I'm like, "I'm not doing the webOS stuff anymore." They screwed up the deal with the carriers. They really didn't get the deal with the carriers. They kind of screwed up the Touchpad.

Spicer: Was it just too painful for you?

Rubinstein: It was a big company, slow. It was the reason I left HP the first time. It was no different. Actually, it was much worse. It was much worse, and I was at a much more senior level. Right? It's one thing when you're kind of an engineer architect down in the machine room, right, shoveling coal. It's

different when you're up on the poop deck and getting pooped on. <laughs> "Hey! There's an iceberg! Someone do something!" So I lasted a little longer, and then they started reorganizing the company, and it became clear I had no business being there, and so Todd said, "Okay. Time for you to go," and I'm like, "Great, Todd. Thank you." But one thing that ended up from the whole thing is Todd and I ended up pretty good friends, so he let me go, and that was fine, and I moved to Mexico for seven, eight months of the year, and I started just working out of Mexico.

Spicer: Did you keep a place down in the city?

Rubinstein: Yeah, yeah, yeah. Long story but after I finished Mexico, my wife decided we needed a bigger place in San Francisco because the place we had was just for weekends, and so during the 2008/2009 debacle, Merrill Lynch and all that, everything craters, you couldn't give real estate away in San Francisco, and so I bought a spectacular apartment that needed tender loving care. It needed to be gutted, and it took me a while to buy it because the guy had to be convinced that the market wasn't going to get better for a while, and he finally sold it to me, and I had spent three years. I gutted it and redid it all. It's beautiful. And so we had that, we had the Mexico place, and I was spending most of my time in Mexico. When we were selling Palm to HP I got approached by Amazon and wanted to see if I wanted to be a board member. This is like I get a phone call from a recruiter going, "Would you be interested in being an Amazon board member?" and I'm like, "Is this an intelligence test?" Like, "Is there multiple choice?" What's the story here? So I said, "Absolutely," and they went "Great," so I started the interview process, and in the acquisition process I was clear with all the people who might acquire us. I said, "Look. One of the things I'm going to go do is I'm going to go join the Amazon board if they offer me the position." So Mark Hurd-- and I asked Mark. I said, "Can I join a board?" He goes, "Well, we have a policy against senior executives being on boards, but if it's a really good board I'll let you do it." And he said, "What board is it?" I said, "Amazon." He goes, "That's a really good board." This was nine years ago.

Spicer: So you were working at HP?

Rubinstein: Well, not yet. Not yet. I was interviewing to be on the board, and we were selling to HP. So then Hurd gets fired, so my permission goes away, so I finish my interview process at Amazon, and their chief legal counsel goes, "Okay, we're ready to move forward." I said, "I need official permission from HP's chief legal officer." I go through my management chain, and I'm like, "Look. I have an agreement on this already. This was pre-acquisition, and you guys agreed to this, so I don't know why we need to re-agree," but it went all the way to the board. The board grudgingly said yes, and then it was really funny because we weren't supposed to announce it for a couple of months. I get a phone call from the chief legal counsel at Amazon. She goes, "I'm announcing this tomorrow." I said, "Wait a minute. I haven't gotten permission yet." She goes, "The fix is in. Don't worry about it. You go check it out, but we're announcing tomorrow before they change their mind."

So I called the management chain, and they go, "Yeah, yeah, yeah. Board approved it." And the next morning they announced I was joining the board, so it was kind of funny. So, yeah, I've been on the board for nine years now. It's been amazing. We'll probably get to that in a minute. So through the HP

experience I was on the [AMZN] board, and then when I left HP I got a call from another recruiter going, "Would you like to join Qualcomm's board?" and obviously I had been friends with Paul Jacobs for years and knew Paul very well, and I like Paul a lot and I think that Qualcomm has amazing technology, so I met the rest of the board. They offered me a board seat, so I joined the Qualcomm board. So basically I got two boards. I'm hanging out in Mexico. I'm advising sort of a dozen startup CEO's just sort of coaching and helping them and stuff and working at it down there, and that's what I did for the next four years basically, four and a half years.

Spicer: What kind of duties on, let's say, the Amazon board? Was it very onerous in terms of workload or?

Rubinstein: No, it's not bad. It's much more so now because for the last couple years I've been lead director, and before that I ran the compensation committee, which takes more time, but initially, no, it wasn't bad. We meet once a quarter. It's a couple-a-day meeting. You need a couple of days of prep. There's travel time, and then in between meetings I spent an hour a day reading stuff about Amazon, what's going on in the world, stuff about the competition, stuff about the government these days and what's going on there, so it's probably a quarter-time job or something like that. It takes a bit of time. I know people who do four or five boards, and I don't know how they do it. I couldn't do four or five boards. I'm only on one right now, and that's just Amazon because I got off Qualcomm a couple years ago, but I'll tell you, between Qualcomm and Amazon that was keeping my pretty busy. It was pretty busy, enough, more than enough.

Spicer: People on multiple boards are probably not participating at the level you are. Possibly.

Rubinstein: Hard to say. Possibly, possibly. I have both the privilege and the opportunity to contribute on the tech side, and they're both tech companies, and so I get much more involved, and I try out products, and I do all that kind of stuff, so it's really fun. The Amazon board has been phenomenal.

Spicer: How did they, by the way, decide to spin up AWS?

Rubinstein: Well, I think they were building AWS for themselves and decided that other people needed it too, and if they were going to invest in doing it for themselves they might as well have other customers use it too. Remember, they're very customer-centric. Everything is customer focused at Amazon, right, so that was sort of Jeff's things was, let's provide this for everyone else, too, because we got to do it for ourselves. So if we're going to do it for ourselves, we might as well have everyone else do it, too, and that's what they do with third-party marketplace, with shipping, with all of that stuff is, let's build the capability for ourselves and then let's sell it to our customers. And it's very logical, so it's-- I mean, it's an amazing business. It's been...

Spicer: I think they...

Rubinstein: They've done an incredible job.

Spicer: People's feelings for Amazon-- I ought to speak for myself-- are extremely positive.

Rubinstein: They love the company. It's a great company.

Spicer: They really are.

Rubinstein: On every dimension, it's a great company.

Spicer: Yeah, it's an-- yes.

Rubinstein: And it's been great being on the board.

Spicer: There's nothing like it.

Rubinstein: Yeah, it's been a great experience, and...

Spicer: You mentioned competitors. Do they have any?

Rubinstein: Well, they got lots of competitors. Right? I mean, Walmart, to start with, right? I mean, there is a lot of really big competitors, Microsoft. I mean the list goes on and on and on of competitors, right? I mean, that's just in the U.S. You go overseas, you got Alibaba. You got-- in India, you got all kinds of stuff. You got-- in Europe, you got-- I mean, there's none of that. It's this monopoly thing is so crazy because they're just not, right? I mean, the thing about online sales, start there, right? I mean, you just switch to which website you go to. If you don't want to buy from Amazon, you switch to somewhere else. You buy it somewhere else.

Spicer: Very true.

Rubinstein: I mean, there is no lock-in. There's none.

Spicer: They just happen to be-- have prime mover advantage, I think.

Rubinstein: They love the customers. The customers love them and they're all about customer satisfaction and it's about the customers, right? And you look at the-- Amazon's core principles, they're so great, those 14 principles.

Spicer: Oh, I'm not familiar, but I'll look those...

Rubinstein: Yeah, you go online.

Spicer: I'll look those up.

Rubinstein: They're great. They're great, and that's what really drives the company. So...

Spicer: I was working with Jeff Bezos...

Rubinstein: ...it's great.

Spicer: ...and a interesting...

Rubinstein: He's so smart, and he's very different than Steve. So I specialize in crazy billionaires, right? So I've worked for a bunch of different of them. I've interacted with several of them and so it's kind of my specialty and Jeff is phenomenal to work with. He's very, very smart. He's very thoughtful, and while whatever you say may not sink in right away, he thinks about it and he comes back later and he goes, "Yeah, I thought about that." Right? And he gives credit to other people.

I mean, he was on stage. Someone asked him about something, and he goes, "Well, Bing Gordon gave me that," and because Bing was on the board while at Kleiner Perkins and so he's very generous in that way. And he's got a very loyal team that's been with him a real long time, and they're very good at managing. They're very thoughtful about managing, and look, he's a data guy. I mean, he's a quant. He came from D. E. Shaw, quant guys, right, so everything is quant. Everything is about data. It's all data driven. I mean, those guys walk in. I mean, Apple, nothing is about data or maybe now because Tim is running things, things are about data but when Steve was running things, nothing about data. There were no ROIs. I mean, Apple, before we got there, had all ROIs. It was all about the business. It was the business first, product second, right, and if you ask what's the key thing that we switched at Apple is we flipped those and it was the product first. Business was second. And Fred would watch the business to make sure it was okay. He'd hide margin. He argues he didn't, but I think he did. He'd bury a couple points of margin in products where we couldn't find it so that when Steve lowered the price we didn't go bankrupt, and he'd play kind of tricks and stuff.

But-- and then look, we had a great finance team, but the company was not a data-driven company. Amazon is. Jeff is a data-driven guy. He's not a-- he's a micromanager, but he also allows people to have their own shops. Right? So I mean, Steve could never really divisionalize because he needed to control. He needed to be the control point for everything, all the information flow. Jeff is the opposite. He's got different groups. They run their own thing. They're masters of their-- of their kingdom. There's a lot of-- lot of interactions between the groups. They're-- they were designed that they have to have communication between them to be successful, so I mean, the retail store relies on AWS. There's stuff in AWS that relies on other groups, and so they're all intertwined just enough to force them to work well together, right, which I think is really smart.

So very different people but it's great working with Jeff. He's a pleasure and it's really interesting to watch his thought processes and how thoughtful he is about things and he-- Steve's brilliance was choosing the fork in the road, right? You'd be going down the road, and Steve wasn't thinking out three to five years. He was thinking about the next fork, and he was very good at choosing forks and very good at reacting if you chose the wrong-- if we chose the wrong fork, very quick at getting us back on track and very nimble and very flexible. Jeff is the opposite. Jeff thinks-- he doesn't want to think about the next fork in the road. He's thinking about the fork in the road a couple years from now, right, and putting the company on the

path to get to that fork a few years from now and the day-to-day forks are being really chosen by the leaders of the groups. And they screw up sometimes and they get beat up by Jeff and whatever, but in general, if he-- he likes to operate three to five years out. Steve never operated that far out. I mean, he had a vision of where things were going in general, but we
were-- he was very serial.

Spicer: In some ways, which do you think-- because technology changes so fast, is one approach better than the other?

Rubinstein: I think for doing world-class products, probably the short-term focus is better, right? Big picture, multi-cylinder-engine companies, I think the long term is better, and that's why the two companies are so different from each other, right? I mean, Apple is very focused on what the next product is and building-- I mean, they build the best products in the world, right, and Amazon builds great products, but they're not in the same league. Right? I mean, that's really honest and I'd probably get beat up for that but it's the truth. Right? And Dave Limp has done a phenomenal job of building products that are kind of just underneath Apple's, right, cost-wise, product-wise, all of that, because I don't think he...

Spicer: I'm sorry. Who is the...?

Rubinstein: Dave Limp runs the-- runs Amazon, all the Amazon digital stuff.

Spicer: Oh, okay. Thank you.

Rubinstein: Yeah, yeah, yeah. He owns Lab126, and he owns...

Spicer: Like the Kindle and...

Rubinstein: The Kindle, all the digital stuff.

Spicer: ...Alexa and...

Rubinstein: Yeah, yeah. He owns all that. Yeah, and he used to be at Apple in the old days before I got there, and he's been in a bunch of different companies, but he's a product guy and he does good stuff. Right? But they're not as good as Apple is, right? Apple is the best, and-- but I think it comes from a different way of thinking about things. And I think-- I don't think he would disagree with that, right? I mean look, there's things that Apple hasn't been able to do.

They weren't able to do Kindle. They weren't able to Echo, right, because they weren't thinking out far enough. Right? I mean, Steve's view was nobody reads, right? That's clearly not true, right, and Siri, I don't know. I don't know what happened with Siri. Some of the issues at Apple, I think, are because everyone is in their own silo, right, and at Amazon it's not that way. They all work together, so you can do an Echo product and work with the Alexa team and kind of have them all work together to make it

happen. I'm not sure it would have even occurred to someone for Siri team to work with the audio team to build a product like that at Apple. I don't know.

Spicer: So in the same way that the iPhone works with the App Store and the music store, is Alexa's purpose to kind of drive...?

Rubinstein: Well, they have, in effect, a store.

Spicer: Oh well, that's true.

Rubinstein: Right? I mean, they have that. Yes.

Spicer: They-- Amazon also has its own-- yes.

Rubinstein: I mean, my view is that Alexa is going to be the operating system of the home.

Spicer: Well, that's what I was wondering is...

Rubinstein: No, no. No question. I'm a big IoT thing kind of guy, and I've got my Alexa hooked up to my Lutron control system hooked up to my RTI controller for the TV and all this stuff. Right? And...

Spicer: When a plane flies overhead, your garage door opens, right?

Rubinstein: I don't have a garage. Well, I do have a garage, but yeah, yeah, yeah. So...

Spicer: You get the idea.

Rubinstein: But I think that Alexa is the interface of the future. I don't think it's going to be the watch or the phone or the-- a pad on the wall, right? I think it's, you walk into a room and you go, "Turn the lights on," or even better, she knows when you walk in the room that the last time four times you walked in the room you told her to do X, Y, and Z. She does the same thing. So if it's six o'clock, you walk into the family room, it puts the shades in the right place. It puts the lights in the right place, and it turns on the TV and turns to the channel you'd normally turn to or turns to Netflix or Amazon streaming. Right? And it just knows because you've done it a bunch of times and it learns.

Spicer: It's basically the vision that we've had of the automated home for...

Rubinstein: For 20 years.

Spicer: ...the last 50 years. Well, even I would say like, "The Jetsons" or even...

Rubinstein: Well, yeah. Exactly. Right. I mean, when we brought out the Echo Show...

Spicer: ...you talk to your appliances.

Rubinstein: ...right, the Echo Show, when I saw it in the board meeting the first time they showed it, I'm like, "Great. This is the AT&T videophone," and I brought up the old World's Fair, 1967 World's Fair video from it, right, because it is. Right? It's great.

Spicer: It is, but hopefully it's-- I think it's more successful than...

Rubinstein: Well, it actually works, right, whereas that one didn't really work. So any case, the Amazon thing has been a great journey. Qualcomm was really interesting. It was tough. I mean, we had a CEO transition. Basically, Microsoft tried to hire the number-two guy, Steve Mollenkopf, and so we had to make him CEO a couple years before he probably would have been CEO, when Paul stepped out of the role. And then we had an activist come after us, and so that caused a lot of drama. And then we had China coming after us and Korea coming after us and fighting with Apple and the U.S. government coming after us. And it just got to be-- I mean, the board got to be not about the products, and it was about all this other noise. Right? And while-- I learned a lot, right? I mean, we got all these derivative lawsuits and I ran the Derivative Committee and I learned all about derivative lawsuits and all that stuff. And we had a committee to investigate splitting the company and I got to do that and so I learned a lot. I mean, it was all really valuable experience, and it was interesting, but it wasn't fun. <laughs>

Spicer: It was kind of a distraction.

Rubinstein: It's a distraction from the products, and I'm like, "We should be focusing on 5G and...

Spicer: Exactly,

Rubinstein: ...Internet of Things and all these other things," and...

Spicer: Do you think that-- just because you just mentioned 5G, could the-- well, let's just call it "harassment" of Qualcomm have been related to China wanting to move...

Rubinstein: Of course.

Spicer: ...5g into...?

Rubinstein: Of course, and Intel was behind-- Intel was behind a lot of this. Apple was behind a lot of it. No, no, no. There's no question. I mean look, I can't give you a piece but, I mean, you can go read the lawsuits, right? I mean, there's a whole bunch of stuff in the lawsuits. You can read about it, but no, no, no. I mean, people couldn't compete from a technology point of view with Qualcomm. Their technology was too good, and so they had to compete with them in other ways and the ways was using government regulation and antitrust lawsuits and stuff, right? Yeah, I mean, it's ridiculous.

So look, you can get into a whole argument about Qualcomm's licensing stuff, right, and that's a whole discussion and there's lot of different points of views around that. But the reality is they created the technology, right? I mean, Irwin [Jacobs] in the old days created CDMA, and everyone else said, "Bullshit. GSM is the way to go." They were wrong. Right? Now everything is based on CDMA. 5G is amazing. It's going to be incredible. It's going to enable all kinds of good stuff, and it's based on a lot of the work Qualcomm did. Right? And they deserve to be really successful because they spent all-- I mean, when Paul took over as CEO, the first thing he did was integrate the radios and the processors. I mean, no one had done that before. I mean, it's so-- you couldn't do the products we have today if you didn't have those. Right? It's such an enabling thing, so...

Spicer: Is it the SHARC? Is that their processor, the Qualcomm...

Rubinstein: I don't remember.

Spicer: ...processor?

Rubinstein: I mean, they had a whole bunch of processors. I don't know.

Spicer: Oh, okay. I thought that was their main one.

Rubinstein: No, they got a bunch of them, and they bought the low-end PowerPC group from IBM in Raleigh a bunch of years ago. And those guys were-- they switched to ARM and did their own ARM Core, right, and I don't remember what the codenames are.

Spicer: It's not-- if it wasn't the SHARC, it was...

Rubinstein: Yeah, they got a whole bunch.

Spicer: ...something else. Anyway...

Rubinstein: They got a whole bunch of different...

Spicer: ...Snapdragon?

Rubinstein: Snapdragon.

Spicer: That's what it was. Yeah.

Rubinstein: Yeah, Snapdragon. That's-- yeah, they got a whole range of processors and stuff. But look, I mean, the reality is they're just doing better stuff. So it was interesting to be on the board. It was frustrating because we didn't spend time on technology. The beauty of the Amazon board is you spend all-- I mean, you have to do your fiduciary duty. You do all the stuff you got to do for the shareholders,

SEC, all that kind of stuff, but you spend the bulk of your time thinking about what's the future and where is the company going. And it's great, so...

Spicer: Anything you can tell us about drones?

Rubinstein: Yeah, I mean, they work great. Right? I mean, we...

Spicer: Are they coming soon?

Rubinstein: Yeah. Well I mean, the FAA is holding things back right now in this country. In other countries, they're already delivering medicine and stuff and-- right, but in this country, no, the FAA is-- look, are they ready for primetime? Probably not quite yet.

Spicer: Is that a play on words?

Rubinstein: Exactly, exactly.

Spicer: Yes.

Rubinstein: I mean, I'm working with some guys who are doing autonomous drone stuff that-- more in the consumer range, right, and their stuff is incredible. You take your drone. You throw it up in the air, and it follows you, right? [Skydio]

Spicer: And they have self-avoiding stuff.

Rubinstein: No, no, no. It's unbelievable. You can run through the jungle and it...

Spicer: Avoids everything.

Rubinstein: It avoids everything. It knows you not because you're wearing a wristband or something. It knows you because it sees you, right? It knows what you look like, right, and you're wearing this color and you got a bald spot on the back of your head and whatever else. Right? So-- and it follows you, and it's amazing. It's amazing. And so this stuff is all coming. It's just a matter of time, right? I mean, there's a set of issues around battery life and noise and Jacobs and I used to-- Paul and I used to joke about the fact that once some of these problems are solved, the noise problem, the battery life problem, and everything, like every teenage boy is going to have a drone follow him around just like "The Jetsons."

Right? I mean, wherever they go, there's going to be a drone over their head sort of following them for a variety of reasons. Any case, so-- but I was on the Qualcomm board and it was kind of painful but I had made a commitment and all that and so I kept doing that and then I get a phone call one day from Craig Mundie. And Craig, I'd known Craig for years so actually went all the way back to Ardent. We bought our graphics chip from Craig's company when he was in Boston in those days and then he'd gone to Microsoft to be CTO and he was CTO of Microsoft for 20-something years. He tried to hire me a couple of

times to come and do hardware at Microsoft and I never bit on that but-- so I mean we weren't really friends but we knew each other. And he called me up and he goes, "I'm working at this-- I'm advising this hedge fund, and they're looking for a co-CEO, a technology co-CEO, not to buy technology but to manage technology. It's a quant fund and they do massive amounts of technology and they need someone to help manage it and to take them into the-- sort of the next generation."

And I'm like, "That's crazy. I don't know anything about finance." Right? I mean, what do I know? And he goes, "No, no, no. Like, this is going to be really interesting. I've been spending a whole bunch of time there the last couple of years. Why don't you come out and visit?" So I went out, and I talked to them. I spent a bunch of time talking to them and I spent a bunch of time with Craig and my conclusion was that the computerization of Wall Street or the Silicon Valley computerization of Wall Street was about to occur or was occurring. So in the past, I mean, they've used tons of computers, but they use the sort of consultant version of computers. They hire these big consulting groups and they do these big, waterfall projects and it's just the consultant view of the world. Right? And there was a transition going to sort of the Silicon-Valley-ization of technology in finance. And I thought, you know what, that's something I've never done before. It's interesting. It'll give me an opportunity to be an AWS customer, right, so it gives me-- get to see it from the other-- I mean, I've watched AWS grow up from the inside-Amazon point of view. I get to be a customer, so that's kind of cool. I get to learn stuff about finance, right, and so that's kind of cool because I don't really know much about finance. And I get to help a company really advance their technology base to what's possible because what's possible today is amazing.

And so we went back and forth and I watched lots of videos about the culture there and, I mean, it probably-- my fault because I thought, gee, it can't really this bad. And we talked a lot and so the structure was supposed to be I was co-CEO and then there was two other people that the guy who was the current CEO was going to step down into co-CEO and then there was a woman who ran operations and she was going to be co-CEO. It was going to be the three of us, and so he was kind of CIO [Chief Investment Officer]. She was operations, and I would be technology and the three of us would be the co-CEOs running the company. That kind of made sense, and Craig was going to be co-chairman along with Ray Dalio.

So Ray and Craig were-- sort of Craig was the technology/security chairman and Ray was the investing chairman and that would kind of be the structure. And there were about 2,000 people at the company and I had half the company, right, something like that because he has 1,000 technology people there. Right? It's a lot of software written. So that was the concept, and so everyone thought another one of those, are you crazy? Why would you ever go there? And they turned out to be right in this case but for the wrong reason. So I got there and it was pretty obvious pretty immediately that it was a bad culture fit, right, that I was not going to fit into Ray's "Principles"-based culture. Right? And my argument with Ray was, if you read Ray's latest book-- and look, Ray is brilliant, no question about it-- his perspective is the culture is the reason why the company is successful. And my answer to that is, "Gee Ray, how do you know? You've never run the experiment both ways." Right? That's one.

Number two, I said, "Look, I understand why you think you need to run research, the core of the investment engine, with your management principles, but I don't understand why technology should be

running with those because you manage technologists in a different way." And so we basically just didn't agree on how to do things, right, and the other thing is, while I was gone, he demoted-- between when I signed up and when I arrived, he demoted Greg [Jensen the CIO], big drama because it was like his son and lots of drama. And he took over as co-CEO, so it was him and me and the woman who ran operations, which was really weird because it meant he was really CEO and I was kind of CTO. And then Craig left and Craig came back as an-- I mean, it was just a lot of drama and I didn't get anything done. I was there 11 months, and I didn't accomplish anything. I learned a lot, but I didn't accomplish anything. I didn't agree with the "Principles." I'm not a religious guy, and it's a religion. And my point to Ray was-- if you read his latest book, he's got 375 "Principles," and I'm like, "Ray, Toyota, 14 principles, Amazon, 14 principles., the Bible, 10 principles. Three hundred and seventy-five, that's not principles. That's an operating system. It's an instruction manual." Right? And so I just didn't fit it, and we-- I didn't feel like I could get anything done and I felt bad about it but I just couldn't do it.

Spicer: It does have a reputation as a very difficult...

Rubinstein: Very high turnover.

Spicer: ...very-- yeah.

Rubinstein: Very high turnover, very crazy place. And look, for the right people, if they love it, more power to them. Right? And look, they're incredibly successful. They are the largest hedge fund in the world. Their returns, given the size of the portfolio they're managing, are incredible. Ray is a really, really smart guy. I think he's a little nuts, but-- and you got to judge for yourself. You got to read his stuff, right, and decide if you like-- I mean, people like Scientology. Right? That's-- it's a personal choice thing, so I'm not a religious guy. It's not the religion for me, right? I'm a computer guy. I'm-- that's my religion, I guess. I don't know, but whatever. It didn't work out and I was smart enough or sensitive enough to know that it wasn't going to work out and I needed to get out. And so it took a couple months. I gave them-- we didn't, I didn't do a, "I quit. This stinks," kind of thing. I gave them plenty of notice and we worked out a transition plan and then I left the company and, I mean, they're so used to high turnover that, I mean, the guy before me, they thought he was a bozo and now he's running GE. So I mean, maybe he is a bozo. I don't know, right, but...

Spicer: Oh, the new CEO?

Rubinstein: The new CEO of GE, yeah, but he wasn't a cultural fit, either. Whatever. But in any case, I had to get out of there. It wasn't for me, but my premise for going there was a good one. So I got back-- I moved back to-- I was living in Connecticut, which I didn't love, either, and I mean my idea was I'd live in Connecticut. I'd be close enough to New York. I grew up in New York. I can go hang out in New York with my friends, but then I ended up working seven days a week again because Ray would give homework assignments on Friday afternoon that were due on Monday morning.

So I mean, we got homework assignments. I'm co-CEO of like the largest hedge fund in the world and I got homework assignments, of which I fail because my principles are different than Ray's "Principles." So

it was kind of silly, so-- but the basic concept was not wrong. And then I get back to California and a couple months goes by and I get a reach-out from a company called PDT Partners and from a guy named Pete Muller. And Pete is the CEO of PDT Partners and PDT used to be part of Morgan Stanley and when the Volcker Rule kicked in, they had to spin out of Morgan Stanley so that they-- basically, they had been prop trading, proprietary internal money, for Morgan Stanley. They spun out, and now they kind of do their own money and a couple other customers and-- but it's a small shop. It's 200 people. Half the people are technologists, and...

Spicer: Sorry. How would you describe their firm, what they do?

Rubinstein: They make money. <laughs>

Spicer: No, but I mean, is it called like a...

Rubinstein: It's a quantitative trading firm.

Spicer: ...like an-- okay.

Rubinstein: So it's all computerized.

Spicer: Hedge fund? Would that be...?

Rubinstein: It's a hedge fund. It's a hedge fund. It's a quant hedge fund. They develop algorithms that run on the computers that then-- every day the market has data. They crunch enormous-- they have a huge grid computer which, they basically went to Livermore Labs. They got, "A Dummy's Guide to Supercomputing." They download that. They build a grid computer with InfiniBand and all of that, and they got, I don't know, 20,000 nodes or something. And this, I mean, we're talking about major horsepower.

Spicer: Do you know a guy called D. E. Shaw?

Rubinstein: Yeah. Well, that's where a lot of these guys came from. That's where Jeff Bezos used to work.

Spicer: Okay, because we are getting one of their computers. I forget what it's called, but it's for molecular simulations.

Rubinstein: Yeah, that's their...

Spicer: It's all it does.

Rubinstein: But that's all he does now, yeah. In the old days, he used to do quant hedge funds. That's where his money comes from.

Spicer: So...

Rubinstein: You dropped your mic.

Spicer: ...yeah, that's very interesting that they're sort of related.

Rubinstein: Yeah. No, no, Many of these guys came out of D. E. Shaw.

Spicer: And so are the 2,000 people at...

Rubinstein: Bridgewater.

Spicer: ...Bridgewater, and they like engineers or programmers or...?

Rubinstein: Yeah, it's a funny...

Spicer: ...analysts or...

Rubinstein: No, no. There's a whole bunch of Harvard Business School people, a lot of economists because the core of the engine is long-term economics. It's not really short-term quant, so it's a very different kind of firm. They look at trends, market trends in the 160 markets they trade, so it's different. But they use a lot of computer power. I mean, they got algorithms and they run computer simulations and they do portfolio creation and all that using computers. So they use a lot of horsepower, too. It's just a different kind of thing.

Spicer: And microseconds count in those <inaudible 02:27:50>?

Rubinstein: Not so much at a company like Bridgewater. Bridgewater is a different kind of hedge fund, right? The quant guys, so Renaissance, D. E. Shaw, Two Sigma, PDT, those guys are all massive horsepower and predict what the market is going to do, right, kind of thing like on a short term. So in any case, they-- I got involved with them. I'm an advisor to them. We've been doing a cloud migration on AWS. It's going awesome. We've rebuilt the engineering team. We've brought in new head of engineering and all that stuff, and it's been really, really fun. So I think my point of proof around this is that my original concept of Silicon-Valley-izing finance in New York is the right one, right, and the-- it's just that I was in the wrong place because we're going gangbusters right now. And it's going really, really well and everybody's happy and it's opening up lots and lots of opportunities to be able to deal with a lot more. I mean, we're dealing with a huge amount of data, and we can deal with a lot more data. And I mean, these are big compute problems, big data problems, and it's really fascinating and I can't talk about anything because it's all proprietary, right, and super-secret because it's all about intellectual property.

Spicer: Well, the turning of data-- which is, in some ways, has some noise inherent into it-- into wisdom is kind of what these systems do.

Rubinstein: That's exactly right.

Spicer: Actionable intelligence from this huge, inchoate, mass of data.

Rubinstein: Of just this massive inflow of...

Spicer: Tidal wave.

Rubinstein: Tidal wave, it really is. It's really fascinating. So I'm having a good time with that. As part of my joining Bridgewater as co-CEO, Ray wanted me to get off all the boards. I hedged on the-- so to speak, on the Amazon board, but I did get off of Qualcomm. So when I joined Bridgewater, I stepped off of that. So these days, I'm doing the New York hedge fund thing, which is great. I'm an-- a big AWS customer-- not big but I'm a reasonable-sized AWS customer. I'm on the Amazon board where I get to see AWS from the other side. I still have a handful of startups I work with doing interesting things and...

Spicer: Do you provide financing or more advice?

Rubinstein: No, more of the advisor. I'm a shitty investor, right? I mean, I'm just not good at investing. I just don't have the-- it's just not what interests me, right, so I'd much rather be advising on management, product strategy, those kind of things.

Spicer: Technology.

Rubinstein: Technology. I'm good at choosing technologies. I'm good at building management teams. I'm good at systems, right, both management systems, development systems, and products. Right? And so I tend to focus around that and help people-- help people do those things, so I think my customer base is pretty happy. I got a handful of startups that the CEOs are happy with the help I've given them and...

Spicer: I'm sure they're pretty grateful that you are advising...

Rubinstein: So it's fun, so I keep my hand in on that. So that's kind of what I'm up to these days.

Spicer: Any hobbies or interests before we wrap up?

Rubinstein: Well, I'm going back to try to learn to play golf... <laughs>

Spicer: Oh yes, you mentioned...

Rubinstein: ...which is really hard. I mean, it was one of those things where it is so far out of my comfort zone, right? So I think it's important that occasionally you go and do something that's out of your comfort zone, right, because it completely realigns your outlook on life when you do that.

Spicer: You realize you're living in a very comfortable world.

Rubinstein: Yeah, where you're kind of good at things and whatever. Like, I run and I bike and do yoga and stuff like that, Pilates, whatever, right, but I've never done sports. Right? No basketball, baseball, tennis, none of that, golf, none of that. I mean, I never held a golf club, and it just sort of-- I needed something to do down in Mexico. I tried surfing, didn't like that. Tried stand-up paddle boarding, didn't like that. I tried the golf thing, and that kind of clicked.

Spicer: Fishing?

Rubinstein: And it's so far out of my comfort zone. It's so far from anything I'm good at that it was kind of a challenge, and I think it's been really good like both psychologically for me to really work on something that I kind of suck at, right, and get better. I mean, I can see slow-- it's very slow progress but I'm getting better and I've made lots of new friends. And one of the things about being here in Silicon Valley is it's very ingrown. Right? I mean, it's a group of people constantly interacting, and yeah, I mean you get new people coming because the younger generation takes over and whatever, but it's very insular, Silicon Valley, San Francisco, all of that, and...

Spicer: At the senior levels too, I think, it's...

Rubinstein: Especially, right?

Spicer: ...it's very interconnected.

Rubinstein: And so it has given me an opportunity to meet a whole bunch of people that are in completely different worlds, which is fascinating because you get to learn about stuff that you never would have learned about.

Spicer: Just over a golf game.

Rubinstein: Over a golf game, so that's been really good. So that's been one of my challenges and really fun and I'm always keeping an eye out for some-- I mean, I spent a lot of time on Internet of Things and kind of watching what's going on in the world and I'm very bullish on what's happening right now. So I'm excited about what's coming and something will come along that's really going to be interesting and I'll jump on that. I mean, I won't go run it because I think I'm kind of past that now, right, and I got too many interests to focus on one thing and I like getting-- as we were talking about before, I like getting eight to nine hours of sleep. So the 7 days a week, 18-hour days, those days are over for me. I can't do that anymore. As much I loved it and it was-- I mean, we used-- Steve used to always tell the groups, "This will be the high point of your life," and I was thinking to myself, "God, I hope not," right, because that's really a sad way to think. What he was trying to do is get everyone really invigorated.

It's okay to work 18-hour days, 24 hours a day for-- I mean 7 days a week for months and months and years or whatever. And when you look back, it will be the crowning moment of your life, and I don't look at it that way. I look at it, that was phenomenal, and what we accomplished, particularly what Steve and I accomplished together, is amazing. And even with other groups of people, we've done, I mean, great

work everywhere. Even the stuff that wasn't successful, it's been so phenomenal, but I don't think any of it is like the highest point of my life because I always look forward to what's coming next. And I think the acceleration of technology is phenomenal, and so it's all very exciting and interesting.

And this place-- coming back to the Computer [History] Museum, and I've been hanging out here, I think, since late '80s, early '90s or something[3], I mean not this facility per se but I've been hanging around the Museum-- I think it's so important, like what goes on here and what you guys are looking at for the future of sort of making it bigger than just a bunch of old computers and crusty computer guys. Right? And sort of the bigger picture of the education part, one of the things I really push with everybody, especially the kids I run into, is STEM is so important, right, because it doesn't matter what field you go into in the future. Right? But having a feel for technology is so crucial to everything that's going to happen in the future and it's so important that people get that skill and capability and the ability to do computer stuff, whatever that is, right, is essential.

Spicer: I agree. I wish this country would reinvigorate its attitude from the '60s when science and engineering were really kind of-- the whole nation was on board and...

Rubinstein: The NAE -- I'm honored to be a member of the National Academy of Engineering and the National Academies-- I helped with one report, but the NAE-- has a variety of reports about how important STEM is and...

Spicer: And science literacy.

Rubinstein: ...and the future of work and all of that. And there's half-- I don't know. They've probably done by now half a dozen reports that give the path, right, and talk about how to make this work. And the government kind of looks at this stuff and doesn't really pay attention, which is too bad.

Spicer: I see basic science literacy as fundamental to democracy.

Rubinstein: Exactly right.

Spicer: People are easily swayed if they don't know, if they can just be told any nonsense.

Rubinstein: That was an interesting thing because one of Ray's big things is to question what is true. Right? And I have to say that's one of the things I learned from Ray, right, is it used to be people would say stuff to me, and I would go, "Okay. Well, that sounds a little funny but okay, whatever. I mean, they must know what they're talking about." And now whenever I hear something I think to myself, okay, I can hear Ray's voice, "Well, what is true?" because as an investor, knowing what is true is really important...

Spicer: There's a lot of noise.

[3] [Interviewee's note] The correct year was 1996.

Rubinstein: ...and you can't make any assumptions. Right? And so that's one of his principles, I think, that he has. Look, there's a couple of dozen of his principles that I think are really profound and there's a bunch of them that don't make any sense but that is such an important thing, I think, that "What is true?" And I think you need to have a background in technology and science and whatever to be able to ask that.

Spicer: Right. And so final question for you, if you had any advice or encouragement for kids who are interested in science or engineering, what would you tell them?

Rubinstein: Well, do it. I mean, just do it. Go to science camp like I did. I mean, the golf camp is probably fun but go to science camp and take science in school. And, I mean, you don't have to major in science necessarily, but you should learn about how it impacts whatever it is you're really interested in. Right? And no matter what, you're going to be using computer science. Right? I mean, that's just one way or another, you're going to be using computers in whatever you do. You're going to be interacting with computers in whatever you do. The home is going to become-- I mean, you're going to become computerized. I mean, they're going to build in something in your head to-- that you can control your computer from your head and from your arm or whatever, right, and it's going to be ubiquitous. I mean, it's getting close, right? I've always thought this, and so when we did the NikePlus iPod things, I mean to me, that was sort of the first widespread consumer computerization of people, right, instrumentation of people. It was the first step.

Spicer: Like the quantified self thing.

Rubinstein: Exactly. Right? And I mean now, I'm fully. I mean, I got this and I got an app that tracks what state I'm in so California can't tax me and I got an app that tracks me...

Spicer: Interesting.

Rubinstein: I got an app that tracks my runs and an app that tracks my bike riding and yoga and my golf game and all of this data gets dumped up to the cloud and I can look at where I've been and what I've done and how I've done it and how well I've done it and all that stuff. It's all quantified and it's up in the cloud and that's just the beginning. Right? That's just the beginning.

Spicer: My final question is, how important is it for kids to take stuff apart as a way of learning?

Rubinstein: I don't think it's crucial, right, because you could argue that if you're a computer-- if you're just on the software side of things, that's not a skill you need to have. I mean, there's brilliant software people that have no clue how to change the oil in their car, right, whereas if you're a mechanical or electrical type, you got to know all that stuff. Right? I mean, you should be able to do all that. Right? Maybe not in a modern car because they're impossible or they're electric, so you can't do it. But-- so if you're in the physical sciences, you-- I think that's really good, right, if you're a little kid and your proclivity is to being a software type, you ought to be tearing into all the different software stuff. And if you're a systems person, because a lot of stuff is about systems, you ought to understand both. Right?

Spicer: Okay. Well, thank you, Jon.

Rubinstein: It was my pleasure.

Spicer: Anything else you'd like to say?

Rubinstein: No, I just-- I think you guys are doing a great job and I'm excited to be part of the Museum and having been a part for many, many years and I hope this video goes for some kind of use in the future. Who knows, right? But I think that's fun and, I mean, maybe we can do this again in another 10 years and we'll see what the next 10 years-- but I mean, look, I'm excited about what's coming.

Spicer: Exactly. Yeah.

Rubinstein: All right, so I'm excited about the future, and I think the world we live in is an incredibly exciting place.

Spicer: Ten years from now, the world is going to be a different place.

Rubinstein: Completely different.

Spicer: It's going to be a very different place...

Rubinstein: Completely different.

Spicer: ...even climate-wise...

Rubinstein: Well no, that's right.

Spicer: ...if nothing else, and yeah.

Rubinstein: Yeah, it's going to be vastly different and I'm...

Spicer: I feel that's the problem that actually all of humanity should be focused on, is climate change.

Rubinstein: Yeah. Well, it's...

Spicer: I-- we're not going to be around if we don't solve that. So anyway...

Rubinstein: Well, some people think we should all be moving to higher ground right now, right, and there's other people that are sort of doing "The Fountainhead" thing of wanting to build separate communities and stuff. And I don't know, whatever. Yeah, it's interesting but the world is going to be very different in 10 years and I'm-- and there's lots of bumps along the road. There's no question about it and

there's really big problems that need to get solved but I'm very bullish on technology and science and where that’s going to take us and that it's all really positive.

END OF THE INTERVIEW

