



## **Oral History of Bruce Daniels**

Interviewed by:  
Hansen Hsu

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**Hsu:** Okay, it is August 1st, 2023. I am Hansen Hsu here with Bruce Daniels. So to start with, where and when were you born?

**Daniels:** I was born in Houston, Texas, January 10th, 1949.

**Hsu:** And where did you grow up?

**Daniels:** Mainly in Oklahoma. I grew up in Oklahoma City for a while, that was kind of the elementary school, and then most of junior and senior high school were in Tulsa, Oklahoma.

**Hsu:** Okay. And what were your parents' background?

**Daniels:** Ah, well, my mother, interestingly enough, when she met my dad, he got out early because he was flying bomber missions. She was in medical school. She was in her second year of medical school, which was, of course, very rare back then. For a woman to be in medical school in the 1940s was incredible, so I think that's where I got some of the things I've gotten from her. And my dad, he was born in West Texas, and so that's kind of him.

**Hsu:** You said he was in the war?

**Daniels:** Yes, yes. He was. It was kind of quite interesting. He was in the war, World War II, of course, and he was a navigator for bomber. And, of course, then the American bombing raids were all daylight, high altitude, and it was very dangerous. You know, something like 5 or 10 percent of the bombers wouldn't come back from each mission. But fairly early on, my dad got, and his group, got pulled out and sent to North Africa, where instead of doing daylight runs, they were doing nighttime runs over the south of France, and he didn't know what he was dropping. He would go up and find locations, and they would drop in several tons of stuff out the back of a plane. He wasn't allowed to know what it was. He basically was supplying equivalent arms and food and everything to the French Resistance.

**Hsu:** So what are your parents' ethnic and religious backgrounds?

**Daniels:** They were just regular Anglos, and at the time, they were both Southern Baptists.

**Hsu:** Oh, okay. Do you have any siblings?

**Daniels:** I have one brother, four years younger.

**Hsu:** What were your interests, hobbies, or favorite subjects as a child?

**Daniels:** Oh, all kinds of science stuff, you know, I had a chemistry set, and an erector set, and had some biology stuff I messed with and everything, and built various things. I built a go-kart, for example, using a lawnmower, and all kinds of crazy things like that. Played music, stuff like that.

**Hsu:** And any mentors or teachers or heroes?

**Daniels:** Well, you know, of course, every year I'd get new teachers, and probably the one I know most is, you know, in my senior year of high school, we had calculus, and the teacher was, I don't even remember, Mrs. Matthews, that was her name, and she taught calculus, and that was really fun.

**Hsu:** What sorts of books or films or TV shows did you consume?

**Daniels:** Mainly books. I read all sorts of things. I think I read all the Dickens novels. I read a lot of the Russian novels, all the English authors, some of the American authors, you know, The Last of the Mohicans, and stuff like that. And so, all kinds of reading.

**Hsu:** What was your first introduction to computers?

**Daniels:** Ah, well, I think it was the end of my senior year, I got a job, I was in Tulsa then, and that's where several of the oil companies exist, and particularly their research events are held there. So I got a job at the Sinclair Research Facility, and I got a job, it was a half job, half of my time I did x-ray crystallography, and the other half I did computer organizing. They collected a lot of data about some of the sites they were going to be drilling in, and so forth, and that was served on the computer, so they had me doing some organizing of things with that.

**Hsu:** This was senior year in high school?

**Daniels:** Mm-hmm, yeah.

**Hsu:** So that was, how did that come about?

**Daniels:** Well, I was in the Boy Scouts, and Sinclair had a facility that they allowed us to use as our facility, and I got to know several of their researchers, and asked for and got a job there, so that was great.

**Hsu:** So where did you go to college?

**Daniels:** MIT, which is kind of nice, MIT has this policy that in your junior year you can apply to MIT, and if they accept you, then you are accepted, which was kind of nice. It means that in my senior year, I didn't have to fill out any applications, because I already had been accepted, and that was great. Everyone else would wander around and fill out dozens of, or maybe tens of, five, several, certainly, applications to make sure they got in somewhere, and I never had to do that. So I went there.

**Hsu:** Was it common for, you know, I'm wondering how did you decide to apply to MIT?

**Daniels:** Well, I was interested in science, physics really at the time, so, you know, the two best schools would be MIT and Caltech, and Caltech didn't have an early acceptance program, and MIT did, and so

that's where I sent in my application, and they accepted me, and I didn't have enough information to decide between the two of them, so since I was already accepted, I just went to MIT, which was great.

**Hsu:** And so did you major in computer science?

**Daniels:** Actually, I majored in physics for the first two and a half years, but one of the, MIT also has a great finance policy for school, and as part of that, you would, you sometimes got free grants and things, but also they expected you to do some part-time work, and in the physics department, they had me doing computer programming, actually, and, which was fun, and doing the physics and the computers, I thought the computers were much more flexible, I could do anything with them, and it was more fun than the physics. So in my junior year, I switched majors to computer science, and off I went.

**Hsu:** What was the first program that you ever wrote?

**Daniels:** Well, it was this program that they had assigned me. It was a program to calculate for, I think we'd call them atom smashers, or what they did back then, and so you have this accelerator, it would accelerate particles, and it'd collide with other things and produce new particles, and they had a detector, which was a big, huge, giant magnet, and you would calculate, you know, for a given strength of the magnetic field, how quickly things would bend, given how fast and how heavy they were, and so there was a computer program that they had started to do that. So they had me take that program, and they wanted it converted from, it was in Fortran, and converted it into PL-1, which was, at the time, quite, you know, the new thing, and so that's what I did the first time.

**Hsu:** Who influenced you in college?

**Daniels:** Well, all the professors. I mean, the professors there were just, you know, really exciting people and top-notch, and you could ask them any question you wanted, and they knew the answer, and could point you often to the paper or the book and, you know, where to read out more on it, so they were a great group, so that's why I stayed there through graduate school.

**Hsu:** And both during your bachelor's and master's, you did work on programming languages?

**Daniels:** Yes, yes, and we actually created a new language that was called MDL. It was for modeling. I was in a modeling group, and our head was J.C. [R.] Licklider, and he was pretty famous because earlier, he had been the head of DARPA, the Defense Advanced Research Projects Agency, so they would fund projects that they thought the military might find useful, and the group I was in was looking at Morse code. Turns out that, you know, it's not just dots and dashes, that you can listen to someone sending code, they call it the fist, that you could tell who it is because they had certain behaviors in how they send Morse code, and that's often how they could track groups around, just that they would learn how this person works, and they would see him moving around the country, and they would know his group was moving that way. They had to do that personally, and so they wanted that automated, and so my group was working on a scheme to catch these behavior traits that people would use and then be able to label a particular message with who probably sent it, and so that's the work my group did.

**Hsu:** That sounds very contemporary.

**Daniels:** Oh, yeah, yes. Well, of course, now they don't send Morse code by hand. Instead, they, you know, in fact, they usually encrypt it, and machines send it, and machines receive it, but back then, it was quite unique and worthwhile.

**Hsu:** Yeah. I'm just thinking in terms of, like, the kinds of, you know, personal surveillance tracking information that companies try to, you know, discern individual patterns of behavior.

**Daniels:** Yes, yes. It was very much like that. It was very early, of course, to do that, so that's the project that we worked on.

**Hsu:** Yeah, and you also did work on LISP?

**Daniels:** Well, the model language we used was a kind of expanded LISP. LISP was the basis of it, you know, not physically, but intellectually, so that's the language we worked on.

**Hsu:** And I also read that you were involved in the original Zork.

**Daniels:** Ah, yes. When I started working on my Ph.D. thesis, there were others there, and there were four of us who, you know, kind of in late hours would play around with this, and we had seen a game on the Internet very early in it. In fact, it wasn't really Internet, it was ARPANET. MIT was one of the first hookups to that, and we found this game called Adventure and played it. It was pretty simple, and we thought we could do better, and so we started just playing around and creating something, and it was cool. One of us did the language stuff, and, of course, the language, instead of just, you know, verb, you know, thing, or verb, noun, we started adding things. We'd add, you know, three things, one red, one blue, one green, so you'd have to, say, pick up the red thing, or the blue thing, or the green thing, or adverbs, and so it became quite a natural language processor. We did, as just a hack, as we called it. And invent, you know, puzzles that you'd have to do. That's mainly what I did, and others would do other parts of it, so it was quite something. And since we were on the Internet at that point, people could log on and play the thing, and so it started, you know, ones or twos or threes, and we would watch them. There was a way to watch another terminal. That way, we got to see what mistakes they made, what things they tried should have worked and didn't work. We'd go fix the natural language to be able to do that. In fact, that's kind of how, you know, I got to working on the Lisa, that it was the same thing. You want to do user testing, watch them, see how they do it, see what mistakes they made, how to improve things. So that was, you know, an early drop-in of that capability.

**Hsu:** And, you know, so then, you know, Zork ended up becoming a commercial product.

**Daniels:** Right.

**Hsu:** You decided to sort of stick with, you know, not go off and join them.

**Daniels:** Kind of. I actually, they created a virtual language, and then they started implementing it for various machines. And since I was at Apple and the Macintosh, not the Mac, it was the Apple II, they wanted an implementation of their virtual machine on the Apple II. So I did that for them. I wasn't part of the group in terms of being a partner or anything, but I did do that one, and they gave me some money for doing that.

**Hsu:** Right. So you were an Apple employee. Yes. But doing basically contracting work for them, for Infocom at the time.

**Daniels:** Yes.

**Hsu:** And Apple let you do that because?

**Daniels:** Well, I was doing it on my own time. I wasn't doing it as an Apple employee. I mean, I'd work on it at night or weekends or something, and it was pretty straightforward, so it didn't take a lot of time, but as a freebie.

**Hsu:** Right. So then you finished your PhD?

**Daniels:** Not there. Not the MIT PhD.

**Hsu:** Okay. So you left with just a master's.

**Daniels:** Yes. I worked on the PhD. I already had a first draft done. I wasn't greatly excited about it. I had this notion that it should be something really novel and creative and advanced, and I didn't think the work I was doing was quite that. So I kind of slowed down and slowed down. Eventually, in fact, I think I'm probably still on leave of absence from MIT, but I never finished it.

**Hsu:** Right. And that was the work on the MDL language?

**Daniels:** Yeah, MDL. Well, actually, the PhD work was on APL, that programming language, because it had the feature that you would express something you want to do one way, but you would never implement it that way. For example, if you want to make the sum of the squares of the numbers from 1 to 10, so 1 squared plus 2 squared plus 3 squared in APL, you create a matrix where each row and each column is this, and then you do the product of the diagonal. So you create a whole matrix, but you'd only use the diagonal. Anything else would be thrown away. But that would be a lot of work for just summing that diagonal. So how can you have a language like that where you express a desire, but you don't want it to implement that way? So there are lots of languages like that today. You want to express things because it's more concise and quick to do, but you don't want to implement things that way. So it was on those issues. So, yes, I didn't finish it.

**Hsu:** So you decided to go to Hewlett-Packard?

**Daniels:** Yeah. Well, that's the neat thing about MIT is that lots and lots and lots of companies come and interview students at MIT. And if they like you at all, they'll invite you to come to their facility and talk to their executives and programmers and such like and show you what they're doing and try to get you excited. So I did a lot of that. I maybe visited a dozen different companies in my last year. So it was HP I eventually decided to go with.

**Hsu:** Yeah. So what was the reason behind that?

**Daniels:** Well, people. There was a person there, John Couch was his name, and I really liked him and the group he had put together. And so that was where I went.

**Hsu:** And what was the group working on?

**Daniels:** It was programming languages and programming tools. So some of the same kind of things I'd done at MIT, and I was kind of excited to do that.

**Hsu:** And what sort of product line did that language--<inaudible>?

**Daniels:** It was on the HP 3000, so it was like a minicomputer. They hadn't gotten into PCs yet. It would be years after I left before they'd do that.

**Hsu:** Right. So then talk about how you moved from HP to Apple.

**Daniels:** Well, in some ways it was simple. There were some issues about HP that I didn't like. We would, of course, enter our programs using a terminal, and they didn't give us a terminal. Instead they had this bank of terminals over here, and you'd have to sign up for an hour at them. And often you could only get one hour a day. And we found out later that they made these terminals, and they cost about \$75 in dollars that day, that year, that time. And that just seemed silly to us, that we would spend much of the day kind of sitting there twiddling our thumbs, waiting to get online so we could do some things. And they were doing it to save buying us a \$75 or banking us a \$75 terminal. That was kind of upsetting. And the manager I liked, John Couch, had moved over to Apple. He was the vice president of software, and his boss had moved over to the executive vice president of all engineering.

**Hsu:** At HP?

**Daniels:** No, at Apple. So my management team basically moved over to Apple, and so in some ways, I didn't move. I just stayed with the same organization, but it went to a different place.

**Hsu:** So like the whole tree, the whole branch just moved over.

**Daniels:** Well, I did anyway. I had the strangest interview, too. I mean, when I had gone interviewing with companies, you'd spend all day, maybe two days even, talking to various people in the organization. And my interview at Apple was, it was during the gas crisis, so me and John Couch sat in his car with this line

of cars trying to get up to the pumps to fill up his car, and that was it. And that was all I interviewed and all I wanted and all they wanted, and so I was hired.

**Hsu:** And this was 1979?

**Daniels:** I think so. I can look on the thing here. That's how it says?

**Hsu:** That's how I have it written down, yeah. And, okay, so you mentioned John Couch and also his manager. Who was that?

**Daniels:** His name is Whitney. I forget his first name.

**Hsu:** I think it was Tom?

**Daniels:** Tom Whitney, yes. Okay.

**Hsu:** And who else from HP joined Apple or was at Apple already?

**Daniels:** Not many there already. I'm not sure I remember precisely. I know that once I started in the Lisa project, there were a number of Apple people that we hired that were from HP, and so we had a lot more after that.

**Hsu:** So describe your first meeting with Steve Jobs.

**Daniels:** Ah. Well, of course, he's very passionate and very excited about things. I don't know that I... The only one I really remember is, I was on this project called the Apple III, which was going to be a successor to the Apple II, and one day I was walking down the hall and my boss, John Couch, said, hey, some of us are going up to Xerox PARC this afternoon to see some of the things they've got, and it turned out Steve Jobs was there as well, and they were showing us some things they had been creating. It turned out, I didn't know it, but there already was a project called Lisa at the time. It wasn't anything like what we eventually did, but there were some people that were working on that, and this was really a demo for this Lisa team to go and see this thing and some of the research they had been doing up there, and I just kind of tagged along just kind of by accident. If I hadn't been walking down the hall at that point in that time that day, I wouldn't have gone, so I went up by myself, my car, the other group kind of went together, and we spent about an hour there, and they showed us all kinds of fun things they were doing, and we got to see the first mouse, which was more like a brick. You'd move it around. They would move things around on the screen, and some of the things that are familiar today. They've been working on there, and so at the end of the day, Steve was there, as I mentioned, and he asked me to ride back with him in his car. I had to get somebody else to take my car back to Apple, and he and I talked on the way back. He was excited, and I was excited, and we talked about what it could be and what it was like and, you know, all these things, so the next day, I just continued my work on this Apple III stuff, and a couple months later, John Couch came to me and said, We'd like you to become the manager of a new Lisa group, and that's how that all started. They tried during that time to get the management team of that old Lisa group to take



up some of these new, exciting capabilities, and he didn't want to do it. He wanted to stay with what they had, which was actually kind of a boring computer and not very original or creative or anything, so, you know, Steve talked to him, and Couch talked to him, and he just kept saying no, no, no, so eventually they fired him and his deputy because they were recalcitrant. So I suddenly was the manager of a group. We were going to do this brand new thing with all kinds of new technologies, and so that's how that all started.

**Hsu:** So you had never met or interacted with Steve before?

**Daniels:** I think I met him to talk about the stock options maybe, but he was off doing these other things, lots of things, and he really wasn't very excited about the Apple III because it was pretty ordinary. Instead of a 24x80 screen, it had 25 lines, and that 25th line, where you put titles, and they had buttons under that, so you could type, you know, cut, and there would be a button under it for cut, and I could put paste, and so there were like six buttons or seven buttons down below, and you could label each of the buttons, and that was the only exciting thing about it was these physical buttons and this 25th line where they could put a label, and the screen was still character-based, so you couldn't do graphics or anything, just like a terminal, so very much like what HP was doing those days. Everything everyone was doing was 24 lines by 80 characters.

**Hsu:** Right, and so your first project was the Apple III. Yes. Yeah, and so why was it, how did you get on that project instead of other projects?

**Daniels:** It was starting up, and Couch thought I could be of help, and so I said okay. It turned out, you know, in software, it was pretty interesting, and we did, I was in charge of the software for this Apple III, and it was the hardware that failed. It was at the time when the FCC was requiring that, you know, things not emit radiation, radio interference, things like that, and so the computer actually was cast iron, the physical thing of it, and so it was a heavy machine even without any innards in it, and also being cast iron, it retained heat, so they had problems all along with, you know, chips not working or chips even popping out of the sockets because, you know, when you heat things, they expand, and so it never got it to really work, but the software became the basis for the new operating system for the Apple II, and there were other things that we had done with software that made their way into the Apple II, but the Apple III never really worked, but I was long gone by then.

**Hsu:** So what you just described on the Apple III with the buttons at the bottom sounds pretty similar to the....

**Daniels:** That was the Lisa, that was the old Lisa.

**Hsu:** Oh, the old Lisa.

**Daniels:** Yes, that wasn't the Apple III. The Apple III would be very much like the Apple II, just with the faster chips and more memory and stuff like that.

**Hsu:** Oh, okay, okay, I thought you were talking about the Apple III. No. Okay, but you were talking about the Lisa because that was what I remember....

**Daniels:** That was the old Lisa, yes, before I started.

**Hsu:** Right, with the softkeys and the, right.

**Daniels:** Well, no, the Lisa had a mouse, so you could actually type. If there was a word there, fuzzy buzzy, you could type on the word fuzzy buzzy, and if you drew a box around it and made it a different color, then visibly it was like a button, and you could put the buttons anywhere if you wanted. So where you would put them and how they work was part of the user interface design, whereas the Apple III, you know, the buttons were always at the 25th line of the screen with these physical buttons below it. That was the Apple, not the Apple, the old Lisa was that way. The new Lisa was not.

**Hsu:** Okay, so it was not the Apple III that had the 25th line, it was the old Lisa.

**Daniels:** The original Lisa, yes.

**Hsu:** The original Lisa had the softkeys with the 25th line and no mouse.

**Daniels:** No mouse.

**Hsu:** Right, and then after the PARC visit, then they brought in the mouse.

**Daniels:** And a whole new user interface.

**Hsu:** Right. So, I mean, I was really curious because, you know, you mentioned there were a lot of people from HP in the Lisa group, and, you know, one of my colleagues, Al Kossow, has said that that original Lisa interface, he thought was very similar to the HP 300 Amigo interface that also had softkeys.

**Daniels:** Oh, okay. I didn't think it, I mean, it doesn't have, the original Lisa had these, they were not soft, they were hard keys. So a physical punch into the socket keys, and then this 25th line just above the keys. So if you put a name right here above that key and pressed on the key, then the assumption was you were invoking that function.

**Hsu:** Right, so it's like a function key.

**Daniels:** It's like a, exactly, like a function key.

**Hsu:** But then with an on-screen representation at the bottom. Like you see the label.

**Daniels:** Right. So the physical keys didn't have anything on them. They were unlabeled. Instead, it was the label on that line just above it. So there would be a key and some text here, and then a key and some

text above it, and then a key and some text above it. That was the entire revolution, if you will, of the original Lisa.

**Hsu:** So then, you know, you mentioned the story about the PARC visit, and then you were brought on to be the manager.

**Daniels:** A couple months later, yeah.

**Hsu:** A couple months later. That was in 1979 or '80?

**Daniels:** It was '80. Because the visit to Xerox was late in '79. And then I came on as head, you know, like April maybe, something like that.

**Hsu:** And when you came on, had the team already decided to go with the Motorola 68000?

**Daniels:** No, I don't think so. I think that and the new software direction all kind of happened together. I know that Rich Page was the one who kind of championed the 68000. I know he was looking at it and thinking about it. He maybe even had a sample he had started playing with. But, you know, we kind of made all these changes at the same time.

**Hsu:** And did that decision significantly affect the software, or was it?

**Daniels:** It was pretty independent. I mean, we did most of the software for the Lisa in Pascal. So that could run on anything. I mean, there were certainly hardware issues because you would have to, if you had a physical mouse attached to the hardware, you would have to be able to, from software, read that mouse and where it was moving and what button was clicked and so forth. But that could be done with another hardware structure.

**Hsu:** Right. So we've talked about the PARC visit. And so talk about this process of actually just changing the whole project around to now follow the PARC ideas.

**Daniels:** Well, it was a big change. I mean, for us, we had gone and seen a demo of some of these ideas, really. Like Xerox PARC had gotten this mouse idea from, well, what's the guy's name? Anyway, some other guy had been working on this notion of a pointing device.

**Hsu:** Doug Engelbart.

**Daniels:** Engelbart, yep. And so they had a klugey implementation of that. It literally was like a brick that you would move around. I don't even know if it had a button on it. But anyway, you would move it around and then you, from software, it could read where it was and move the icon, you know, along with it so that the two would stay together. So there was a hardware to software connection there that would allow that to happen. But, and other ideas, you know, they had menus that popped up. And one of the things we looked at was doing that. And we thought the system was a lot more powerful than it was. They could

only put one window up at a time active. So if you wanted to have another window active, you'd have to bring it to the top. Now that it's active, you could write in that one. It could only be a square-- windows, or rectangular. And in our work, we thought, well, you should be able to, if you have multiple of them and they're different applications, they couldn't do that. They could only have one application driving the windows at a time. And we wanted to have, you know, a word processor and the spreadsheet, dot, dot, dot, all of them active, which means that, you know, in theory, you might want to write on the partly covered one. And Xerox couldn't do that. They didn't even thought of that. And we wanted to do that, and all kinds of things like that. So, you know, as we thought about what we wanted and how we wanted it to work, we had to, well, we started from zero. We didn't take any software from Xerox PARC. We took, you know, some ideas, but we didn't take any software. So we had to, you know, in creating the software, we had to put into the software the capabilities we wanted, in many cases, way ahead of what Xerox had done. So there was a lot of discussion about that, a lot of discussion about how many buttons you want on your mouse, and so forth. As I kind of vaguely mentioned before, we did user testing. So we would bring people in and have them try something, watch what mistakes they made, and how they tried to do it, and it didn't work. And we'd discuss and say, well, is that something we want to add to it? So there was a lot of experimentation and trying. We were our own guinea pigs [in the] beginning, and then we brought in people who hadn't ever used a computer before, because Steve Jobs says we want to build a computer for the rest of us, which means that, you know, you don't get to spend hours playing around or reading manuals. You should be able to just try something and see how it works, and it hopefully would work the way you think it should, and if not, you could figure out real quickly how it does work and then not have to mess with a manual or anything. So there was lots of those kinds of activities going on.

**Hsu:** Right. So just going back, the original system that you saw at PARC was Smalltalk, correct?

**Daniels:** I'm not sure. I mean, they had such stuff in Smalltalk. I'm not sure if all the demos were done in Smalltalk. I assumed so, but I didn't know.

**Hsu:** So you mentioned, you took some ideas from PARC, but then other things you wanted to change. How did you decide that? Was that just based on the testing or based on your own opinions?

**Daniels:** Well, testing, certainly. We certainly added things. Some of it was just kind of, you know, what do you think? What would you like it to be like? What makes sense? What's logical? So there were a lot of changes like that. You know, we mainly just saw demos at PARC, so we saw what they were doing and how it worked. But, you know, when you sit down with just a piece of paper, you can think of a lot of other things that maybe it should work that way. So there were a lot of things added, in some cases, just kind of stupidly because it turned out they couldn't do that thing. But we thought that was, like, they must have had that working that way because that's the logical thing to do. And we didn't know that they hadn't. So it got added just automatically.

**Hsu:** And so, you know, things like, you know, direct manipulation, drag and drop, that sort of a thing.

**Daniels:** Yes, yes. They did – I don't – I know you can move windows around, but I don't think they had the kind of icon drag and drop effect. I don't even remember whether they had icons or not. I know they

had menus. But, you know, I think icons were one of the things we added. You would have a checkbox, so there's a little check, and you could check it. And they didn't have that. There was radio but[tons], we called them radios. You'd get circles. Instead of checking individual ones, you'd pick one, and that would become the active one. So there was a whole kind of vocabulary generated of, you know, the things you would like to do, in some cases, based on real world. I mean, a lot of us had seen, you know, a radio where you'd punch something, and that would be the station you'd listen to, or punch another one, that would be the station. So only one of them would be active. A lot of us had seen paper forms where you'd check and check and check. So we tried to think of real-life activities and how you'd do them and how can we do the same thing in software. So there was a lot of that sort of thing. So we literally kind of started with a blank slate and worked our way up from that, adding things and trying it and thinking about it and adjusting it and user testing and adjusted again. And so there was a lot of that kind of work.

**Hsu:** I remember Smalltalk did not have icons.

**Daniels:** Right, right.

**Hsu:** Yeah, that was definitely something new. And, you know, you mentioned the mouse button decision.

**Daniels:** Right.

**Hsu:** So talk a little bit about that.

**Daniels:** Well, some of the people that had been at Xerox, there were a few people who had joined us from Xerox, and the mouses there typically were three buttons. And so there were some folks in that camp and other people who'd seen it too that wanted a three-button mouse. And some others of us, I was in that camp, wanted a one-button mouse. Because if you have a three-button mouse or a five-button or a 12-button or whatever, you have to remember and know which button does what. Whereas if you have a one-button mouse, all you have to know is find the thing you want and you click. I mean, it's almost like this kind of a click. I mean, people don't click with, you know, all their fingers. They click with that one finger. They point at one finger at a time. And so I ended up making the decisions because there was some yes, some no, some maybe, and so it came back to me. And I said, we want it to be as simple as possible, and so let's make it be a one-button mouse.

**Hsu:** You mentioned, you know, a lot of people came over from PARC. Talk about some of those people.

**Daniels:** Well, some people were already there. Two people working on the word processor had come from PARC, and I don't remember their names offhand. And then once we got going, one of the things we wanted to do is not just go out with a bare-bones system. I mean, like if you go buy a computer of any kind today, you don't get a word processor, you don't get a spreadsheet, you don't get graphics program, you don't get dot, dot, dot. You just get a piece of hardware with some operating system. And we didn't want to do that because we wanted to make sure that people would have something from day one they could actually do real work with and not just play with it. So we have the operating system and stuff like

that, but we also had seven applications we were building, so that meant a lot more people were required. We had about 35 in total to do all those various pieces. And we had a word processor and a spreadsheet and a graphics program and a database and a few others. So that required a lot of stuff. And so many of us talked to some of the people we knew. So I'd been at HP and a few of the others had been at HP. So we would talk to some of our friends and others [who] had been at Xerox and they'd talk to some of their friends. There were some people that were from other places. And the most interesting thing about that is we made offers to people we thought were really good, and we were getting, like, 35 people, and we only had one person turn us down. They kind of, if they see this thing or even just see some of the concepts, everyone wanted to be there. Everyone wanted to take part in this because it was, I mean, all of us felt it was going to change the world. And, in fact, it has. You know, I was on the Lisa, and as my stuff was getting done, Steve Jobs came to me and asked me to go over and join this Macintosh group. They didn't have an idea of what they wanted to do. In fact, most of them had been on the Apple II, and what they wanted to do, their first idea was, let's get a Basic interpreter, and then we can write things on the screen, peek and poke on the screen. And they'd have no idea of building applications and drag and drop and all that stuff. And so I showed them what we were doing on the Lisa and how it worked and why it was good, and they started doing that. And then something Steve did, I didn't think was a good idea, but he did it. He wanted to, therefore Steve, wanted to get applications for the Mac. He didn't want to bring in a large group to do it like we did with the Lisa. He wanted to have somebody else do them. So he went and talked to Bill Gates and Microsoft to get them to move Microsoft Word and Excel and other applications onto the Mac. And so he gave them two Lisas so they would have an idea of what they were building it for and how it needed to look and how it needed to work. And I guess he never had them sign non-disclosures or limit their exposure, so surprise, surprise, in a year or two, Windows 1 came out. It was not very good, but the ideas were transported. And there was a big lawsuit over that and, of course, Apple lost because they didn't have a signed non-disclosure with Microsoft. But the other thing is today, every computer has a graphical user interface, and in fact, many applications. You use Google or you use Amazon and you find the same kind of click boxes and check boxes and behavior like that and you point at things, even though you can be certain none of them run on the Apple hardware or the PC hardware. So they've emulated that user interface on their system because that's what people want and that's what they're used to. So this whole thing has been a complete overturn of the way software was. There's a new way of doing things.

**Hsu:** I want to step back and talk about Larry Tesler and working with him.

**Daniels:** Yeah, he's a great guy. He had been at the demo with us. He was working on Smalltalk, I know, and I guess our excitement got to him and there was frustration, in fact, sometime later someone said that the biggest exodus of people from Xerox PARC was to Apple because they would do work. I mean, all this work that we saw never really made it out there because Xerox kind of thought, okay, we're a printer company and if we can make things to help people use printers and buy more printers, then that's okay, but just a computer? No, it's not really. They did something, but it didn't take off. So a lot of people left and Larry was one of them. Once I was over there, actually, that was when he submitted an application. I brought him over and showed him what we were doing and he was excited and signed on the dotted line and he was there. As time went on, he took over all the application software. He was the manager for that group. And, of course, he was also a real expert in user testing, so he did a lot of the user testing for this.

**Hsu:** Right, yeah. So we've talked about user testing. Is there any more you want to add about user testing?

**Daniels:** Well, I mean, we thought it was important. We tried to do that not just with the fundamentals but each application. The first thing we would always do is use it ourselves and see what we thought of it, what we would like to add to it or change. Then we would share it with our next-door neighbor. So the person over here who was doing the spreadsheet would come over and use my word processor and vice versa and get feedback as to what they would like to add. So there was internal user testing and then external user testing. And that carried right on through. One of the things I started doing late in the project was doing demos for business people, editors, journalists, and so they would often give feedback of, you know, what's this and why is this, and that would feed into things. So even late in the party we would change things.

**Hsu:** I also wanted to get at, Larry was a real proponent of not having modes in the user interface.

**Daniels:** Right. And that was good. We thought that was a good thing to do because modes, if you have layers of modes and modes and modes, you can easily get lost. What sub-mode or what big mode or what giant mode are you in? What's it going to do? It adds to complexity. For an expert, that's fine because they understand the complexity and they use it all the time, all the day, and so they get to know those things. But for someone who is a casual user, that's just confusion. So we tried to avoid that.

**Hsu:** Yeah, so Larry became the head of the applications group. Application software. And so there was also the system software, the development tools. Who were the other managers that reported to you?

**Daniels:** Well, there was the operating system group, as you say, so that reported to me. And for me, there's always the before Macintosh and after Macintosh. I went over and spent about six, nine months with the Mac group, and when I was in the original Lisa group as the manager of the Lisa group, I couldn't just manage. I had to get my hands in it, too. So I did a text editor with it. It was very early on, and it was good because, you know, the actual applications, you know, if you're doing a real full spreadsheet, you're going to spend a year doing that, and you may not be having anything working for, you know, nine months or whatever. So this little text editor was something I could, you know, cons up in a week or so, and every time the user interface got changed, I could change my little demo thing. So I had done that, and that became one of our early text editors for things, writing code and so forth.

**Hsu:** You mentioned you had to, was it just because you wanted to?

**Daniels:** I wanted to. And it was useful because, you know, a lot of these ideas were theoretical at the point, so having some actual vehicle that you could go and play with, you know, was the first thing that ran on the operating system. It was the first thing that used the graphics system, the user interface system, and as things changed, this was so simple it could evolve with it. So it helped me to understand when I'm managing things, you know, where do we stand, what's working, what's not working, why is it not working, what can we do to make it work? Because I tried it myself and knew some of those things. Many times Bill Atkinson and myself would sit down and talk about, you know, what should it do? As an

example, if you have a screen here and you click here, and by the time the software gets it, the screen has moved, what should you do with that click? Should it click whatever's underneath that screen? Should it be thrown away? And so there were lots of issues like that with timing and behavior that we were surprised by and had to sit down and spend an hour or two talking about, you know, what's the logical thing for it to behave like? And, again, having a vehicle that we could then use that with, it's not just a theoretical discussion.

**Hsu:** So talk about working with Bill Atkinson. How was it like to manage him?

**Daniels:** You don't manage him. He manages. He's doing great stuff, and you just let him do those great things. You can talk to him. He's very interested in talking about technology and how it works. So if you had a concern, you could go and talk to him about it. But you didn't. If it made sense, it would make sense to him, and he would jump all over it. So you never have to give him direction. He would see that, and if he didn't see it, you were probably wrong. So he was a great person, and, you know, he and I got along great. In fact, now I have a 21-foot RV. It turns out he bought the same model of RV that I have, and he's made enhancements to it, of course. And I went to his place, you know, a few months ago, and he spent the day with me making the same enhancements to mine that he had made to his. So, you know, there's a big guy, Bill Atkinson, all over again. He's just that kind of a guy.

**Hsu:** How did the team decide that multitasking needed to be a key feature of the operating system?

**Daniels:** Well, a lot of us had used Unix. You know, many of the computers that were in colleges then ran Unix, and that is just inherently multitasking. And so it just looked like kind of an obvious thing. The reason most of the, you know, PCs and minicomputers, not minicomputers, PCs, is that they just didn't have the hardware to do multitasking. And, you know, that's something nice about the 68000 is it had it, and at least the hardware, we wanted to use that too. So we had, you know, virtual memory. So each application had its own memory space, and if one application were to crash and burn, it couldn't get over to the other memory space and damage that. So, you know, it's just the kind of thing that you're used to with Unix. So many of those good features, we kind of said, well, of course we want that.

**Hsu:** Talk about the intended user of Lisa. Was it a business user? You know, how did you imagine who that user was and what they needed?

**Daniels:** Well, yes, business users. It could be, you know, an executive who didn't use it much. He'd do some word processing and maybe do scheduling. We have a schedule app, <inaudible> thing too. But things like that, it could be a programmer. In fact, you know, that was kind of the division early on. We were thinking about using it as a programming tool rather than a business tool. And, you know, even secretaries, you know, people who edit things, produce memos, things like that. So we were pretty wide in the group. And that's another interesting thing about this. In a lot of companies, there's a marketing team gets put together, and they go off and figure out exactly what they want, create specs for it, and then they bring in some programmers to start monkeying around with it. We didn't have that. The programming team was in place quite a time before. There was even a marketing team. And we were talking about, you know, what should it do, what can it do? You know, before the marketing folks even got



it then. So it was definitely people who were skilled, full-time workers, and people who didn't want to learn programming because computers then were actually programmed in a sense. You know, there was a programming language. If you wanted to delete a file, was it DEL or DE or DL or RM for remove or REM? And the syntax of if you wanted to delete two things, was it first, comma, space, second, or first, comma, second, or first, space, second, or, you know, whatever. And so you had to learn all those things to use a computer, even as a casual basis. And we tried to, you know, get rid of those so that you casually could do things with it. That made sense and that's the way it would work.

**Hsu:** But both the Lisa and the Apple III were targeted at the business market and not sort of the home market.

**Daniels:** I don't know about the Apple III. We saw that as just a better Apple II. And we'd be able to do the same kind of things that Apple II would do. And it certainly was not a brand-new interface.

**Hsu:** But wasn't it a response to the IBM PC, the Apple III?

**Daniels:** There were some enhancements to it because of things that the IBM PC had, but it really wasn't greatly different to the Apple II. We did a new operating system for it. And that became ProDOS when the Apple III died. It became the new operating system for the regular old Apple II hardware. And a lot of the software that we did for the Apple III got put into the Apple II.

**Hsu:** Earlier you mentioned the seven applications. And you mentioned that you wanted the machine to ship with those applications so that users had something to do with the computer. How were those seven applications chosen?

**Daniels:** Well, a lot of us had been using computers ourselves and knew people that used them not as programmers but on a casual basis. Marketing people, for example. A lot of marketing people used computers, but they didn't write their own programs. They would need to do word processing. They'd need to do spreadsheets. They'd need to do business graphics. And so it was not unfamiliar to us, those kinds of things. So that's kind of how they were chosen. It was pretty obvious that if you look out in the marketplace, that's the kind of apps that were available. And so we would want to provide the same kinds of apps with the Apple machines.

**Hsu:** How difficult was it to get the applications to interoperate via cut and paste?

**Daniels:** Pretty simple. I mean, you could have multiple things actually running at the same time. And if you do a cut, it would go into a special place that the operating system had. And then another application could read from that same place. And then there was a mechanism by which you could put things there and get things there. And standard things, like if it was text, it could be from one application into the text buffer, and then another application could read the text buffer. So every time you did a cut and a paste, it would be going to and from that buffer, and another application could read that same buffer. So it was pretty easy. But you had to come up with standards. If you had a graphics, graphics would be put in that buffer, and it would be tagged as graphics. And another application, like a word processor, which wanted

to put the picture up in a document it was creating, it would know enough to be able to display that, but it didn't have all the wherewithal to edit it and change it and so forth. So there were a few standards that got put in place to deal with some of these things.

**Hsu:** Earlier you mentioned the text editor that you wrote. Was that the Lisa Programmer's Workshop?

**Daniels:** Yeah, that became that.

**Hsu:** Okay, so it became that. Yeah, so that was the graphical, the one that actually used the graphical user interface that had a mouse and menus.

**Daniels:** Yes, everything we did was with the graphical user interface. Right. Yes.

**Hsu:** And so there was an earlier sort of text editor that was not graphical, that was more like UCSD Pascal-based?

**Daniels:** I don't remember that. Maybe somebody did something like that. Well, in fact, very early on when we were building things, we were just using the Pascal system.

**Hsu:** Okay. Just directly?

**Daniels:** Just directly, yeah.

**Hsu:** Okay. So maybe that's what it was.

**Daniels:** Maybe, yeah.

**Hsu:** Okay. Talk about the schedule for the Lisa and, you know, kept getting pushed out.

**Daniels:** Well, that's another interesting thing about the Lisa system and effort is that there really wasn't an imposed schedule. In most other places I've been, you know, marketing. In addition to deciding exactly what it is they want and how it's to work, they delineate a schedule that they want to have it in. So often it's not kept to the schedule, but it comes from marketing. And that didn't happen in our case because we were there starting to put it together and make advances with it before marketing even existed. And so it was. One of the things that I think a lot of people liked working on the Lisa team is that you didn't have someone who didn't really understand what was going on coming in and imposing what they wanted. Instead, we were kind of putting together what we felt would be great. We would get some feedback from other people. But, you know, the schedule was more like they, like us, wanted something excellent, something new, something that would be revolutionary, you know, computer for the rest of us. That was the most important thing. And all the features that it would take to make that were mainly up to, you know, the software team to do that. And then the schedule was put together by the software team with how long they thought it would take to do that. And so it was pretty free and easy in that regard.

**Hsu:** Did the failure of the Apple III affect the Lisa schedule at any?

**Daniels:** No. It was a completely separate team. It was for a completely different problem. If we had built the Lisa with a cast iron box, I mean, it could have happened to that. But, you know, it was much more like current computers, mainly plastic with a thin layer of metal inside to keep the radiation from escaping, pretty lightweight all in all. I guess we learned from that mistake.

**Hsu:** Yeah. How did the release of the Xerox Star affect the development of the Lisa?

**Daniels:** We went and looked at it, but we didn't like it a lot. A lot of the things that were wrong with the Star system were also in that system. It was not a personal computer. It was a group computer. It was a big box, shared box. Your things and other people's things would connect to it. And so it was a group computer rather than a personal computer. So we went and looked at it, had some good ideas. A lot of the things that we had put in, they didn't have even yet. So it didn't affect it a lot. It didn't change the schedule, didn't change. I mean, maybe there were a couple of features that we saw that we hadn't seen or considered that may have made their way into the Lisa, but I don't even remember if that was the case.

**Hsu:** Talk about the switch to using icons for the desktop manager.

**Daniels:** Ah, okay. You probably talked about the fact that the original Lisa, when we were working on it, had much more things laid out in rows and columns, kind of like a spreadsheet sort of. And some of the Mac people had been working along with using icons, and that's what we wanted too. And so the schedule was getting late.

**Hsu:** So the Mac did icons before the Lisa did?

**Daniels:** I think so, yes. Before Lisa even went out, before it was announced. So both groups were working along, and there was a lot of sharing. There was something like 30% of the code in the Mac came from the Lisa. All the graphic stuff, you know, the drawing circles and all that was stuff that Bill Atkinson had done for the Lisa, and he took the code over and ported it to the Mac. Other things, printing was all from the Lisa, memory management was from the Lisa, on and on and on. So the ideas flowed back and forth. At the top, I know there was some kind of rivalry, but down at the bottom we were all trying to make everything good. So, you know, as I mentioned, I went from the Lisa over to the Mac group to get them started, and I took a copy of our manual, not a user manual, but a software manual, about how each of the pieces work, how the memory management works, how does icons work, how does the so forth. And so we shared a lot. And so, yeah, they were the first ones that had the icons for the desktop. We had icons for other things by then. So, you know, if one team found something useful and interesting, they'd share it with the other, and the other could decide if they wanted it.

**Hsu:** Right. And so during that period, you know, the Rosings Rascals period, you were back on the Lisa from the Mac. So you had gone to the Mac and then come back during that period. Talk about the idea of the stationary pad icons that you could tear off to create new documents. Where did that idea come from?

**Daniels:** Well, you know, you've got pads of paper over there, right? Right there I see some. And, you know, it was trying to take a useful concept that people already knew and using it for a computer concept. And we did that. I don't think that was the greatest concept in the world. And, you know, that has disappeared from the user interface of systems. Instead, you go into an app and you say new, and that's how you get it. And that's better because, you know, there's not – over here is a place you can go to create new ones, and over here is where you can work on ones. Instead, it merges that concept in one thing. So it's fewer things to deal with. That's better.

**Hsu:** I do find that it matches the sort of programming model of object-oriented programming more closely.

**Daniels:** Yeah, yeah. And, you know, the object becomes – the object is both the actor and the creator.

**Hsu:** So stepping back a little bit, you know, before Steve went to the Mac team, so there was a reorganization that led to Steve going over to the Mac team.

**Daniels:** Yes.

**Hsu:** And then basically that led to John Couch becoming the head of the Lisa division.

**Daniels:** Well, Couch going over to the Lisa division was earlier.

**Hsu:** Oh, okay.

**Daniels:** In fact, there was a bit of a hullabaloo about that. I learned later. But, you know, Steve really wanted to be the head of the Lisa.

**Hsu:** Right. And Couch was head of software originally.

**Daniels:** Yeah, yeah. But not just the Lisa. But not the Lisa. Right.

**Hsu:** Okay.

**Daniels:** The Lisa team was this separate secret organization.

**Hsu:** So that – because Couch told us that, like, the – so he became head of Lisa as a result of the reorg.

**Daniels:** Yes.

**Hsu:** Okay. So, you know, how did that reorg affect you?

**Daniels:** I didn't even know it had happened. I mean, I knew that, you know, Couch had been given charge of the Lisa. I didn't know how that had happened. I was a little surprised that Steve Jobs wasn't

the head because I knew in our conversation in the car coming back, I could tell that he thought this was, you know, his reason for existence was the Lisa and some of those concepts. A little surprised. Something else I didn't know is that he was told, don't bother the Lisa group. Don't have anything to do with them.

**Hsu:** Told by whom?

**Daniels:** The president of the company at the time. What's his name?

**Hsu:** Michael Scott.

**Daniels:** Mike Scott, right. And so we didn't see much of him, which I thought was kind of strange because I knew he cared about this. I only learned much later that this had all been going on and, you know, it opened the stratosphere.

**Hsu:** Right. And so were you already the head of Lisa Software when that happened or was that later?

**Daniels:** I didn't know when that had happened because I didn't know it had happened at all.

**Hsu:** Right. Because I'm just thinking if you were head of Lisa Software, your report, your direct report would have changed, right?

**Daniels:** No, yeah. Well, I guess it probably had happened earlier. I guess. Since I never knew about it, I couldn't say when it had happened. Was it that day? Was it the week before, a month before? I don't know.

**Hsu:** Okay. So it sounds like by the time you were asked to join Lisa Software, that change had already happened.

**Daniels:** I guess, yes.

**Hsu:** I mean, there was also like a layoff, like a Black Monday sort of thing that ended up causing Mike Scott to leave. How did that whole thing happen?

**Daniels:** In terms of Lisa, not at all. We didn't lose anybody. We heard some rumors that something had happened, but we were not touched. Because by then, I think all the executives had this feeling that it was the future, is that the Apple II had to compete against all the other personal computers, and this was an opportunity for the company to get out ahead of everybody and take over the lead. And so that was the glorious thing about working there. For that, is that we kind of ran it ourselves, and we kind of had all the resources we wanted.

**Hsu:** Who came up with the name Personal Office Systems?

**Daniels:** Well, certainly Couch was part of that. And I assume marketing was involved in that. We were just told what it was. They were not asked to feed into that decision.

**Hsu:** Nobody thought of like the acronym, like realized what the acronym was?

**Daniels:** Well, we did. We did, but, of course, it had already been made, and we weren't part of it.

**Hsu:** Okay, so you mentioned moving over to the Mac team. First of all, when did that happen, and why did you decide that it was okay? That like, okay, Lisa's fine, I can actually go over to the Mac now?

**Daniels:** Well, it was a bit more than that. As I kind of mentioned earlier, there was some notion that, okay, this is a great computer for the rest of us as we're making it, but, you know, all of us programmers were using it as a programming tool, and we could make, I mean, at the time, you know, a computer like this was very expensive. I mean, just getting Unix was \$1,000 a copy, and, you know, so building up a personal workstation was a very expensive thing, and, you know, here we had this thing. You know, we had tools for it. We had compilers for it. We had an operating system for it. We could make a programmer station out of this, and that's, in fact, kind of a semi-split at that time. Larry Tesler took over the application software, and I took over the system software, so the system software and the programming tools and all that, and we were thinking of making a product out of that, and we started making progress on that, and at some point, again, way above my pay grade, Couch and probably Marketing decided they didn't want that diversion of effort. They wanted just to produce this computer for the rest of us, and we, of course, would do some programming tools, but not make a product out of it, not have manuals for it and testing tools for it and blah, blah, blah, blah, blah.

**Hsu:** So by product, it would have been a separate product?

**Daniels:** It would have been a separate product. It would be the same hardware, same software, but a separate product.

**Hsu:** I see. So there would have been, like, Lisa with all the applications and then Lisa with just the development tools.

**Daniels:** Yes.

**Hsu:** Interesting.

**Daniels:** And I don't know. They might have called it other things. Maybe they'd call it personal development system or something, but I don't know. But anyway, it got canceled, so I was kind of – I'd been leading that arm of the thing, and that's when Steve Jobs approached me and says, you know, "we're going to do some great things over here. I'd like you to come and join us," and we're going to talk to him. So I went and did it because that was – I didn't have any responsibility on the Lisa at that point. And they were – you know, the other tools we were doing, we didn't have to make them product quality and product features, and they were okay. And I thought, well, I can continue on and be okay. Turned out

I was wrong. When I came back, the operating system was just floundering. It was really slow. They put some features in, and it was just a really slow system. That was one of the first things I worked on when I came back.

**Hsu:** So then, you know, you've mentioned that when you first joined the Mac group, they weren't doing the Lisa-based graphical stuff.

**Daniels:** No, no. As I said, you know, the first software meeting I went to, they were talking about making it like the Apple II. Let's get a Basic interpreter in there, and you can use this to put things on the screen, you know, draw circles, just like you do on the Apple II because that's what they were used to. Most of them had graduated high school but had never even gone to college. There were no computer scientists there. They hadn't had much of the experience that the Lisa team had. So that was their notion of computers was the Apple II or maybe the Apple III.

**Hsu:** So this was pretty early then. Like what year did you move over to the Mac?

**Daniels:** So you were asking when did I go from the Lisa to the Mac group. It was probably '82, '83, somewhere in that range. And we had made a lot of progress with the Lisa. It wasn't done. And the Mac was kind of the first software meeting I went to at the Mac group. They were just getting started. They were starting to think about, okay, what do we want to build? Most of them had been involved in the creation of the Mac-- of Apple II. And so they were talking about Apple II concepts, about getting a Basic interpreter in. And you could click on the keyboard and move the mouse around and draw things on the screen and write Basic programs to peek and poke on the screen and put dots and draw lines. That's the kind of computer they were talking about. And by that time, I had myself a breadboard prototype of the Lisa. So I was able to show them what the Lisa could do. And I had a yay thick manual, a programming manual, of all the different components of the Lisa software and how they all worked. I showed that to Atkinson. Not Bill Atkinson, sorry. Hertzfeld. And he said, oh, no, no, it's much too complex for us. And the next week we had another software meeting. He says, oh, I got it to work real easy. It's great. You know, it's done. And so that's, I kind of think, when they started following the Lisa roadmap of software components. And that's why they did-- many of the components they did from scratch, but they did them following the Lisa guidelines for this component structure. So it's no surprise that the Lisa and the Mac look and work an awful lot alike.

**Hsu:** And, you know, you mentioned that Bill Atkinson brought QuickDraw over. You know, so I guess I'm trying to figure out like, you know, like QuickDraw was brought over, pretty much that code was just ported over, but other things were from scratch. How was that, how was it decided which things would just be written from scratch versus ported over from Lisa?

**Daniels:** Atkinson himself, let's talk about QuickDraw. Atkinson himself, he developed it in Pascal. But, of course, you can speed things up by writing it in assembly language. So over time, pieces of that, by the time it went over to the Mac, I think most all of it was in assembly language. And so it was fast and like. There's a funny joke about that. You know, when Bill Gates came down to talk to Steve Jobs about this notion of porting the Microsoft apps to the Macintosh. Sorry, not the Macintosh. The Microsoft apps to the

Macintosh. He asked himself, okay, what hardware do you use to speed up software applications? You clearly are not doing that in software. But Atkinson had everything working just in software. There was no hardware speedup at all. He had done such an excellent job of it that it looked like there was a hardware speedup device in there to make all these graphical things, you know, snap. That was impressive to all of us. So what was the question about?

**Hsu:** Was why some things were ported from Lisa?

**Daniels:** So why were some things ported and other things weren't? In some cases, it was the expertise for doing it was in the Lisa group. And the Mac folks had never done that, like the printing software. Printing software is nothing that the Apple II ever had done. So none of the people there really did printing. And, you know, we'd fought the battles of, you know, how to use these bitmap printer things to make things happen. And so Owen Densmore is the fellow who did those, and he wanted to help out, like all of us. So the Mac group, you know, took it on with great joy because this is some complex stuff that they didn't have to learn or start from scratch on. So that was kind of the decision. If something they could do that they'd already done part of, then yes, but if it was something complex and different and strange, then let's use the Lisa version of that. So it was, you know, pragmatic.

**Hsu:** One of the things that the Mac did not do, take from the Lisa, was multitasking and protected memory. Why was that decision made?

**Daniels:** Well, it could have. I mean, the basis for that was the 68000 processor, which has that capability to do that. But it's effort. So a lot of effort would have to be put into that. And that was the thing that kind of drove me out of the Macintosh group, was Steve has, he wanted to ship this thing in three months. We've got to ship it in three months. And that went on and on and on and on for about two years or three years. And that kind of pressure, I was, in theory, working on a word processor for the Mac. And I took my text editor and started, you know, evolving that. He wanted schedules for things, and I brought in schedules. Me and one other person would take two years to get a real word processor. And, oh no, we can't do that. We have to ship it in three months. And so we fought over that. I felt certain that that was crazy. I was setting myself up to fail, even though I wouldn't be replaced, because how are you going to bring someone in and start over from scratch and beat me at what I was doing? But still, I didn't want to say something I knew was false. And we fought about it, and I just said, okay, I'll leave. I went back to the Lisa group. And so he brought in [Randy Wigginton] one of the people that had originally done software for the Apple II. And it's a funny situation. It was done at an off-site for the group. And he went in and talked to Steve and came out and said, yeah, I told him I could get it done in two years, some months. And then he asked us, what is a word processor? So he had never used one, didn't know what a word processor was, didn't know how it was different from a text editor, and he told him he could do it. And so he ended up producing something. It did take him about two years, and I think he had three people working on it. But I just couldn't do that, so I went back to the Lisa. And as I said, when I went back to the Lisa, the first thing to deal with was the operating system, which was slow. So I spent some time with the operating system group and helped them grapple with the reason it was slow and what could be done to fix it up. Because one of the things we were doing with it is, even with the Unix system, if the system crashed and damaged the things on the disk, you could lose everything. And we needed to build a



system that didn't need an expert to get back from that. So we designed the operating system to save enough hints in there so that the file system could be completely destroyed and we could scan the disk and find all the files and build a new directory from that. Hard work, but, you know. And we didn't want it to be slowing the system down, so that was some of the issues that we had to deal with.

**Hsu:** Yeah. So the word processor that eventually shipped for the Mac was MacWrite. That was the one that the other person did?

**Daniels:** He did.

**Hsu:** Okay. And... So you mentioned the Lisa OS was slow. Why in particular was it slow?

**Daniels:** Well, it was just in the operating system. It wasn't the apps. It was all this file stuff. They were really careful, and they would write a bunch of stuff out and go read it again to make sure it got out, and that just slowed things down immensely. And, you know, there were other ways of doing things. So they'd just taken a rough cut at that thing, and they needed to do it a more efficient way.

**Hsu:** And so then when you went back, what was your role when you were back on Lisa?

**Daniels:** I was considered the chief programmer. That's the title they gave me. And I was kind of the same thing I did when I was managing originally, is I would help out in things. I would sit down with Atkinson and work through some problem with the user interface, and I sat down with the operating system folks and worked with them. I mentioned that I did user demos at that point. We were getting enough stuff working that we would bring in all sorts of people and give them demos, and I would do it. We were starting to go out to magazines. In fact, I took a prototype of Lisa and went to Massachusetts with it to show it to Byte magazine, for example. I would do that. Steve would occasionally be invited to conferences. He couldn't go, and so he would get it for me. So I gave one of the opening speeches at the IEEE conference that year. So lots of things like that. Anything that needs to get done, I would get the arrow and make it happen.

**Hsu:** So how did you sort of end up doing all this public relations work when you were just originally a manager or programmer?

**Daniels:** Well, it needed to happen. I mean, I could talk about anything the person wanted to talk about about the Lisa. Marketing was still a small group, and they hadn't yet learned enough about all the details to be able to do all that. I was available. It sounded exciting to me, and so I did it.

**Hsu:** I'm trying to get the timeline. So the Lisa shipped in 1983, January. At what point did you move back to the Lisa group?

**Daniels:** It was before that, before the ship. Let's see. I think there's the announcement date and then the shipment date.

**Hsu:** Oh, okay. So maybe the Lisa was announced in January of '83?

**Daniels:** Yes. And it didn't ship until later that year.

**Hsu:** Okay. And you also worked on the Mac Emulation for the Lisa. How did that come about?

**Daniels:** Well, we had an off-site, and Bill Atkinson and I took a walk. And I said, it's something I had tried to do when I was in the Mac group, because the functionality was very similar, both user interface and low-level program interface. And it seemed senseless to me to have those interfaces be just slightly different. If you made them the same to do, you know, go get me a piece of memory, and it was a different interface to do that on the two machines. And they did essentially exactly the same thing. Why do that? Why not make it exactly the same interface? And then you could run all of the apps that we were doing for Lisa on the Mac. So he [Steve Jobs] could get seven applications, all the ones he had gone to Microsoft to do and therefore gave him a head start in doing a similar machine. But he didn't want to do that. So I came up with this notion that, well, since they're so similar, we could write a little layer of software that would look like a Lisa software layer here and connect to a Mac layer there. And that was going to be MacWorks. We could have a Lisa machine act like and run Lisa software. Sorry, Mac software, right.

**Hsu:** And who was against it and who was for it?

**Daniels:** I never saw anyone against it. I mean, there was the effort it would take to do it and time. So it had to take place kind of off schedule. So if someone had already finished some piece of software or some activity and was free, then let's have them work on this. They were certainly familiar with the Lisa interface and probably were fairly cognizant of the Macintosh interface and it could make that happen.

**Hsu:** One of the things that's different about between the Mac and the Lisa is that the Mac has square pixels and the Lisa doesn't.

**Daniels:** Yes, that's correct.

**Hsu:** Did that make it--?

**Daniels:** It was all done in software. In software, you just put text up there and the software would take care of it. And it was done for a real reason. If you look at text like this, you'll notice that there are a lot more up and down things than across things. So if you pick the optimal distance for things, you would put more pixels this way and get sharper text than if you put them this way. So we made the pixels literally closer together this way and farther apart that way and you would actually get text that looks better. And with software, you just say put up an A and a B and a C and software would have the pixels do that. It was all in software. Again, all Atkinson's plain stuff up there.

**Hsu:** Right, so it was an earlier decision to optimize more for text than graphics. That resulted in this rectangular pixels.

**Daniels:** Well, the screens, I mean, you go find a computer somewhere and look at the screen and you'll see there's not much in the way of real graphics there. There's a lot of text there. So we were optimizing for what you use the machine for mainly, more, which is pictures of text across. So it was optimized for that. And then if you draw a circle, it's probably going to be a big one. You're not drawing circles that small, though you can have text that small. So the text would look worse if you had square pixels. And the circle, any reasonable size circle, you wouldn't see the difference. So you wouldn't be penalized for real graphics, but you would be penalized for real text. And therefore, it made sense to optimize for the text and you wouldn't even notice any problem with graphics.

**Hsu:** Right. But then if you draw a circle, it looks like an ellipse.

**Daniels:** No, no, no, no. You would say to the software, to the Atkinson software, draw a circle, start it here with this diameter, and it would draw a perfect circle. You would never have access to the actual bits. There would always be a layer, but there always is a layer of software between you and the bits.

**Hsu:** Right. But then once you're doing, once you did MacWorks, because the Mac software is assuming different things, right? So the Mac software is assuming square pixels. So then when they get translated to Lisa hardware--

**Daniels:** Well, the Mac things were using the same software because Atkinson ported his system over to the Mac. And so people would be using the same software and the software would know which machine it's on and the size of pixels and all that. And so you'd get a perfect circle on Mac, a perfect circle on the Lisa.

**Hsu:** I read on folklore.org that at some point, Burrell Smith on the Mac group tried to convince Wayne Rosing to adopt square pixels for the Lisa. And that Wayne decided against it.

**Daniels:** Well, it could have been done from the software because it was just the graphics for that would have to change. And all the software above it, all the applications, everything would never know it. So it could have been done. But, you know, things would look a little worse on the Lisa. So, and it was pretty late in the schedule, I expect. I never saw when that happened.

**Hsu:** Yeah, I think that was probably the main reason. There was also a game, a chess game that was ported from the Lisa to the Mac.

**Daniels:** Steve Capp's Alice? I don't know about that.

**Hsu:** Can you talk a little about the Lisa Toolkit?

**Daniels:** Okay. Well, that was the development tools. And it was kind of a, because at one point we moved off of UCSD Pascal. And the bigger thing to change was we wanted to make the system object-oriented. If you look at the way you would write, you know, some kind of interface for Address or Person. So you put up Person: and then there'd be a space and you'd type in Joe. And then Lastname: Fred. So

it's this very linear kind of system. And the software is very linear. But the Lisa and the Mac don't work that way. They put up a form, and you can type in in any order you want. You can go to another application and get, you know, your address, bring it over and paste it into the field. And so everything is acting as an object. So there's a string object that has been put there for you to put your first name at. And another string object to put your last name in, and so forth. And you can put them in any order you want. You can change them, make a mistake, tap back over it. And then when you finally get done and everything is good, you push a button at the end saying, okay. And that's difficult to do in a linear language. Instead, you have to put these things up and know where you're putting it. Are you putting it here or are you putting it there? And each of those then is acting as an object. And it would be good if the programming language had support for that. And so we, not all of us, it was Larry Tesler who did a lot of that work of making Object Pascal. So it was an enhancement to the Pascal that UCSD did. And that was part of the Toolkit. And then I think my text editor eventually became the programmer editor. And eventually we wanted a real compiler for that. It wasn't just byte codes that we interpreted. So there was a number of things that got done, word processor things and text editing. It would evolve. Because indeed, as time went on, a lot of the Macintosh stuff was done with those same tools. Because you couldn't do real development on the Mac.

**Hsu:** Right, you needed to do it from the Lisa.

**Daniels:** Yep.

**Hsu:** Yeah.

**Daniels:** Because the Lisa had more memory, had virtual memory. You could have your text editor here and your compiler here and your debugger there all on the same screen and push back and forth. Couldn't do that with the Mac.

**Hsu:** So talk about the Lisa announcement, the launch. You mentioned you were already doing public relations for it.

**Daniels:** Yes.

**Hsu:** And so you went out to Boston and other places. What was it like sort of announcing it for the first time?

**Daniels:** Well, I'll go back. Before the actual announcement, we brought in maybe a couple hundred people and showed it to them. Business analysts, editors, people from companies. We were trying to [raise] interest in this. And so some of the people were technical, so they could appreciate it. It was difficult. If you were a head of a company and you had never programmed before, explaining why this is better than all the other things out there was difficult. And so that was something I and a few others strived to do. How can you convey to someone who's never used a computer why this computer is different and better than the other ones, particularly for people who, like you, have never programmed? And so that was a challenge. We did a lot of that. And I would go places and show it. Some people would

come in and look at it. So it was a lot of that. I gave talks at conferences, as I said, explaining how the operating system is different than others. So there was a lot of that that happened early on, and a lot of that fed into the announcement. I think we learned a lot of what you have to explain to get people to understand why this is valuable. I thought the announcement went really well. There was a lot of excitement in the hall that day. It was sad that we didn't have devices that we could give people then. It was another six months before the thing was ready to ship.

**Hsu:** So then you mentioned, so it ships six months later. That's around June or July.

**Daniels:** Yeah, June, July, something like that.

**Hsu:** So then it goes on sale, and then what happens?

**Daniels:** I was still tied up in doing PR kind of things. I think there was a lot of early uptake, just like there was a lot of early uptake on the Mac. Something new, something different, something obviously with new features that I'd never seen before. So there was a lot of uptake. So for six, nine months, maybe a year, that all went on. And so all I heard was good news, that things were selling and it was good. So I think the big problem happened later.

**Hsu:** So it's like six to nine months later that the sales start to drop off.

**Daniels:** Well, certainly one of the problems was that the Mac, as I mentioned, looked and acted a lot like the Lisa. So you'd have to explain to people, why is this one different than that one? Why does this one cost different than that one? And why does this have that and this one doesn't? So there was a lot of confusion for that, in the field. Certainly by that time, a lot of things were sold, not by Apple themselves, but by all kinds of sellers. And so we had to train them to make the distinction between them. And I don't know when I left. Well, I left and started my own company in the same 19...

**Hsu:** 1984. Yeah, you left. Okay. But before that, so what do you think are the main reasons why the Lisa wasn't successful?

**Daniels:** The biggest one, I thought, and I complained at the time, was even today, even then, you don't sell everything in one giant package. If you go buy a computer, you get a box and a piece of hardware. Usually you get an operating system, but you don't get any applications. You never get a word processor and a spreadsheet and a graphics program and a dot, dot, dot, dot, dot. Those are all separate and you go and buy them if you want them, like that. And that was not done with the Lisa. Everything was included. And that was a mistake, because it meant this is horrendously expensive and that seems cheap. But if you were to actually just sell it, and they did later, as I heard. I never knew it at the time, but in talking to folks now, I've heard that, you know, like two years later, they dropped the price of the Lisa to, I don't know, \$3,000, \$3,500, something like that. And you would then have to buy the software separately. But compared to the Mac, this has a lot more features. So, you know, making that decision, you could make it fairly easily and say, you know, I want those features and I'm willing to pay for it. Or I

don't want those features, something that can't do all those things would be fine. But they didn't do that. And that was, I thought, the killer.

**Hsu:** Right. So that inflated the price beyond the point where it was...

**Daniels:** Yeah, beyond the price.

**Hsu:** Yeah. Was the software too sophisticated for the hardware at the time?

**Daniels:** Never felt so. It seemed to work pretty good.

**Hsu:** You didn't think it was too slow or needed more memory?

**Daniels:** No. Even after I left Apple, I used it for a lot of stuff. It seemed to work okay. Just like the software on the Mac worked okay. They had the same processor. They had the same 68000 processors, you know.

**Hsu:** Do you think, you know, was Apple inexperienced in marketing to business?

**Daniels:** Oh, yeah. In fact, you know, as I say, most of the sales had taken place through these independent software or hardware sellers. And Apple didn't do much of that. So, you know, getting into the business market was a new thing for them. So there was a lot of learning going on with that. Hard work.

**Hsu:** So one of the things is that, you know, of course, the Mac operating system would go on to, you know, be very successful for over a decade. But then it had trouble, you know, incorporating more modern features like multitasking that the Lisa operating system already had.

**Daniels:** Indeed.

**Hsu:** So, you know--

**Daniels:** Well, let me tell you about that issue because, indeed, the Lisa was well advanced from the Mac. It took years for the Mac to just catch up to that. But, you know, one of them was managed by a Vice President. And the other was managed by the Chairman of the Board. So guess which one got canceled, and which one kept going. I think that was part of it. Because, indeed, why would you kill the one that was already, you know, years ahead of this one?

**Hsu:** Well, I mean, that's also partly, you know, due to the fact that Steve had been removed from the Lisa. And so he had some personal vendetta.

**Daniels:** He had ownership of the Mac, both intellectual and physically and organizationally. So, yes, the reason the Mac went on and tried to catch up to where the Lisa had already been and the Lisa got canceled.

**Hsu:** Yeah. So then after shipping, well, actually, let me just go back to that. So, like, you know, if things had been different and the Mac had taken up more of, you know, the Lisa operating system's advanced features, do you think it would have had more longevity, that original Mac system?

**Daniels:** Well, sure. I mean, if it had more features and, you know, could do real applications, you know. Some of the things on the Mac were not much more than toys. And certainly the kinds of things people wanted. It didn't have a real word processor. The thing it had was pretty minor. And it didn't have business graphics, and it didn't have spreadsheets, and it didn't have a database. You know, those are the kind of things that people were already starting to use on other computers, personal computers. So the fact that the Mac took so long to get those things was a tough start. I mean, it was like a year before they started getting those kind of things.

**Hsu:** So then after the Lisa shipped, what were you working on?

**Daniels:** I was working on a database product for the Macintosh. What did we call that company? We called it Singular Software.

**Hsu:** Oh, so that's when you had—that you had left. So at what point did you decide to leave and why?

**Daniels:** Well, I had kind of done the Mac and the Lisa, and, you know, they were out there. I knew that they would continue. And I could see the handwriting on the wall that, you know, the Lisa was not favored anymore. So I could go and do something new, and I had two friends that wanted to do it. One of them had been in the Lisa team, and previously HP, and one of them had been at a real database company. We were going to put together something, forge new directions.

**Hsu:** Right. So you formed Singular in 1984. So then between '83 when the Lisa shipped and '84, what were you doing?

**Daniels:** Well, I was still employed in the Lisa group, but more and more I was doing Mac stuff. Like I would give talks about, you know, what the Mac was. That was after it was announced, of course. I couldn't do that before. But I was doing these demos before because they wanted, you know, to build up excitement before it was even announced. Everyone had to sign a nondisclosure agreement, but I did a lot of that.

**Hsu:** So the same things that you had been doing for Lisa, you were now doing for Mac.

**Daniels:** Yes.

**Hsu:** Public relations type stuff.

**Daniels:** Yes, I was doing things for the Lisa, of course, but I was doing the same things for the Mac. In many cases, some things I would do would work for both. They would have, you know, some of the same philosophy and some of the same directions and targets. So some of that work worked for both.

**Hsu:** Right. So that, like public demos.

**Daniels:** Yes, public demos, bringing in, again, heads of companies, heads of IT companies, showing them this and trying to get them excited about what we were doing.

**Hsu:** Were you doing any development work?

**Daniels:** No, not by then.

**Hsu:** Okay.

**Daniels:** In fact, when I came back to the Lisa group, I was, I really wasn't doing much development work. I was working with the developers to get them to understand some of the problems and change things and improve things and finding bugs and tracking bugs. You know, having lists of bugs and where do we stand on these bugs and testing and, you know, the kinds of things you have to do before you ship the thing, even when your software is "done". Manuals, read over the manuals and make sure they're correct and so forth.

**Hsu:** Yes. So like project management type of stuff?

**Daniels:** Closer down to the, that wasn't just management. Like for the operating system problems, I was getting in there and helping, you know, dredge out literally the software issues that were causing the problem. And how can we change those software layers to make them work better and not have those problems. So it was still technical, but I wasn't actually writing code.

**Hsu:** So like, I'm thinking like today that maybe that would be called DevOps or something.

**Daniels:** Yeah, yeah, if you're doing demos, or, you know, tracking down features that don't work well, why and how can we change them so that it does work properly. Some of it is just bugs, you know, some problem where the software blows up. But in some cases it's just the software doesn't work the way we want it to. And so how can we change that software as little as possible and get it to do the right thing and, you know, keep on the schedule. So technical work, but not coding.

**Hsu:** Okay, so then, you know, you weren't really, like, involved in the Lisa 2 revision.

**Daniels:** No, I was gone by then.

**Hsu:** Okay. And you were also gone when the Lisa and Mac groups merged into one, both under Steve. You were gone by then as well. And also, when the Lisa was rebranded as Mac XL, that was also after,



okay. So then, you know, what did you think, you know, when the Lisa was finally discontinued in 1985, what was...

**Daniels:** Well, I was sad because, you know, even then, the Lisa was still heads above the Mac in terms of capabilities. And I thought it was kind of silly to throw away all that. And when, you know, some of the things could be ported or at least use them as educational devices to say, okay, how do you do multiprocessing on the 68000 and get things to work quickly and easily. So just to throw out the window for what may be ego reasons, that's a tough one.

**Hsu:** Okay, so talk a little bit more about Singular and the database application.

**Daniels:** Well, we were doing it for the Macintosh. We wanted to use the Mac features that we were familiar with. So we wanted it... So we started Singular software. We wanted to do a database for the Mac. But we wanted it to have the same kind of benefits and features of other graphical user interface things that we had done for the Lisa. So up till then, if you wanted to do a database, you would write out some text to describe, you know, it has this field and it has that property. And then that text file would be run into a program which would create the database. And you do text things to extract out the things from the database. It was very programming-like to use a database. And there had been some research in what's called object relational databases, where you have an object that you use and you logically connect it to other tables. And we, of course, would use graphics to do that. So you would draw a square on the screen and say, this is an employee object. And then this is a project object. And so employees would have projects they work on. So you would literally draw a line between this box and that box, between the person box and the project box. And that would create a relationship between those two. So if you were writing a program, then you could say for this person, which project are they working on? Which project were they working on? And you might have several projects that a person would work on. So there might be multiple lines going from this person to several projects. And similarly, a project might have several people that work on it. You would draw these lines to show that relationship rather than trying to code that in to the database system. And so that's what we were doing different. And it got a lot of take-up because we would go to some of these fairs and conferences and literally build a database for somebody. We'd say, OK, what are you trying to do? OK, there's that. And draw that. And draw a line between it. And does it go this way? Or does it go that way? Or does it go both ways? And in 5, 10 minutes, we could create a fairly sophisticated database for the person. And they got excited about it. So we would sell dozens and dozens or hundreds and hundreds of these things at a conference. And people got excited about it. And it was something to benefit the kinds of things Apple was doing because we were showing why this paradigm has benefits. Things you could do with it, the ease of use you could have with it that you couldn't have doing it the old way.

**Hsu:** And so then you sold the company and the product to Borland?

**Daniels:** Yes. Actually, Microsoft and Borland both made offers.

**Hsu:** And so this is what year?

**Daniels:** Let's see. What is that year? '86.

**Hsu:** So how did you decide which company to sell it to?

**Daniels:** Oh, they actually made essentially the same offer in terms of benefits. But the Microsoft one had this hook on it that we had to move up to Seattle. And one of our group thought that was good. And two of us didn't. So we turned that one down. All of us went to work for this local company. And then that went on for a while and then we split up in our separate ways.

**Hsu:** Okay. But you were at Borland for at least--?

**Daniels:** A year or so, yeah.

**Hsu:** Okay. You were at Borland. Yes. You decided to leave Borland in '87. Why did you decide to leave?

**Daniels:** I had met someone and she was having some issues with being at Borland. And so kind of in solidarity I left with her. And it's a good thing I did because the next year they decided they didn't want to do Mac products at all. So all their Mac products went in the dumpster. And so that was a shame. Their work had been basically thrown away. So I moved on.

**Hsu:** So ironically, if you had sold the product to Microsoft, it might still be around.

**Daniels:** Well, they made it pretty clear from very early that they wanted our bodies, you know, our knowledge. Because they wanted to get into really-- computers. I mean, sorry, into databases for computers. And that's really what they wanted. They didn't really want our product, which ran on the Mac. They didn't, you know, that was not of real interest to them. So that was kind of known as that-- If we were to accept that offer, it would be to start over and build something brand new.

**Hsu:** Oh, really? Oh, okay. So it might have been like a database product for Windows.

**Daniels:** It would have been.

**Hsu:** Okay. Interesting. That's an alternate reality.

**Daniels:** Well, I mean, they went out and got one.

**Hsu:** Access. Yep.

**Daniels:** Yes, Microsoft wanted a database for their platform. And it was kind of understood that they didn't want our product. They wanted our expertise and our knowledge and our skills and background to do a good thing for Microsoft's platform. So that didn't bother us, I don't think. We just looked at the two offers. And funny enough, when we turned the Microsoft offer down, they doubled the offer. And we were unwilling to change our acceptance of the Borland thing. So we stayed there.

**Hsu:** So then your next job was at Sun. Talk about joining Sun.

**Daniels:** Well, when I joined Sun, it was kind of ironic because some of the Apple folks that I had worked with were there at Sun in the research lab. So Wayne Rosing, who had been the head of engineering for Lisa, was there. And so it was kind of interesting to go someplace where I already knew somebody. So that was a good time. We started working in the labs. And fairly quickly, I got moved over to a group that was doing standards for development of software in the company. Because every company has their own software for running their business. And, you know, what database do you use and what user interface do you use? And so that was a group that I joined then to do that. And that was interesting. I'd never done that kind of work. It was the time when work was going on in browsers, the World Wide Web. And Sun was trying to deal with this. What is this software? What is its capabilities? What are its dangers? And how can we do this and not allow those dangers to happen? So what do we put in place to make things not be dangerous? So I did that. And I also did user interfaces for them, too. What user interfaces should our internal apps have? So that was interesting work.

**Hsu:** And then you were actually at Sun twice. And in between that, you were at Oracle?

**Daniels:** Yeah. Oracle was the largest database company in the world, still is. So they wanted my expertise. And one of the things they wanted is they have lots of applications at Oracle for managing your database and using it. And they need to have those applications run on lots of platforms. And they had done them by having everything have a text interface, like the old way. And, of course, everyone was going to these graphical user interfaces. And they wondered how in the world they would be able to do that and not write the same application several times. So the work I had done there and the work I was familiar with at Microsoft in their user interfaces, we were then able to produce a toolkit. So you would write something and you'd say, I want a button here. And on the Mac it would do something. On Windows it would do something. And you'd have the same thing working differently. But for the higher-level software of that application, it would be the same. So that was why they wanted me. That's why I worked on that.

**Hsu:** Right. So that experience with the Windows interface, that had come from your previous work at Sun?

**Daniels:** Yeah. Well, I certainly had looked at the competition and tried to understand what it was, why it was good, and why Apple might want to copy some of those capabilities and change things a little. And, of course, I was interested as well as how it could be adapted and used. So, yeah, that's one of the things I did when I was there. They had a lot of change things so that they could move things around. And I learned a lot more about databases than I ever did.

**Hsu:** I'm also curious, you know, this is late '80s through early '90s is also the period when Apple and Microsoft and HP get into the lawsuit over the graphical user interface.

**Daniels:** Yes.

**Hsu:** Were you ever involved or called in?

**Daniels:** I was called in by the attorneys for both sides. They asked me some questions, and I would tell them what I knew. But that was the end of it. So I didn't know much about the legalese, and that was, I think, what it really circled around. They would ask a few technical questions, and I could give them technical answers, and that's all.

**Hsu:** So your stance was that Apple changed things enough from PARC that they had done something more or less original?

**Daniels:** Yes, oh, yes, and that's the case. When we started the work on Lisa computer, we started from scratch. I mean, we had some ideas of, okay, we could have buttons and windows and not even buttons because I think they didn't have buttons, but they did have windows and that you could move them around. So very, very primitive ideas, but we didn't really take much from that in building the Lisa. And, in fact, I think most of the Lisa user interface is stuff that the Xerox system didn't have. And I know that there was some agreement, some legal agreements that was done between Apple and Xerox. I was never a party to that, but I know that those discussions happened. Everything was copacetic between those two.

**Hsu:** Right, but then Windows is much more similar to the Lisa or the Mac than the Xerox.

**Daniels:** Yes, and certainly there, there's a lot more grounds for copying because Steve Jobs gave a couple of Lisas to Bill Gates at Microsoft, and as I understood later, there was no real agreement about what you can use and what you can't use, what's ours and what's yours. So that was muddy. I didn't know it at the time, but that was the case. But, you know, nothing that I was party to between Microsoft and Apple.

**Hsu:** Right, and, I mean, the Lisa interface was developed before any of that stuff was patented, right?

**Daniels:** Oh, yeah, yes. I think Apple got under that originally very little because the whole issue of patenting software, patenting ideas, you patent something that was physical. You could patent a combine or a new computer physical thing, but you couldn't do anything with software because there is this notion in patent law that you can't patent mathematics, for example, it's an idea. And so what is software? Is it physical? Is it mental? Halfway between? But that's for the lawyers to deal with. We never did that consideration ourselves.

**Hsu:** So you returned to Sun in '92, correct?

**Daniels:** Yes, I did. I, again, some people I'd worked with at Apple were doing some interesting things. They'd started this research lab, and I worked there on some research ideas. Had a little team.

**Hsu:** At Sun?

**Daniels:** At Sun, yeah. The title was Principal Investigator. It was a research lab, and there were various groups, and each group had a principal investigator who was in charge of kind of running the group. Our group was pretty small. It was three or four people, so we did some ideas. Java was the thing that was being done at Sun at that time as a programming language, and it was fairly traditional. It was object-oriented, though, so that helped. But still, to build an application took a lot of work. You had to specify so many things in code, and we thought that we could do something better, so we created a programming language. We called it DASL. DASL, right, D-A-S-L, Distributed Application Specification Language. So instead of coding an application, you know, writing all the code you need to put up the screen, deal with the interactions with users, you would specify it, and our system then would generate the Java code to do all that, and it was something like a ten-to-one ratio. So instead of writing, you know, a thousand lines of code, you could write a hundred lines of DASL code, and the application would be essentially the same. We were kind of excited about that. We got some companies to start using that. That was good. There was a big backlash at Sun then because Sun wanted Java to succeed, and us generating Java code they thought would take away from the benefits of, you know, having Java as a programming language, so we got kind of sidetracked. But we did produce ten U.S. Patents for it, and at the time that was something important for Sun. So it was a nice thing to do.

**Hsu:** And then you moved on to working on the cloud?

**Daniels:** Yeah, well, that was, they were going to use our DASL system to generate a way to submit applications to a big farm of processors, and it worked well. You know, we produced this application for them pretty quickly, and DASL code was working for that. And around about that time, I don't know exactly when or how, but they decided they wanted to sell the company. And in particular, they were working with Oracle again, and so Oracle didn't want to have one of these big farms where you submit jobs, so we were very much downgraded. We were let go, all the people that were working on it. So I had another decision to make. I went and talked to the folks at Google. They made me an offer, and I decided I didn't want to do that. I had been doing computers for years by then, and I wanted to do something differently. I had already gotten through the governor an entry into the water system, the Regional Water Quality Control Board. And so I started doing that, and I got elected to our local water district in a completely new world.

**Hsu:** So that was all on a volunteer basis initially?

**Daniels:** Initially, yeah.

**Hsu:** And so you were doing that while you were still at Sun?

**Daniels:** Yes.

**Hsu:** And then?

**Daniels:** Sun was very nice, because in being on the Regional Water Quality Control Board, we would have these meetings every six, seven weeks all over the region, and there would be a day or two of that.

They treated that as a jury duty-like thing, but that didn't last long. So eventually I had to make a decision about that.

**Hsu:** Right, but that was only after you left Sun, or even while you were at Sun? You had to make a decision?

**Daniels:** While I was at Sun, early, yeah, I did that. But then it got more complex and more, particularly once I was elected to the local water district, that was more time to consume. So I eventually left. Sun.

**Hsu:** You left the board? Or you left Sun, right. But you were?

**Daniels:** I stayed on the board. In fact, I just resigned from the board last month, 22 years on the board, on the water district board.

**Hsu:** So you were basically a casualty of the Oracle acquisition?

**Daniels:** No, I had gotten a job offer from Google, so I could have kept doing the same kind of stuff I had been doing. But I was a little bored with it and wanted something new and different. I had some interest in the sun up there and its effect on water and the whole thing.

**Hsu:** So then you decided to go back to school to pursue a new graduate degree in a new field.

**Daniels:** Completely new. It's a field called hydroclimatology. It's water systems and how climate change affects those systems. And so I started, I went and talked, I knew someone at UC Santa Cruz who had been doing climate change. She was a professor of climate change. And I knew a professor there who did hydrology. And I talked to the two of them and said, would you be interested in working with me on this? They said, we've never had anyone interested in both of our fields at the same time. And yes, we'd like to work with you. So I sent in an application and started as a student from the bottom up. Six years later, I had a PhD.

**Hsu:** So I guess I kind of want to take a step back. So you had already, you had first been appointed to the regional board by the governor in '99. First, how did that happen?

**Daniels:** Well, the governor asks people, there are like nine regions. So our region is the central coast, it's called. So from like Santa Clara all the way down to San Luis Obispo. And further, I think, Riverside. And he, it's a political decision. So, you know, he asks folks in the region, you know, who would you suggest? And there were some people I'd met and I'd worked with, and they suggested me for the position. And the governor took my application and I guess, I don't know, asked around. I know several people supported my application and I was appointed.

**Hsu:** I guess I'm really curious, like, because you had, at that point, had no experience in that field.

**Daniels:** Well, that's the way the regional boards work, is that the regional boards have certain categories. So there's a category for farming. So at least one of the members is a farmer. And they have a couple kind of more scientific categories, and I was put in one of those. And so they have seven people on the board, I think it is, and so they need to fill all these categories with people who have an interest. And I clearly had shown an interest by submitting an application. So I got on the board. And then it's a four-year term, and at the end of my term, I applied and got reappointed and kept going for a while. The board is a government agency of the State of California. It's the Regional Water Quality Control Board. So it literally deals with pollution and various things like that, and it's done by region. There are nine regions in the state. I could either be on the Central Coast region, which goes from Santa Cruz all the way down the coast, like L.A. I could be also appointed or instead appointed to the Bay Area. There's a region that includes the Bay Area. And because I was working in the Bay Area then, so I could reasonably work there, but I had to pick one or the other. So I picked the one where I was living, the Central Coast region. These implement the Federal Clean Water Act regulations, and they also implement the state water quality requirements. And we are required to make sure those are all correctly done in the region. And we met something like two, three days every six, seven weeks, looked at those issues.

**Hsu:** And could you also describe the Soquel Creek Water District?

**Daniels:** That's where I live. The Soquel Creek Water District is in Santa Cruz County. It's about a third of the people who live in Santa Cruz County, maybe 25 percent, something like that. 44,000 people. It includes Capitola, which is the city I live in, and then other areas which are not cities. Soquel, Live Oak, not Live Oak, Aptos, other areas. So it's about along the Monterey Bay. It's about seven miles along that and then two miles up to two miles inland. So a good chunk of territory. So that's one of the regions for the board, Soquel Creek Water District board. And so unlike the regional board, which implements regulations and penalizes people who violate them, we are a water supply agency. So we have various wells that we pump water out of. We have pipelines that run all over the area and supply water to those 44,000 people.

**Hsu:** Could you talk about your thesis?

**Daniels:** Sure. It was a combination of my thesis at UC Santa Cruz in the Earth Sciences Department. It was something I came up with of, how does climate change, all of its things, affect water supply? Does it affect it at all? It could be that water supply, you know, you pull up out of the ground or it comes down as rain, it doesn't change at all and climate change affects other things. So it was an investigation of what does climate change do to water supplies? And so I did it. Sometimes you see these climate change things are done all over the world and I restricted it to just California. I found something like I wanted to find changes over the long term and there are various stations there like the city of Santa Cruz has a weather station and they have 120 years of rainfall data as well as other places. San Francisco has 85, 90 years of rainfall data. The biggest one is... Let's see. It's the capital. They have 124 years of data. Anyway, so there's something like 80 stations that have at least 75 years of data. So you've got a long record of that and you can see maybe how things have changed, if at all, and that's what I did. I was looking at rainfall and rainfall is interesting because it doesn't flow every day and it flows usually several days in sequence. A rainstorm which lasts two, three, four days, different amounts each day and I was

doing scientific studies of what those are. What I found at the end of it is over those 70, 80, 100 years of rainfall, the storms are getting weaker in terms of how much rainfall you get per day but the storms are getting longer in terms of how many days you get in a storm and the time between storms is also increasing. So clearly, in the last 120 years, there have been changes. That's climate change. No one had really, to my knowledge, done that research and had that information. So the next part of it is given all those changes and I also did statistics to show that that change isn't accidental. It's a change that's real and significant. Significance is the term that's used for that. How does that affect water supply? Well, it turns out our agency, Water District, had done a water model so we could tell when water flows in, what happens to it, how much flows to the ocean, how much is available to pump out and we wanted to see if any of that stuff had changed and indeed it had. Those climate changes meant that there was less water in creeks, flowing in creeks, and there was less water that soaked into the ground to be available to pump out. That's what our district uses is water pumped out of the ground. We don't use anything out of creeks or streams. So our water supply was clearly affected and the city of Santa Cruz uses water that flows in the river and so they were affected. And so that was my thesis was how does climate change affect water? And it clearly is affecting it and so that's something to be nervous about. And you see that continuing. The last three years there's been drought, so less rainfall. This previous, this current year, we got more rain than ever. It was more flood than it was rain year and that's what all the other models out there are predicting is that we will see that kind of thing. So we'll get rain, rain is out of proportion either less or more and kind of the normal stuff won't happen anymore. We won't get a normal rainfall year. It'll be either lower or higher than normal. Those two make a big problem. That was my thesis work.

**Hsu:** How does computing intersect with the work of water management?

**Daniels:** Well, for me, for my thesis, it was all part of it. I wrote 60,000 lines of Java code for my thesis, both analyzing the rainstorms and their patterns and their behavior and this model I was using was a computer model and I did some things with that computer model in writing code. But we also, you know, the code, the model itself was developed with computers and so it's all there now. It's all, and the system we built to get around that is also a giant computer model. We've built a big facility to make us drought proof because of all the things we learned. So it's there. You don't want to go off and build a \$10 million or \$100 million thing hoping it's going to solve your problem. You use a model to analyze what the problem is and understand what effect this change is going to have and does it really solve it. And if it doesn't really solve it, how can we change that thing you're going to build so that it does and we've done that. So we built a \$180 million system to make sure that we will have no drought problems for the rest of the century.

**Hsu:** So what is your current job?

**Daniels:** Well, as I say, I just resigned last month, but I was the senior member of the board of directors of the water district. So it's the group, just like a corporation, it's the board of directors. So we approve all big purchases, we approve all the projects we're doing, the directions those are taking. So it's literally running the water district in terms of the important issues. And I did that for 22 years.

**Hsu:** So you mentioned that you have made the district drought-proof. How does that work?



**Daniels:** We built this facility. It's taking currently all the wastewater, like sewage water. Yes, okay. So how do we make it drought-proof? Currently, all the wastewater in our area and other areas goes to a single treatment plant that treats it to what's called secondary. There's primary treatment, secondary treatment, and that's what gets dumped out in the ocean. If you treat it one more step, it's called tertiary, and you can use that for crops and irrigation. You can even use it for organic crops. But then there are additional steps beyond that. We take that and take that tertiary treated stuff that is at the treatment plant and we pipe it up to another plant that we've built from scratch. It's a very powerful treatment plant. We first use little fibers with tiny little holes. That takes out all bacteria and a lot of particles. And then we do that, run that through reverse osmosis, and that takes out even more stuff, even tiny stuff, because that's capable of separating a salt molecule from a water molecule that's used in D cell. So it's very tiny holes. And if that's not enough, we run it through ultraviolet light, very strong ultraviolet, powerful enough to tear molecules apart so they're not damaged, organic molecules and other things. And then we run that through hydrogen peroxide, which again is strong enough to tear things apart. So at the end, the reduction of any contaminants is 30 trillion times. So it's the cleanest water you'll ever see. It's cleaner than our groundwater, which is quite clean, and it can be then used to restore groundwater levels. It will actually take groundwater levels and raise them because we will get half a billion gallons of water every year, including drought years, and that will be put into the ground, raise groundwater levels. It'll stop the saltwater intrusion that's happening now. We have one area, Aptos, where it was 70 feet below sea level, which means that you kind of were drawing the saltwater down into the aquifers that had the fresh water in them. And that's not going to happen anymore because we'll raise it up so that it's actually flowing out into the ocean instead. So it's safe, and that's important because the state passed a law, and now your basin has to be sustainable. And now we can prove with this change it's sustainable. We'll actually be putting water back out into the ocean instead of drawing saltwater in and polluting things. And we've designed it using some of the thesis work I did so that we know it's going to be good enough to make us go to the end of the century. Big project. In fact, it was such a good project that the BBC, which was doing a big documentary on water and water supply and how you treat water, and they wanted to pick two organizations in the United States, others all over the world, and we were one of those. So it's kind of nice that other people are recognizing how good this is. We got \$90 million in money from the state and the feds grant, and \$130 million from those two groups in low-cost loans. So the entire project is so exciting that it was paid for by governments.

**Hsu:** So you mentioned that you just recently stepped down from the board.

**Daniels:** Right.

**Hsu:** So have you retired?

**Daniels:** I've retired. I was considered an employee of the district, even though it was a case of, I could have continued, and I got paid a little bit of money for being on the board.

**Hsu:** So what's your outlook on the future, whether that's computing or the environment or both?

**Daniels:** Okay, what's my outlook on computing? Well, it clearly keeps getting improved and changed, and I think it'll continue. I'm sure as everyone has read lately, artificial intelligence is a big thing. Natural language is a big thing, and those will continue getting better and better, and that's kind of nice. Sometimes they're a little scary, artificial intelligence in particular. If that keeps going and you end up with computers more intelligent than you are, what does that mean? Could that be dangerous to people? There's a lot of social aspects there, so it's nice to see things being investigated, but also where is it going, and what could be the problem? I'm glad I'm not having to deal with that. Now, for climate change, I think that's one of the scariest things around, because you can see the effects already out there, big effects. You know, the forest fires that we've been having, the temperatures. I know that I think it was Phoenix that had over 30 days of 110 or higher, and that makes life getting close to being impossible, particularly if you don't have air conditioning in your house or your office or whatever, and that's going on. It's not going to stop magically now. We're slowly dealing with that, some organizations, but some are not. Some companies, countries, all of them. Some are happy to just keep going the way they're going, so it's going to be a scary world. When I think previous generations looked at the future, they thought, well, you know, we're leaving a better world for our children, and I don't think you can quite say that now. I think we don't know, and there's a lot of implications that maybe we'll leave it a lot worse. That's a scary thought.

**Hsu:** Along those lines, what advice would you give to a young person today?

**Daniels:** Well, I think you should do something, not just let your life exhaust. Find something that you like to do, not just something that's going to make you a pile of money, but something you'll be happy to do, something you'll feel good about when you stop doing it, something that you can tell other people, and they'll get excited about what you're doing, maybe even want to join and help you do that. That's important, I think. Kind of the way I've lived my life. Don't be afraid to change. When you feel like you're getting kind of old at something and doing the same old thing, there are other things that can be done, look into them, see what they are, and enjoy yourself. Enjoy people around you. Do good things.

**Hsu:** If you had one word of advice that you would like to give to a young person, what word would that be?

**Daniels:** Love. Love. Love what you're doing, love who you're with, love what you accomplish. Just love.

**Hsu:** All right. Thank you very much.

END OF THE INTERVIEW