



Oral History of Robert “Bob” Schreiner

Interviewed by:
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Stephen Diamond: We're here at the Computer History Museum with Bob Schreiner. It's June 10th, 2013, and we're going to talk about the oral history of Synertek and the 6502. Welcome, Bob. Thanks for being here. Can you introduce yourself to us?

Robert "Bob" Schreiner: Okay. My name is Bob Schreiner. I'm an ex-Fairchilder, one of the Fairchildren in the valley, and then involved in running a couple of other small semiconductor companies, and I started a semiconductor company.

Diamond: So that would be Synertek.

Schreiner: Synertek.

Diamond: Tell us about that.

Schreiner: Okay. As you know from an earlier session I left Fairchild Semiconductor around 1971. And at the time I left I was running the LSI program at Fairchild, and I was a big believer that the future marketplace for MOS technology would be in the custom area. And since Fairchild let that whole thing fall apart, I decided there's got to be room for a company to start up to do that very thing, work with big producers of hardware and develop custom chips for them so they would have a propriety product that would be difficult to copy. So I wrote a business plan, and I went around to a number of manufacturers. I had a computer guy [General Automation], and I had Bulova Watch Company, and I had a company that made electronic telephones [American Telephones], and who was the fourth guy? Escapes my memory right now, but the pitch basically was, "Your business, which now you manufacture things with discrete components, it's going to change. It's going to change. It's going to go to [semiconductor] chips, chips of large complexity. And in order for you to anticipate what's going to happen, somehow you need to connect with a semiconductor company who's doing that sort of thing. So why don't you consider putting in a fourth share with other systems companies? Not your competitors, once I have a computer company I won't talk to any other computer company. But I would like four people to share in the equity in this company," and indeed I found four investors who put up a modest amount of money, and we started Synertek. Actually the first money in the company was my own. I took my savings, and rented an office, and decided on the name of the company, and I even hired some people that I was paying out of my own savings account. That's how it got going. And, in fact, a good portion of our business did turn out to be custom chips. We built quite a few custom chips for all kinds of people. And I think there was a related question, oh, how do we decide to build a microprocessor? Well, that's a good question, okay. I came from a computer background with General Electric Computer [department], and so I was a believer in computers. And I knew that someday way, way down the road there was going to be a computer on a chip, but I didn't know how long it would take to get there. And I wanted to have a computer microchip. And I was pretty sure I had designers, chip designers, and process guys that could actually build a

microprocessor, design and build one, but the thing that frightened me the most was all the support that would have to go into it. I'm talking about the training of customers. I'm talking about software assemblers, compilers. All my experiences with General Electric, the worst ones had to do with developing software. I could make hardware, and then I would get some software guys to come and help me, and they would blow the budget and blow the timeframe. And so I felt that trying to design a microprocessor from scratch with our limited resources was going to be a bet the farm deal, and I didn't want to do it.

Diamond: So you didn't want to design one from scratch because of the software, support, development systems?

Schreiner: I didn't want to design one from scratch because of all the support you have to put into it to make it a successful product. A guy is not going to buy a chip from you if you can't give him at least an assembler or a compiler. And where was I going to get that know-how? And my experience in the past was that was difficult.

Diamond: What did you consider?

Schreiner: Well, we basically said, "We're not going to be in the microprocessor business. We just haven't got the financial resources. If we start it and things go wrong, it's going to be the end of the company. We have no depth in terms of financial resources." So you're basically living on almost a week-to-week business. And it was okay. We made money, and enough money to keep the place going, but not enough money to go into a big project. Well, I happen to know the guy who designed the 6800 [at] Motorola, and it turned out he also designed a better product at MOS Technology. And I also knew that MOS Technology was not that successful in marketing their 6500 [microprocessor] family because they had no second source and they were a small company. So no big company would roll the dice on a sole source who was not economically in very good shape. So I approached the president of MOS Technology—it was John Pavinen—and said is there any way we could do a cross-licensing deal? I've got guys who can design things like peripheral chips that don't require any software support, and you have a—you already have a running microprocessor with support, why don't we just cross-license all this stuff, and then there will at least be two sources. He thought that was a good idea, so we went and did it.

Diamond: Was he concerned that he would be able to compete with you, or you were too new, or too small?

Schreiner: Well, no. He was—we had—there was no funny business about how we're going to control pricing and any of that kind of stuff. It was like, "Hey, we exchanged licenses, then [we each] do whatever we think we should do." And it turned out that the 6500 family was one of our most successful profitable products. We sold a ton of them. And it gets down to other questions like...

Diamond: Well, let me ask you, did that create friction with your 6502 relationship...

Schreiner: No.

Diamond: ...because you were basically running away with the market compared to MOS Technology?

Schreiner: Well, if there was any problem, I knew John Pavinen fairly well, but if there was any problem he never said anything to me about it, and we never had any phone calls about that kind of a problem. It turned out that all the people to whom we sold 6502s used MOS Technology as a second source and bought—to make sure that if something happened to me, there was somebody else that could make the product. So he was getting a lot more business as a result of this cross-licensing than he had before. So I think he was reasonably happy that it was a good deal.

Diamond: So it was a win-win relationship.

Schreiner: Yeah. It was—we both made out.

Diamond: And had he already settled the litigation at the time with Motorola?

Schreiner: No, he was still facing litigation from Motorola who claimed that he stole Motorola technology, which really wasn't true.

Diamond: So you signed the deal with him while that litigation was going on.

Schreiner: Yes. That was a role of the dice situation.

Diamond: How did you make that decision? It could have gone very badly.

Schreiner: Well, not for me, because I didn't steal anything. I didn't hire any Motorola people. I didn't have access to any Motorola documents of any kind.

Diamond: But you might not have had the right to ship that 6502.

Schreiner: But that would be up—yeah, that would be a matter of litigation, and I don't see how damages would accrue on my side. The biggest threat in that litigation is the award of a very large

amount of damage which MOS Technology could not afford. It would have shut them down. But I don't see how they could have gotten me to pay any damages because it didn't hurt them in any way.

Diamond: So part of the settlement was they changed the pin out from what was the 6501 to the 6502.

Schreiner: There were quite a few differences between the 6500 family and the Motorola, what did they call it?

Diamond: 6800.

Schreiner: 6800, there were quite a few differences. There were instructions that were in the 6500 computer that were not in Motorola's. And Chuck Peddle, who I also knew very well, swore that he did it completely independently, he started from scratch with a clean piece of paper, and designed the 6500. Now yeah, he learned a lot designing the 6800, but he also learned about the mistakes he made which he corrected in the 6500. So all the people that I know that evaluated both machines always told me the 6500 was the superior product.

Diamond: Yeah, I remember one of the designs we had was a chess computer that one of the Russian chess masters was associated with. And he looked at the instruction set of the 6800 and the 6502. And for the algorithms that he was doing, the 6502 was far and away better than the 6800.

Schreiner: We heard the same thing from the Apple people, and the same thing from the Atari people, that they had looked at both machines and the 6500 was a superior machine. So...

Diamond: You mentioned Apple, tell us about how you [got] the 6502 [designed into the first Apple computer].

Schreiner: Well, there is story that goes along with that, that probably would be worth getting somehow documented in the history. I was sitting in my office one day at Synertek, and my secretary said, "There's a couple of guys out here, want to talk to you." And I said, "Well, okay, send them in." In come these two characters. Both of them were in sandals and jeans, and they both had these Indian bead things around their forehead. And I looked up and I said, "Yeah, what can I do for you?" And they said, "Well, we came here and we would like to open up a line of credit." And I said, "What's the name of your company?" And Jobs says, "Apple." Wozniak never said a word during the whole interview, he just stood behind Steve Jobs. I said, "Apple, well, what is it you do?" Well, they described their plan. They were going to make these boards that people could assemble themselves and make their own little computer. And I said, "There was a company that used to do that." Maybe you could help me, it was a kit company.

Diamond: Well, there was Southwest Technical Products at the time.

Schreiner: Yeah, there were a couple of companies that made electronic kits that you could assemble yourself, and reasonably successful.

Diamond: Heathkit?

Schreiner: Heathkit was the name I was trying to think of. I said, It sounds kind of like a Heathkit deal." "Yeah, a little bit like it." "Well, it's not a bad idea." I said, "How much credit are you looking for?" And Jobs says, "I'd like to have an open line for \$30,000." And my next comment was, "What's the capitalization of your company?" And Steve Jobs says, "Capitalization? I don't know what that means." I said, "How much money have you got?" And the answer was, exactly his words, he says, "Well, I sold my Volkswagen Microbus, and my partner here sold his Hewlett Packard Calculator, and we raised \$800." And I said, "Now your company has \$800, where is it located?" "In my father's garage." I said, "Now let me get this straight. You've got a company called Apple, working out of your father's garage, and you have \$800, and you want an open line of credit for \$30,000?" I sat there and scratched my head and I said, "Well Synertek is doing well enough at this point in time that if you used \$30,000 worth of product and never paid me, it wouldn't break us. I'd hurt for a little bit, but it definitely wouldn't break us. I'll roll the dice. I'll do it." And I picked up the phone and I called my controller and said, "These two guys that you sent over to my office, I'm giving them a \$30,000 line of credit under the following circumstances. If they go one day—you have 30-day line of credit limit. If any of your accounts go over 30 days, from that day on you're COD for the rest of your life, so don't miss a payment. You've got 30 days to pay." And they never ever missed a payment, and they got to the point where they were a multimillion dollar a year customer. That was the story with Apple.

Diamond: That's how you...

Schreiner: Never heard that story repeated anywhere, but that's a true story.

Diamond: So that's how you got it designed in.

Schreiner: It got designed in, the Apple I and the Apple II.

Diamond: So tell us a little more about that.

Schreiner: We were the sole source suppliers for the first three years, and we got to the point where we couldn't keep up with the demand. And so we had to say, "Hey, why don't you go see MOS Technology or somebody else."

Diamond: Rockwell.

Schreiner: "We can't supply this many parts." And Atari was a similar story.

Diamond: Well, before you switch to Atari, tell us a little more about dealing with Apple. How was it working with Jobs and so forth over the years after that?

Schreiner: After that first meeting with Jobs I never heard from him again, ever. Oh, I'm sorry, I take that back. I heard from him once after that time. We were selling parts to Atari for about three or four years, something like that, and I got a call from Steve Jobs. And Steve called up and said, "Well, we like your product, we bought a lot of parts, but the time has come to go to a 16-bit machine. Are you going to design a 16-bit version of the 6500?" And I said, "No." I said, "Would you be willing to fund it?" And he said, "No." I said, "Well, let me tell you, to take on a project like that is absolutely betting the farm, and I can't afford to do it, and I don't think my board would let me do it. So the answer is no." And he said, "Well, you have to understand that that means you're forcing us to switch to the 68000." I said, "Yeah, I knew that was going to happen someday, Steve, but there's nothing I can do to prevent it. I don't have the resources to build—design, build, and support a 16-bit machine. Even though you're a great customer, give us lots of orders, I just can't afford to take that gamble." And so I knew we were going to lose him as a customer. Okay. Then the story with Atari, you wanted to know how that got started? Well, Jack Balletto, who was our marketing manager, came into my office one day and said, "Hey, I just visited a company called Atari. They were down near Los Gatos someplace. God, they've got these games that you can play, electronic games, fantastic. They're selling them at airport terminals and places like that, and I think we should go over and visit them." And so we went over and visited them, and talked about our microprocessor family, and met Al Alcorn. And Al said, "I already looked at it. I like it. It's a good little processor, and we could use it for consumer games." So I said, "Well, we'd love to be your supplier." And they again said they had been around the valley, and they had been to Intel, and they had been to National. And again, because of the nature of their business, nobody would give them a line of credit. They all wanted them to be a COD customer, and they couldn't stand that kind of cash flow. I said, "Hey, I'll give you a line of credit, how much do you want?" They named a number, I said, "That's okay. I'll do that." And then within a year, between Apple and Atari, they were using 120 percent of our production capacity. Couldn't ship parts fast enough. So both of them were roles of the dice, and both of them succeeded.

Diamond: How was it working with Atari during their ramp-up days, were they challenging?

Schreiner: Well, we had the same problem with Atari that we had with Apple. They were asking for more volume than we were able to supply. So we basically steered them to MOS and North American Rockwell. We had a licensing deal with them. So they were able to make some of our parts, and they were buying a lot of microprocessors and a ton of ROMs. All those cartridges had ROMs in them, and we had a big ROM production line. And they basically, between the two of them, probably represented 80 to 90 percent of our sales, and they wanted more. And I kept saying, I got to have some outside customers besides you guys. I can't give you anymore.

Diamond: You know that Atari actually moved to a chip on board type ROM and put Synertek in that business.

Schreiner: Yes, we made those.

Diamond: So those cartridges in the later days was a Synertek chip on board with plastic around it.

Schreiner: Yeah. They told us they wanted to experiment with just putting a glob of epoxy on top of them, and we said yeah, okay, but I can't guarantee reliability, and I can't guarantee that that thing is hermetic, so if you start to have failures don't come back to me and complain, because there's nothing I can do about it. That's your process. And turns out that those ROMs failed more often than a dip—a chip packaged in a standard plastic dip.

Diamond: The packaging.

Schreiner: But nevertheless, the cartridges weren't assumed to have that long a life, so it didn't really matter.

Diamond: So Atari became one of the largest semiconductor purchasers on the strength of those games, and started pushing everyone.

Schreiner: Not only that, we were also the main supplier to Atari for some of the custom chips that they were using. And our willingness to do custom chips allowed us to get a higher-than-average ASP for the parts we did sell them, because they were buying ROMs from National for a lot less than they paid us. And they were still buying a ton of ROMs, and it was a quid pro quo. You do the custom chips, nobody else wants to. And National told us to get—take it out and we don't even want to look at them. So okay, so we'll buy some ROMs and we'll pay a little extra money for them. So it was a good relationship.

Diamond: So the custom business that you were thinking about when you founded the company was a big part of the connection with Atari.

Schreiner: Yes.

Diamond: You had the custom chips, you had the microprocessors, and you had the ROMs.

Schreiner: Right. We had the whole—we had everything they needed except memory.

Diamond: Right. You remind me of the game part of the business. Synertek had a lot of business with Arcade games, based on the 6502, some of the companies like Bally and so forth, what was that like? These were Chicago companies?

Schreiner: My recollection is that Bally mostly bought ROMs. Now you're talking about Tandy, Tandy bought a lot of ROMs. Bally bought a lot of ROMS.

Diamond: Tandy was there, but Bally made video arcade games.

Schreiner: They were not big customers for microprocessor parts.

Diamond: What was it like dealing with them, with that kind of business? Anything you can say?

Schreiner: There are so many anecdotes there, too. I got a call from Tandy's president [head buyer] complaining about the fact we didn't ship as many ROMs as we promised them. And I never heard so many four-letter words in a single sentence in my whole life, but he used every one that I knew. And as I listened to him I got so goddam mad I hung up on him. But what he told me just before I hung up, what he told me was he was in Texas. Said, "If you ever come down to my office, I'm on the third story and I guarantee I'm going to throw you out the goddam window." I sent Joe Patricks down to see if he could...

Diamond: The sales guy?

Schreiner: Yeah, at Synertek. I sent Joe Patricks down who was one of our sales guys, and I told him what the buyer had said to me over the phone. And I said, "Well, just see if you can spread a little—I lost my temper. I said some things I shouldn't have said. See if you can make peace down there." Not only did he make peace with those guys, he came back with another order, so we started doing business with

them again. It was kind of interesting. There was a moment there, if that guy was within reach I probably would have punched him.

Diamond: Tell us about how the relationship with Honeywell developed.

Schreiner: Well, Synertek's big problem was it was growing so goddam fast, we certainly had a cash flow problem because inventory and invoices were building up much faster than profits were coming in. And I considered the fab areas that we had in Sunnyvale to be basically Mickey Mouse. They were all built on nickel and dime kind of stuff. In fact, we even bought some used equipment. Not all of it was brand new. And I wanted a really first class fab. The company was growing for quite a few years, like doubling its sales every year.

Diamond: Yeah, every year.

Schreiner: It's growing like crazy, and so money was a big problem. And so I went to our investors and I said, "I would like you to put in another round of financing." And I forget what I was asking for, big number, 250 million or something like that, and they said no. They said, "Leverage it." I said, "Leverage it? Leverage a fab? How the hell do you do that." "Well, find a way." I said, "No, it's not going to work. Not only do I need a lot of money to build a first class fab so I can compete with people like Intel. On a yield basis I could not compete with Intel or National. Our yields were never that good because our fab areas were never that good. And I wanted a first class fab, and I figured the only way I could ever get my hands on it is to go to a big company to whom a couple of million dollars is chicken feed. So I approached some people like Standard Oil who, by the way, made an offer. And I went around to some computer guys saying, "Boy, unless you get tied in with these semiconductor guys they're going to come back as your competitors and wipe you out," which actually did happen. And Honeywell said, "It's not a bad idea. What about we—instead of us just investing, we'd like to acquire the company." So they made us a pretty good offer. And I said, "Here's my plan for a new fab. I don't want it here in the valley where I could get raided every day for my best people. I want to put it over in Santa Cruz where once a guy is over there he ain't going to want the commute of coming back over here. I'd probably get him locked up for the rest of his life. They thought that was a good idea, and they actually funded one hundred percent of that fab area, and it was a beautiful fab.

Diamond: It was.

Schreiner: Beautiful fab. And—but that was at the point in time when things started to turn sour with Honeywell, and I had already made up my mind. I was—before the fab was finished and opened, I made up my mind I was leaving.

Diamond: So how did that relationship sour?

Schreiner: Well, I was a little skeptical about a little semiconductor company in Silicon Valley being absorbed by a large eastern corporation. Because all my experience in sitting at Fairchild watching all this—RCA tried it, Univac, Unutra tried it, Union Carbide tried it, a lot of big companies tried it, all of them with dismal failures, and what makes me think that Honeywell could make it work? And I had some really good discussions with Ed Spencer, who was the CEO of Honeywell, and he assured me this was going to be a hands-off deal. "We'll acquire the company, and with a stock-exchange kind of a deal so you have no tax consequences, and we'll stay hands-off. You run the company the way you've been running it. I'm not going to tell any of our divisions they have to buy from you. They don't have to buy from you, you don't have to buy from them. It's a hands-off deal, and we think that's the only way it would work." And I said, "Well, I agree with you that's the only way it's going to work, and then you'll have to be thinking about compensation. Because let me tell you something, the kind of hotshots I've got around here, if you start talking to them about how good your pension plan is, I'm going to be talking to a very lonely building. You're going to have to find some way to reward these guys if they succeed by whatever yardstick you want to create. If they do it, they've got to make a lot of money. That's what happens in all the other companies around. They call it stock options." Okay. He said, "Well, that's going to be a more difficult problem, but we'll find a way to solve that problem. Maybe we'll issue phantom stock which they can cash-in based on some price-earnings ratio, something that would give them a reward similar to what they would get if they went over to Intel." I said, "Well, that would be good if you could do something like that." Well, the first time I knew something was wrong was when I decided we needed a decent computer to support the kind of CAD [computer-aided design] stuff that we had over at Fairchild. So I wanted to buy a PDP-11. Because PDP—Digital Equipment Corporation already had quite a bit of software, application software working, and that was [in] my competitor's shops. And the word came back, "You can't do that." I said, "Why not?" "Because we're in the computer business, we're in the mainframe business, and our competitors will say, "Hey, what do you think about their subsidiary out there buying a DEC computer when they make their [own]—it's going to really hurt our mainframe computer business. I said, "B-b-but Ed, you promised, and we've looked at Honeywell [Computers]—you don't have one single application on your machine that we can really use." And his answer was, "We'll get it. So for free we'll put in one of our big mainframe computers," which they did.

Diamond: For free?

Schreiner: For free, no charge, no rental charge, free. "How can you beat that?" I said, "Well, if it works, I can't beat that." They never once got any of the applications that we needed running. So we sat here as a custom chip company without a computer. And all these little guys are popping up and they're getting the newest, greatest stuff from all the [computer] vendors, I didn't have a computer that I could use for designing. So then I said, "Uh-oh, this really isn't going to work." And right then and—that same day that would have dawned me of this—that they weren't going to keep their promises I wrote a resignation letter and I left the date blank. And I went to my boss and said, "Okay, when I've finally had enough either you or I could fill in the date, cross-mail the letters, and it's over." Well, I thought that might work, but that didn't work either. I actually signed the letter one day and gave it to him, but the fact of the matter is, it didn't solve the problem. There was more and more interference from Honeywell management. It wasn't a hands-off deal like they promised. And I finally said, "This isn't going to work." And then we started losing

good people. I lost my VP of finance. I lost Bill O'Meara [VP of Sales]. I lost a lot of good people. They all looked and said, "It's just a salary. We're never going to get anything out of this," and they went to places where they could get stock options. And they basically cleaned out my top [talent]. About a month before I left I was the sole remaining founder of Synertek. Everybody else had left. I just said, "The end, it's basically the end. There's no sense of me staying here. I don't want to watch a funeral." And the company did spiral down into the tank. Not only did they lose their best people, they couldn't hire anybody else because people would walk in and say, "What are the goodies besides my salary," and the answer was, "There aren't any." Can't hire anybody.

Diamond: We used to say the phantom stock was something that could not possibly have been more appropriately named, because it was just a phantom, so there was no equity at all.

Schreiner: Well, but you could make it look like a stock option, because you could issue certificates. And what does it cost per month? Nothing. And then you could say, "Okay, what we'll do is, we'll agree—we'll negotiate a price earnings ratio. The price of the stock is worth, say, 20 times our net profit per share. That's the same way you cash out with Intel or anybody else," I said, "why can't we set that up?" And his answer was, "How am I going to square that away with all my other divisions?" And I said, "Hey, yeah, you should have thought about this long before we did the deal." And the fact of the matter is, they hadn't thought about it. And they weren't capable of understanding the mentality. They kept tell me about, "Well, look at our pension plan." "I don't want to look at the pension plan. Tell me how I'm going to lock these guys in here and stop them from leaving." Couldn't do it.

Diamond: Then they couldn't come up with an answer.

Schreiner: They couldn't come up with an answer. So that was really basically the end of the company. It just slowly spiraled down and we kept losing good people. Couldn't hire any new people that were really good and experienced, that had the reputations for whatever chip designs, or logic designs, or software or anything. The only thing we didn't lose was our production people, our process people stayed on, but everybody else left. And pretty soon I was all alone, sitting there, "Where the hell is everybody? All gone."

Diamond: So while Honeywell owned Synertek they had a solid state electronics division in Boulder. Do you think that was part of the problem because there was a competitive group?

Schreiner: No, no. There was a little bit of problem with those guys. At one point in time, I made a pitch to Honeywell's management. We had to do a business review every year and I said, "You know, there's a problem coming up. We're an N channel silicon gate company." I got this terrible feeling that CMOS was steaming down the road and was going to wipe out all the other technologies. "We need to get some research going, some R&D going on developing CMOS, not only design capabilities but processing technology and I haven't got the money, so how would I fund this?" No answer. And then the guys from

their semiconductor operation department came up and said, "Well, we'll do it for you." Hmm. I didn't like that as an answer but it's better than nothing. And it turns out they never came up with a CMOS process. So at the time I left, we had no [real] CMOS capability. We made a few CMOS chips, Bulova, for their watches, small chips. The process wasn't that great.

Diamond: Was that silicon gate or metal gate?

Schreiner: No, we did it CMOS.

Diamond: Oh, CMOS.

Schreiner: We did it in CMOS, but we didn't really have a solid process. We made some chips. The chips worked. As far as I know, they didn't have any reliability problems but we weren't competitive with the other companies around here, and I didn't have any people with direct CMOS experience. Not one guy ever had any real experience. We had a process guy, he jimmied up a process. We made a few chips that made Harry Bulova Henshel happy. You know, got some chips. Couldn't make them at a price where we could make any money.

Diamond: Were you involved with the negotiations with Zilog on the Z8 processor?

Schreiner: No.

Diamond: That was something that was originally driven by Honeywell. They were looking for a microprocessor for their thermostats.

Schreiner: Oh, okay.

Diamond: They called it the chronotherm, which was a microprocessor-based replacement for the round Honeywell thermostat.

Schreiner: Yeah, I'm familiar with those.

Diamond: The 6502, they didn't like the idea of making a microcontroller version, so we did a second source deal with Zilog.

Schreiner: No, I didn't get involved with that.

Diamond: Were you involved in the discussions with SSED, the Solid State Electronics Division, about building a microprocessor for Honeywell's mainframes?

Schreiner: Mm-mm. I don't remember getting involved in that either. It never happened.

Diamond: It didn't happen, but there was an effort underway to have SSED define an architecture for the mainframes, but it didn't succeed.

Schreiner: No one ever called me about it, discussed it with me. So it was down at your level. If there were negotiations going on, you were the guys that were doing it.

Diamond: So were you involved in discussing what was going to happen at Synertek after you left, in planning for your succession?

Schreiner: No. Honeywell, in its infinite wisdom, put a guy in charge of Synertek whose previous job at Honeywell—he was fast-tracked. Honeywell had something they called fast-track; promising managers that were being accelerated up the management path. They had a guy who was doing well on their fast-track program and his previous experience was running a plant in Mexico that made die cast control valves for hot water heaters. Wouldn't know a semiconductor from a hot stone. Put him in charge of Synertek. I went to the top, I said, "It's not going to work," and it didn't. He had no idea what to do, none at all. Couldn't make any decisions.

Diamond: So Synertek peaked out at about \$100 million in revenue.

Schreiner: Something like that, yeah.

Diamond: Of course, there was a huge hit when Atari volume evaporated.

Schreiner: Yes, Atari blew up and Apple switched over to Motorola products.

Diamond: Apple switched over to the 68000.

Schreiner: Right, 68000.

Diamond: So a lot of the high volume runners--

Schreiner: Gone.

Diamond: Were gone. Shortly thereafter, subsequent to that--

Schreiner: And because we had been neglectful of our custom ability, we had no way to rush out and start soliciting a lot of custom chips, because we were doing everything by hand.

Diamond: Most of the revenue is from ROMs, from microprocessors and peripherals.

Schreiner: Yes.

Diamond: And a lot of Atari and Apple.

Schreiner: We had custom chips. We had some custom chips we were making for people.

Diamond: But it was a small part of the business.

Schreiner: Well, they were relatively low volume, but that's what we thought it would be.

Diamond: Maybe a quarter of the business.

Schreiner: We expected it to be a low volume business. Got good ASPs for them. You didn't have to have rock bottom prices to sell somebody a custom chip, because it was his way of locking the secrets up in his machine. Hard to copy a machine that's got custom chips in it, when they have numbers that means nothing to anybody else.

Diamond: Right. Of course, the lead time and the ramp up is a slow thing.

Schreiner: Yeah, that takes a long time, because you've got to design a chip and they've got to check the prototypes. From the time the guy hands you a logic diagram to the time he places the production order is a year, year and a half.

Diamond: When Honeywell decided to shut down Synertek, did you think about buying it back?

Schreiner: No. There wasn't anything to buy. All the good people were gone. Had no new products in the pipeline. Didn't really have the custom capability that I envisioned when I started the company. They still had their goddamn Honeywell computer sitting in a lobby that nobody wanted to use. No, it was basically over. There was nothing to buy back.

Diamond: Subsequently the factory that had been built in Santa Cruz was finished.

Schreiner: Factory got finished. Never came up as a running factory and you know why? Because the key people who I was going to export over to Santa Cruz looked around and said, "I don't think this company's going to make it and I don't want to be stuck in Santa Cruz with no way to get back into the Valley because I sold my house and house prices are skyrocketing. I can't buy a house like the one I had. I'm not going over there." I couldn't find anybody who wanted to go over there. I was ready to go over there. I said, "Hey, man, I'll move my office over to Santa Cruz in a flash." But then I began to have the same thought as I watched all these problems developing. I said, "You know, what happens if I go over to Santa Cruz and I take one of the offices in this nice, beautiful building and then this thing crashes? What then? How do I get back into Palo Alto?" you know. I had the same problem the other guys had. Nobody wanted to go. Everyone thought it was a beautiful factory, a beautiful fab. Santa Cruz is a beautiful area to live in. What happens if you suddenly have to go back and work in Silicon Valley and your home is in Aptos or wherever?

Diamond: Basically, your strategy was right in that once people moved down there, they were kind of stuck down there.

Schreiner: They were. They were trapped.

Diamond: That was correct.

Schreiner: That was the strategy.

Diamond: The problem is, your own strategy--

Schreiner: First of all, it's a nice place to be.

Diamond: —did you in.

Schreiner: We're able to buy land at a reasonable price. Once I got my good guys over there, I can't see any of them coming back. I knew I was going to have trouble with compensation, problems with--

Diamond: With Honeywell.

Schreiner: With Honeywell. It was a crapshoot. It's one of the ones that I lost. The building was finally bought by another semiconductor company and they ran it for quite a few years.

Diamond: I think it was AT&T.

Schreiner: It was a company out in LA. Do you remember who it was?

Diamond: I thought it ended up in AT&T's hands. I'm not sure.

Schreiner: No, it was a company, now they make disk drives. A company that used to make semiconductors, now makes hard drives. It's still in business.

Diamond: Western Digital?

Schreiner: Western Digital. So yes, somebody did finally use the factory for a while and I think they probably had some of the same kind of problems. You know, they wanted to staff it with their people and people said, "Well, how do I get back to LA if something goes wrong?" The part of the strategy they didn't correctly foresee. But if Honeywell had put together a decent compensation program, I still think it would have worked.

Diamond: To move people down there.

Schreiner: Yeah. I think it would have worked, because the few people that lived over there loved it over there. We had some people making the--

Diamond: It was a beautiful fab. I remember that you had windows that you could see through the building.

Schreiner: A lot of engineering went into it. We had all the areas where we had the masking stations all isolated from ground movement, you know, on cushions and bearings, so we could minimize vibration and make tight geometry devices. It was a really well planned fab.

Diamond: What was the geometry in those days? What future sizes were you doing?

Schreiner: Numbers like 5 microns stick in my head, but I don't really remember for sure.

Diamond: I think that sounds--

Schreiner: But we were looking ahead to the point in time when just ground vibrations could be a big problem. So we did a lot of stuff on, how do you isolate the fab? We really had blocks of [floor] concrete sitting on rubber rollers that could move back and forth, and stay still, even though the rest of the building was shaking. It's known to be an earthquake area, so we had to worry about that.

Diamond: Looking at today's world, are you surprised at how ubiquitous microprocessors are in designs?

Schreiner: Yes. They're everywhere now. Like I said before in the other session, I never foresaw the point where they would become so cheap that a guy could say, "Hey, all I want to do is lock the car door. Why the hell is it so goddamn cheap?" What other way is there to do it? You're going to take TTL and put them up on a circuit board when you can buy a microprocessor for 5 bucks? You sit down and write a program, it takes a day or two, you're done. Don't use the whole microprocessor. That never sunk in until I saw how cheap microprocessors finally got to be.

Diamond: I remember when I joined Synertek, we were involved in some design effort for some customer. I'm not quite sure who it was. The sales guy said, "Well, the decision about what microprocessor to use is a CEO-level decision." This was while you were still at Synertek. The CEOs of the company—these were large companies—had to be involved in making the microprocessor decision, because it was such an impact on the company when you considered the development systems and the software and the emulators and things that you were talking about. Now it's a throwaway. You put the microprocessor in. It doesn't matter if you have to use [all of] it or not.

Schreiner: That's right.

Diamond: But back then, it was--

Schreiner: That's right. That's something that I didn't actually foresee. We tried approaching some big companies like General Motors and Ford. They right away gave us the, "Well, what about alternate sources?" I said, "Well, there's MOS technology." They said, "They're even worse than you guys." They said, "You know what would happen to us if we were counting on you for let's say a third of our requirements." Back in those days, they made 10 million cars a year. "Let's see, we've got you, MOS Technology, which is not in financially good shape, and then Rockwell, whom we don't trust. You know what would happen if we gave you 30 percent of our requirement and then you call up some day and

said, 'My factory just burned down'? You know what it costs us to shut a production line down for one day? We can't afford to buy your microprocessors if they were free." I said, "Okay, we're wasting our time. We're going to get this same song from everybody we talk to," so we just stayed the hell out of Detroit. There was no way we could have penetrated Detroit ever. They wanted a big company like TI who, by the way, they could sue the shit out of. If we shut down say Ford's production line, there could be big lawsuits. If they sued me, they wouldn't get very much.

Diamond: Not enough for their one day.

Schreiner: And if I were running Ford or General Motors, I think I would have made the same decision. I would want somebody big with deep pockets who can jump in with whatever resources are needed to get that damn production line moving again, because I can't afford to be shut down.

Diamond: You mentioned you talked to people other than Honeywell before you decided to go with Honeywell's acquisition. How close were you to doing a deal with somebody else?

Schreiner: Well, I talked to all their top management people. I had several conversations with Ed Spencer before I said I'm willing to go ahead with it. I didn't just say, "Oh, great. You made an offer. I'll accept it." I flew back several times, said, "I want to have lunch and I want to sit down and talk about some of the problems I think may come up. We talked about all these issues and I got a lot of good promises, "Don't worry. We know how to fix these problems. We will find a way to fix these problems." He seemed like a good guy. He seemed earnest, honest. I believed most of what he said, but it turns out even he couldn't really make good on his promises. Probably because of the pressure he got from his division general managers, who basically said, "We don't want Schreiner coming in here and telling us what to do." That's not the only company that's had that problem. General Electric had that problem. Borg Warner had the problem in spades. The general managers said, "You try to force this down our throat, we'll get up and leave."

Diamond: Was culture a big contributor to this?

Schreiner: Yes. Total cultural mismatch between Honeywell Minneapolis and Synertek Sunnyvale.

Diamond: Silicon Valley.

Schreiner: To Silicon Valley. It was no match at all. They can't understand what motivates people. I know people, when I lived back east, that had worked for General Electric all their lives. They graduated from either high school or college, went to work for the steam turbine or the locomotive plant, worked there until they reached the retirement age, went home and retired with a company pension, which wasn't

all that great, but with some medical benefits. They were happy. That was good enough. Out here, nobody who thinks he's a sharp guy would conceive of going for a deal like that when there are so many good stock option programs around with good companies. It just doesn't work. The whole way of thinking doesn't work. People out here are willing to roll the dice on all kinds of deals. You don't roll the dice in Minneapolis and you don't roll the dice at General Electric. That doesn't happen. In fact, the most common comment I got when I traveled around through Borg Warner, trying to get some electronics activity going was—and this is an exact quote, as near as I can remember the words—"I'm only five years from retirement and I don't want you to rock my boat." That's the mentality and that doesn't fit in with the lunatics here in Silicon Valley. It just doesn't fit.

Diamond: Speaking of that, there's been a tremendous changed in semiconductors since the days of Synertek with the advent of foundries, which change the equation.

Schreiner: I had been watching the foundry business right along and my prediction was, foundries won't work. I was wrong about that. The reason I thought foundries wouldn't work was, I knew what it cost to develop a brand new process and build a new factory. When Intel builds a new factory, it costs \$3 to \$5 billion.

Diamond: Big number.

Schreiner: So how are these guys in Taiwan going to come up with that kind of money to build a state of the art facility with all the latest gee whiz 12 inch wafers? How are they going to do that? And if they can't do that, they won't be competitive. So the foundry business is not going to work, other than for maybe some little specialty products. You know, some guy's got a little niche marketplace and can't run over there and get his wafers fabbed. It might work. But across the board, it's not going to work. I was convinced it wouldn't work and I was wrong. It does work and it works real well. There are a lot of fabulous [fab] companies around now.

Diamond: Do you think it's a sustainable model?

Schreiner: Yes. Somehow they were able to generate—the government wants that kind of industry and I'm sure there are big subsidies being passed out to get the latest fabs and the latest, biggest, best stuff, because they want that infrastructure. That sort of escaped me when I was thinking through the problem. But there are some very good fabs in Taiwan and Korea.

Diamond: We were talking earlier about how the 6502 is really at the heart of the formative years of the personal computer industry, 6502 because of its feature set, the pricing and economics around that really enabled the Apple II, which was the rocket booster that created personal computers. Do you have any

thoughts about that, since you were at the formative moment of what's really become a transition in computing for everyone?

Schreiner: I'm not sure I completely understood the question. I knew, almost from the very beginning, that some of these really big customers we have, we would lose. Some of them, because I didn't have the resources to give them the next generation that they really wanted. So it was only a matter of time until it happened. But I was hoping that by then, we would have built up a big backlog of custom chips and we could say, "Okay, we don't make micros anymore. They're unprofitable, selling for 2 bucks apiece. I'd rather make custom chips." But to do that, I had to have the CAD resources, which I never got, which Honeywell promised. I don't think that was my fault. I believed what he [Spencer] told me and it turned out he couldn't make good on his own promises. So what the hell, it was an interesting experience and for a while, it was a great little company.

Diamond: When you rolled the dice on Steve Jobs and Steve Wozniak, you mentioned earlier you said, "Even if they take the parts and don't pay for them, we're not going to be significantly injured." Did you have a sense that there could be something really, really big there?

Schreiner: No. I thought it was an interesting idea. I built some of these kits when I was going to college. You mentioned the name of the company.

Diamond: Heathkit.

Schreiner: Heathkit. I built Heathkits.

Diamond: Where did you build?

Schreiner: In my living room.

Diamond: Stereo.

Schreiner: Signal generators and that kind of stuff. Yeah, I built a whole bunch of stuff. It was kind of a neat way to go. I thought it might work, it might not work, but what the hell. Here's a couple of guys with a good idea, starting a new company and I kind of like the concept. I thought, "Well, I'll take a chance on it." Like I said, it's not going to kill us. We were making enough money back in those days. And Atari, when I went down and looked at their games, I was really impressed. Jack and I spent a whole afternoon playing tank warfare in their engineering room. I said, "Man, these guys have got something going here."

Diamond: So you thought they were going to have something.

Schreiner: I figured they would make it. That was not a big gamble. I thought the Apple deal was a big roll of the dice.

Diamond: So having been through this experience in the early days of Silicon Valley, in the early days of the personal computer business, what would you tell a couple of people today with an idea? Maybe they don't have a lot of money, but they have a great idea for a product. What would you tell them?

Schreiner: Well, there have been a lot of people around with great ideas and not very much money who've made big successes, like Facebook and people like that. I still think there's plenty of room for people to go out and start something. I don't know. I would say if you're young enough, you really ought to take a shot. You really ought to do it. Starting a company and making a success out of it is probably one of the greatest things you can do in your life and if I were young enough to do it, I would try again. I had a wonderful experience with all those startups. I thought Synertek, the first four years, five years, was a great company. Of course, I certainly expected that if nothing else, maybe I could do a little public offering and everybody would get some stock option money, and we could keep it going. But faced with the prospect, I think that fab area in Santa Cruz cost over \$100 million.

Diamond: That was a lot of money back then.

Schreiner: Back then, that was a lot of money. You know what I was offered by underwriters for the first public offering? How about \$18 million? That sounds like a lot of money, huh? Yeah, baloney, man. That doesn't even buy the equipment for the factory, much less buy the building. The only way to get my hands on that kind of money was from a big corporation who wanted to be in this business. \$18 million, what would I do with it? What could I buy? Nothing. It had to be a big pop somehow. Back in those days, first initial IPO of \$18 was pretty common, numbers like that, 18, 20, 25 maybe. It was a big deal. Even today, a lot of companies go do their initial IPO at those kind of numbers. That game isn't going to be played in semiconductors anymore; the only way you could do that, is to have an engineering group and a fab supplier, often in Taiwan, who RAS made the big capital investments. You could still pull it off if you had some really good geniuses designing the world's next best D to A or digital signal processor or something like that, and then let somebody else do the fab. You could still pull it off with a small amount of money, but if you want to go out and build a first rate fab, better have big bucks behind you. I don't think it's possible to do it anymore. I don't think anybody would go for it. So Intel's the last big winner of a company that owns its own fabs. It will never happen again.

Diamond: Bob, do you have any last words for us?

Schreiner: No, I think I'm about talked out, unless you could think of some other questions you want to ask.

Diamond: I think it's a great story, a really mind boggling kickoff to the personal computer business. As we said earlier, I think the 6502, because of its business model and pricing and the way it came into the marketplace, multiple sources, smaller companies that could afford to work with customers in a way that a Motorola couldn't, it enabled Apple and some of the other players in that space to get a kick start and get into the marketplace and really start the personal computer business. I think if it hadn't been for MOS Technology and you deciding to do that second source and then building all the peripheral chips, without those, you wouldn't have had those pieces either.

Schreiner: That's right.

Diamond: You had to have everything. There was a kit of parts there.

Schreiner: As a matter of fact, Rockwell made more money selling those peripherals than we did.

Diamond: Did you negotiate with Rockwell on some alternate source?

Schreiner: Yeah. They approached us and asked us for a cross license. At the time, I hadn't seen Rockwell bother us much in the marketplace. They weren't stealing our own business. In fact, I looked at them as an aerospace company. We're here knocking heads with Charlie Sporck. What the hell do they know about that, with military contracts? They're not going to be a problem. Boy, when it comes to bombing prices, whoo. You must have experienced some of that yourself.

Diamond: I did. I remember one day the phone rang and it was the new VP of purchasing in Apple. At that point, we had 100 percent of the Apple business. This guy shows up at Apple. They hire a VP of purchasing, probably the first purchasing guy that they hired. He introduces himself to me and he says, "You seem to be getting 100 percent of our business. I can't understand this." I said, "Well, we have a long relationship that started from the beginning of Apple and we're very appreciative that you've given us 100 percent of your business." He said, "Well, I can't keep giving you 100 percent of the business. I'd be fired." That was the beginning of the alternate suppliers for the 6502.

Schreiner: Yeah. But they got a lot of business, Rockwell, at prices less than we were getting for our parts.

Diamond: That's how they continued to appreciate us. The same story at Atari. We were getting higher prices at Atari, higher prices at Apple than all of the competitors.

Schreiner: Yeah, but one of the reasons, in the ROM business, National was the price bomber, always the price bomber. But National wouldn't touch a custom chip and since we would, Atari just told me to my face, "Hey, we'll pay you a little bit more than we're paying National because you do our custom chips and we need that capability. So we appreciate it." Oh, 10 percent, something like that. "We'll pay extra" and they did.

Diamond: They did. We got extra from everybody and that continued at least as long as I was there. And of course, we had the whole chip set too, so that was a better deal. And then later in the game, Bill Mensch left MOS technology and started Western Design Center and designed a CMOS version of the 6502, which we licensed. Then he built the 16-bit version of the 6502.

Schreiner: He did?

Diamond: He did.

Schreiner: Somebody did build a 16-bit version?

Diamond: Bill Mensch.

Schreiner: I wasn't even aware of that.

Diamond: Bill Mensch did that. And Apple used it, so that's how they got their 16-bit version of the 6502.

Schreiner: I'll be damned.

Diamond: Bill did it. Western Design Center. He was one of the original 6502 designers, so he took that knowledge, created the Western Design Center and built the 16-bit 6502.

Schreiner: Most of the design work, as far as I know, was done by Chuck Peddle.

Diamond: By the way, they're still selling 6502s.

Schreiner: Are they really?

Diamond: Bill is, yeah.

Schreiner: If someone has a very simple application that could be implemented with an 8-bit processor, it was a nice little machine.

Diamond: When you add the CMOS to it, you have a little power and then he has the 16-bit extension, so there's a lot of volume.

Schreiner: There's a lot of simple jobs that are done in cars that are easily handled by an 8-bit machine. Of course, if you're going to give somebody a desktop computer, you're out of business with 8 bits.

Diamond: Right. Anything else you'd like to say?

Schreiner: No, can't think of anything.

Diamond: Thank you very much. It's been a pleasure.

Schreiner: Okay, glad to be here.

END OF INTERVIEW