
# Oral History of Douglas Fairbairn

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**Hsu:** All right. Today is October 6, 2016. My name is Hansen, and we have here also David Laws and David Brock. And we are interviewing Douglas Fairbairn. So let's start at the beginning. You were born in Pomona, California, 1948?

**Fairbairn:** Correct.

**Hsu:** And your father owned a vegetable seed business. <laughs>

**Fairbairn:** Yes. He was-- I want to say a few words about that, only from the point of view of he was a small business man. Didn't start the business, but took it over from somebody. He was, started selling vegetable seeds, in Southern California in the 1930s, when Southern California was mainly farms, as opposed to the suburbia that it currently is. And I spent a lot of my summers and other times sort of either helping him out at his warehouse or going out to see customers or whatever. And I realized that he was the, set a great example, for customer service. He was always ready to do whatever it took to get whatever the customer needed and spend time with them on a personal basis. And was, you know, farmer had to plant on Monday morning, and we'd make a trip out to the farm on Sunday night to deliver the seeds so that they could plant. So there're a lot of sort of important lessons. Also, I think <laughs> he had the negative characteristic that he was very difficult to work for.

<laughter>

**Fairbairn:** And so he could never keep employees. So it was always a two-man shop, you know, himself and another salesman. He tried to grow it, but it just, it just never worked. He had his own way of doing things that didn't correspond with…

<laughter>

**Fairbairn:** Those he tried to hire, so… But I think I learned a lot of sort of good sort of basic business principles from him.

**Hsu:** <laughs> What did your mother do?

**Fairbairn:** My mother actually had worked in social work. And she died when I was seven years old, breast cancer. And although that was a, certainly a big negative hit when you're so young, the subsequent story is incredibly important in terms of how my own life and career evolved and so forth. So my father remarried three years later to a woman who had graduated from Stanford University and who

  

was actually a classmate, graduated same year as Hewlett and Packard in 1934. Because she claimed to have known them. I don't think she was a close friend, but she was that. So I'm going to sort of jump ahead, because this is an important sort of personal story you wouldn't necessarily trip over. And that is that when-- I have an older brother and an older sister, and when my father remarried, we had to move to a larger house because the woman he married also had three children. So we moved from three kids to six kids, and so we, at the time, we were living in Sierra Madre, and we moved to, back to Pasadena. A large old mansion that was a beautiful old house. But more importantly, I moved to a different school. And this is the middle of the fifth grade. And I walked into the class of Miss Lucille Karpe. And she loaded me down with a bunch of books to figure out what I knew and what I didn't know, or whatever. I'm not sure. Think she gave me bunch of tests. And for whatever reason, she decided I was smart. And that completely changed my whole trajectory in terms of my education. Before then, school was just something I did and I wasn't particularly focused on it or unfocused on it. I mean, I did conscientious work and sort of got average grades, but never took it as a serious endeavor. But she was a teacher whose expectations were high. She taught us a lot of extra things outside of the normal curriculum, including Spanish and advanced math and had expectations of doing reports. We were typing reports on real typewriters in fifth and sixth grade. Fortunately I had her for a year and a half of both fifth and sixth grade. Second half fifth, and sixth grade. And we generated reports that would even now astound me in terms of their size and complexity and so forth. And the fact that I did them on a real typewriter was kind of amazing. But the bottom line was that she just set this expectation that was far beyond what I think most teachers did, and certainly her expectations of me. And so my whole view of education and school changed as a result of that one teacher.

**Hsu:** Wow.

**Fairbairn:** And so my father's remarriage and move and landing in that particular school with that particular teacher had a pretty major impact on things.

**Hsu:** Wow. So I was about to ask about your siblings, but I guess it sounds like a Brady Bunch kind of a situation.

<laughter>

**Fairbairn:** It was a pretty unique situation. I was the youngest of the six kids, and I have a brother and a stepbrother who were within six months of each other and a sister and a stepsister who are within six months of each other. And then a older sister who's eight years older, so we're sort of four years, six years, eight years older than me. I'm-- always been the little, little kid in the house. And the wonderful amazing thing is that, you know, 50, 60 years later, we're all still doing well. We all are still close. We visit each other, attend respective weddings and other activities.

  

<laughter>

**Fairbairn:** We're somewhat scattered around different parts of the U.S. but are probably closer than many natural families are. So it's been a very rewarding combination.

**Hsu:** Did you have a good relationship with your stepmother?

**Fairbairn:** It was I think positive. I wouldn't call it warm, but it was very supportive. And she having gone to Stanford and was a teacher herself and was very focused on education. And in retrospect, I didn't realize it at the time, but she was bound and determined to get one of her kids into Stanford.

<laughter>

**Fairbairn:** And her two daughters didn't for whatever reason. And again, in retrospect, nothing that happened at the time… When I got accepted at Stanford it was like, "Wow." I was little surprised. Because I was a good student, but I was not top of the class. And there are others who were more academically qualified at the time that I thought would be better candidates but… And then in retrospect, I thought, "My mom pulled some strings."

<laughter>

**Fairbairn:** She was an active alum and she knew people and I'm perfectly comfortable with that. I'm okay with that.

<laughter>

**Fairbairn:** But in retrospect it was like, "I think it was not all on me to get in there, but that's okay."

<laughter>

**Hsu:** What's your family's ethnic background? And I guess also your stepfamily's ethnic background?

**Fairbairn:** Yeah. We're all very white, northern European kind of background. I actually, after-- we'll get to this much further down the road-- but after my first retirement, I spent a couple of years just totally embedded in rediscovering my mother's family, because I'd lost track of that whole side of the family after she had passed away. And we really didn't have much connection with them. And so I, by this time, all

  

of the, most of the important genealogy records, were online and so I could do the searches on my computer late at night. And I spent a couple years tracing down all of the ancestors from my, or all the descendants from my great-grandparents on her side. And so-- and those two went back almost 200 years. And their respective families had been in America for 200 years. So I have, you know, lines going multiple directions back 400 years in the mid-1600s and coming to the U.S., so… And they're all from-- and on my father's side-- they were from Scotland. So that's where the Fairbairn comes from, and they came from a little town called Kelso in the mid-1800s. He had eight children, landed in Canada. My father was born in Winnipeg, Canada. And his parents decided it was too darn cold.

**Hsu:** <laughs>

**Fairbairn:** And the neighbors of theirs had moved to Los Angeles the year before and so in 1922, they got on the train and went to Los Angeles. And so they were another immigrant family. And escaping the cold in this case.

**Hsu:** <laughs> What about your family's religious or political beliefs?

**Fairbairn:** Sort of going back, it's all Protestant, you know. On my mother's side that I talked about, these were classic farming, Protestant family. They built a church in Nebraska when they did some homesteading there. There's still a church standing out in the middle of the prairie with their names on it as founding members. And so that was very much the religious background of sort of classic, hard-working, Protestant, farming. That was it.

**Hsu:** <laughs> What was it like to grow up during the Cold War?

**Fairbairn:** Oh, that's interesting question. Yeah. I think about it now in the context of all of the troubles that we face today, and it was, you know, there were-- I wouldn't say I was scared, but I was, you know, you worried from time to time. And certainly the Cuban Missile Crisis was a worrisome time. And on the other hand it was like, "Well, there's nothing I can do about it," so you just go on with life and hope that catastrophe doesn't happen. But it was certainly a looming cloud, if you will, over the whole situation.

**Hsu:** Hm. Certainly the launch of Sputnik was a major milestone during that era, but also personally for you. Talk more about that.

**Fairbairn:** Yeah. So Sputnik was launched in October '58, 59 years ago this month. Couple days ago. And that's what really sparked my interest in science and aerospace. And I remember going out and looking for, that and some of the future satellites that were launched, see them going across the sky. And I started collecting newspaper clippings of all the rocket and space launch related activities. And so I had

  

notebooks of things collected. Unfortunately, those seem to have disappeared into the family history. But I was very much attuned to that. So that was in '58 at same time that my father, that we moved, to the Pasadena I spoke about. You know, that was happening same time. So that all sort of came together and I was… In the eighth grade, one of the things we were required to take…. The girls had to take home ec[onomics] and the guys had to take shop. And in this case, shop meant going to four different shop classes each quarter of the year. Metal shop, woodshop, mechanical drafting and graphic arts. And so in the metal shop, I made a rocket out of a tube and sort of plugged the front and welded in a plug at the top and drilled a hole for the nozzle in a block of metal and welded it into the bottom of the pipe. And I was telling David earlier, you know, it was a good thing I never launched that thing, because I had drilled the nozzle little off center and I thought, "Oh, well, that won't matter."

<laughter>

**Fairbairn:** Course, it would've been disastrous. But anyway. And then in woodshop, I fashioned a nose cone on the lathe that was beautiful, tapered nose cone. And, you know, the graphics, I mean, in the mechanical drafting, we learned all the basics of 3D drafting. And in graphic arts we printed on real printing presses and set type and that sort of thing. And even though it was old technology, the terminology carried over to today in terms of the typesetting that we do on computers today. So it was actually a pretty… Those set of classes, I remember more from those classes than I do any other class that I ever took. I can tell you everything that we built in those classes and every bit of knowledge I accumulated in those classes turned out to be useful.

**Hsu:** <laughs>

**Fairbairn:** And so I built this rocket and I realized that it wouldn't be very interesting. It would just go up and come down. And so we needed to put something in the nose cone. Put a parachute or something. And then you have to have electronics to trigger that. So I decided I needed to learn about electronics. And so I-- this is a story I've told thousand times. I walked into the Rexall drugstore in South Lake Avenue in Pasadena sometime in January of 1963 and bought my first electronics magazine. And I told this story over and over and over again. A few months ago I thought, "I wonder if that story's true." And…

<laughter>

**Fairbairn:** Sometimes, after repeating it, you've sort of created history as opposed to recounting history. And so I went online to see if I could find a copy of that magazine. And sure enough, I found somebody had scanned decades of Radio-Electronics magazines. And I found the February 1963 issue of Radio-Electronics. And I said, "Yep, that's the cover." And so it actually had the whole issue in there. And I then went through it and discovered, "Oh, yeah. There's this article on building a three-transistor

  

intercom." And I thought, "I built that." And I'd forgotten about it. But anyway, that was an interesting magazine in the sense that in '63 there were a lot of articles on how you fix tube-based things like TVs and that sort of thing. But all the do-it-yourself projects were transistor based. So it was in that time when tubes were still very real things. And I remember going down to the local surplus store and buying tubes and so that's what, you know, '63. That was during ninth grade - that's when I decided to be an electrical engineer as opposed to an aerospace engineer, which was my path before that. And everything I did after that was was in pursuit of that goal. I learned from the magazines and built some amateur radio equipment, got my amateur radio license. Learned how to transmit Morse code, transmit and receive Morse code. Got my novice license first, which was WN6JMZ, and my general license after that, WB6ZNB. And actually spent-- I wasn't ever really addicted to it, but I did spend some time, doing social media of the time, contacting people in faraway places using equipment that I'd built and sending and receiving Morse code and doing weird stuff like that. So that's where I got my start in learning and electronics.

**Hsu:** Hm. Were there other kids who shared your hobby or…

**Fairbairn:** Nope. I was on my own.

**Hsu:** <laughs>

**Fairbairn:** I just did what was interesting to me, and I didn't know-- nobody else that I knew, had any interest in the stuff that I was doing or involved in what I was doing, so I just went off and did it, which was fairly typical of the way I'd grown up is that I just, between studying a lot… You know, I said I was smart. Well, I was smart enough to do well, but not smart enough to do well [without] studying hard.

<laughter>

**Fairbairn:** So between some amount of social activities, some amount of, huge amount of work around the house to maintain this place that we lived and working for my father on weekends, I didn't-- oh, and doing-- I also had a paper route for several years. And so that was sort of the sum total of what I had time for during my junior high and high school years, so…

**Hsu:** How aware were you of the fact that when you had this kind of enthusiasm for the space age, for aerospace, that you had arrived kind of that, Pasadena in particular, JPL, Caltech, all of this?

**Fairbairn:** You know, there was-- timing is everything.

  

<laughter>

**Fairbairn:** And being in the right place at the right time is everything. And only in retrospect did I realize. I didn't see… I figured out that I was going to be an electrical engineer and I knew that JPL was there in Pasadena. But I was… But I didn't have sort of the higher realization of, "Boy, I'm in the right place at the right time." I was born in '48, so a year after the transistor had been created, invented, whatever. And so from every aspect, I was placed at the right time at the right place. And I entered Stanford in 1966, a year after Gordon Moore had stated his-- I mean, sort of at the launch of the integrated circuit revolution. And so it was, I didn't-- only in retrospect do I realize how fortunate I was to be in all of the hot places at the right time.

<laughter>

**Fairbairn:** And so I'm still an avid follower of the space program and in awe of what these engineers do in terms of making satellites that last for 30 or 40 years in incredibly difficult conditions and land on comets and Mars and crawl over. It's still thrilling to me to see the discoveries. The thing I do remember is I thought all the planets and all their moons were all just inanimate rocks. There was nothing interesting out there, just rocks and the solar system. And here we, 40 years later, we find that there's, every one of them, is vastly different and doing incredible things. And so I just have a continuing fascination with the whole space program and the engineers who have created the tools that have allowed us to get there.

**Hsu:** Hm. Did you read a lot of science fiction?

**Fairbairn:** I didn't read any science fiction. I had no interest in science fiction at all. I was interested in reality and sort of hardcore things. The other thing I was interested in was meteorology. I actually, <laughs> of all the stupid things, you know, there was no online at the time. So we're talking early '60s, I guess. But I was fascinated by the weather and storms and so you could subscribe to the Weather Bureau's daily weather map, which had a detailed map of all the temperatures and pressure gradients and highs and lows and so forth as they moved across the United States. And so I subscribed to this and you would get one every day, but it was <laughs> three days or four days out of date.

<laughter>

**Fairbairn:** Wasn't exactly timely information. But I combed over that andlooked at it with great fascination and so it was… Anyway. So I always figured, well, if I wasn't going to be an electrical engineer, whatever, I was going to be meteorologist. But that was always sort of second tier. I did build a, one of my science projects, was to build a recording anemometer or something that would measure wind speed and try to record it on a thing that was rotating and so forth, so… Anyway, I must comment on one other thing, only because the timing. Has nothing to do with technology. But the other thing, that in driving

  

around Southern California with my father, we would always listen to the Dodger baseball games. And even then, you know, Vin Scully was the announcer. And I became a baseball fan as result of that. And here in 50, 60 years later, Vin Scully has just retired from broadcasting, a week ago. And so that was pretty, you know, sort of brings back memories of driving around the farms of Southern California with my father and listening to Dodger games and Vin Scully and the impact that had and the amazing amount of time, 67 years or whatever, which he broadcast. It was really quite remarkable.

**Hsu:** Wow.

**Fairbairn:** So I'm still a baseball fan, but I've transferred my allegiance to the local San Francisco Giants.

<laughter>

**Hsu:** So I guess by the time you were finishing high school and applying to college, it was pretty clear that you wanted to be an electrical engineer?

**Fairbairn:** Yeah. I never wavered. I was going to go for electrical engineering. My mother made sure that I applied to Stanford, as I said. Which I had no clue about. I mean, I had no-- I didn't know what Stanford was or I wouldn't, and if not for her, I certainly would never have applied. I didn't have any idea as to what Stanford's place in the universe was. The one I did know about was Caltech, which was two miles from my house. And my father insisted that I apply to Caltech, which I didn't want to go to. I had an idea that that probably wasn't the place for me, and plus, it was two miles from home and that probably was other thing. The good news was that I got <laughs> into Stanford and I did not get into Caltech.

<laughter>

**Fairbairn:** Another fortunate thing. And so… And the only other, as far as I can remember, the only other school that I applied to was Cal Poly, San Luis Obispo, which had a big engineering program. It was an excellent school. But I didn't apply to all these other schools. I did some research. At that time, Stanford accepted 25 percent of their applicants, whereas today it's 5 percent.

**Hsu:** Wow.

**Fairbairn:** So getting into Stanford was a much less onerous task.

**Hsu:** <laughs>

  

**Fairbairn:** The other thing was that the tuition was $525 a quarter, $1500 a year for tuition.

**Hsu:** Wow.

**Fairbairn:** And it's little higher than that now.

<laughter>

**Hsu:** Wow. <laughs>

**Fairbairn:** So I got accepted to Stanford and didn't get accepted Caltech, and that's where I went off to.

**Hsu:** Hm. So when you entered, did you enter into the EE major directly, or did you have to…

**Fairbairn:** Yeah. I think I, I don't, I mean, I certainly entered as engineering, declared as an Engineering major. And there were a whole bunch of required courses … math and other things, that you had to take as well as social sciences and English and that kind of thing. So I'm sure I must've declared a major from the beginning, and the good news, bad news part of that thing was that you had to take calculus, which was five days a week, 8:00 A.M., Everybody else struggled through that. Fortunately and unfortunately, I'd taken a calculus course at my high school, which was actually a college course, it was taught by a teacher from Pasadena City College, and she came to the high school and taught a college course. And so I had taken that and so I placed out of the first year of calculus at Stanford, which I had considered to be greatest thing in the world given that it was an 8:00 A.M. class five days a week.

**Hsu:** <laughs>

**Fairbairn:** The bad news was that my grounding in calculus was not nearly what it would've been <laughs> if I'd really taken a Stanford calculus course. And so I struggled. Everything after that in terms of math, was a struggle, because I just didn't have the, I didn't have the background, the basis, the hardcore understanding that I would have if I had actually taken that course. But yeah, I entered as a an EE student. And my first EE class was from a young professor named Jim Gibbons. He was teaching the EE 101, 102, 103 … my first EE classes. And I didn't know who he was. He was just a guy, right? He was real good teacher and I certainly enjoyed his class. But I didn't realize the importance or stature of him and his past or future dealings. Of course, this was early in his career, so even then, I mean, he was famous for ion implantation, but it was a, I think that was, or in the early stages of that, we didn't really understand what the full impact of that was going to be.

  

**Hsu:** Hm. What sort of topics did you focus on in college?

**Fairbairn:** My focus was on solid-state devices. And I forget whether there was any real special focus. I got a bachelor's and master's degree. I had a master's degree as part of the co-terminal program. Stanford will let you work on your master's and take master's or graduate classes in parallel with your bachelor's. And then in 1970, which was my normal graduation year, I didn't actually graduate that year. I then continued one more year and got both degrees, bachelor's and master's. The particular advantage of doing that in this case was not only getting a master's degree but if I'd graduated in 1970, I would've been drafted. Because at that time we had the lottery where you picked a number. And I think my number was 183, and I think in 1970 they got up to over 200, 220s or something like that. So everybody below 220 was subject to draft. In the following year, 1971, I was still number 183, but they didn't get that high. And so again, timing is everything.

**Hsu:** Wow.

**Fairbairn:** And <laughs> right place at the right time and so… I did my master's work-- we didn't, I didn't even write a thesis. It was just sort of special extra classes, whatever, I think. Professor Angel was my advisor. And that turned out to be good background but it was not the, you know, it was good background in terms of future stuff that I did but wasn't actually the hardcore thing that I was most interested in. I was actually more interested in computers and programming and so forth. I'd actually done my, written my first program, in high school on an IBM 1620 using FORTRAN at the local city college. I'm not sure how we got connected with that, but we punched cards and I was, I actually discovered, my first FORTRAN book and I had everything's underlined and thought, "Oh, yeah, this is where I learned about this stuff."

<laughter>

**Fairbairn:** And I think my first program was probably the one that everybody writes first, converting Fahrenheit to Celsius and Celsius to Fahrenheit.

<laughter>

**Fairbairn:** I got introduced to computers back then. I never was interested in pursuing computers from a computer science point of view, but I was more interested in computers and computer architecture, although I didn't really take many courses in that. I'm not quite sure how that-- I'm not sure exactly how that progressed. But the other important thing as far as the work that I was doing was I got a job at the Stanford Artificial Intelligence Project as a technician. I wasn't involved in any of the research, AI research or whatever. But again, you've got to be in the right place at the right time. John McCarthy was leading this thing. I didn't know who John McCarthy was,- founder of AI and everything. But he was just

  

the gray-beard guy in the corner office. But I was there as a technician. I was maintaining equipment, and so this is when I was an undergrad and a grad student, and so I'd work part-time, afternoons and that kind of thing. But again, the people that you meet and the things that you see and the things that you become acquainted with is what counts for everything. I didn't do any actual consequential work while I was there, but I got plugged into that whole AI community and the people that were involved in it, and that was fundamental to my future success. But before I go to that, I want to go back to my… So my Stanford education, you know, I can't say that there was anything monumentally important about the education itself. It was all about the people that I met and the connections that I made. And it wasn't a bad education, but I couldn't say, "Wow, I couldn't get this anywhere else." But the summer after-- well, the summer after my freshman year I went back and worked for my dad. <laughs> Summer after my sophomore year I worked at Hewlett Packard at their corporate headquarters components group measuring the force that it took to remove a power cord from the back of an instrument, making sure that it wasn't too [difficult] - you're getting down to the nitty-gritty and making sure that… And then the following summer, I worked at Hewlett Packard's newly formed computer group. So this would've been in '69, I guess. And they were doing things around the 2114, 2115, 2116. And this was at the Wolf Road-280 interchange, Hwy 280 wasn't finished. I think 280 stopped right there, as matter of fact. And you got off of Wolf Road in this brand-new facility and that, of course, is now about to become Apple's new campus. But then it was new for Hewlett Packard. And I got the job of designing a line printer interface for the 21XX family of computers. And so that was a great experience. Including the experience of plugging the board in backwards and blowing up all the components on the board.

<laughter>

**Fairbairn:** Back then you could make those mistakes. These days they make things so that are more forgiving. But you could make some pretty big mistakes back then.

<laughter>

**Fairbairn:** So that was my learning. But I got to do interesting electrical engineering work and figuring out how to design a peripheral controller and that sort of thing, so that was pretty fun. And I learned about working at Hewlett Packard and eating off the donut cart that they circulated in the morning and…

<laughter>

**Fairbairn:** And going to the summer festivities in the mountains around here for… So I got a little taste of the Hewlett Packard culture at the time. And then I think after my senior year, I think I worked at the Stanford AI project, as a full-time summer employee. And so yeah. We'll sort of move on to the next part, see if there are any other questions.

  

**Hsu:** Right. I wanted to go back real quick and ask about, I mean, this was the Vietnam era, you mentioned, missing, just being missed out on the draft. What was your view about Vietnam at the time or were there any protests going on?

**Fairbairn:** Oh, yeah. We were definitely in the heart of protests. You know, it wasn't quite as bad as Berkeley, but there were a lot of protests going on at Stanford and shutdowns and that kind of thing. I was-- okay. So I came from a very conservative Republican family. My father was a Reagan Republican. You know, he was Reagan, I mean, other than not being a politician. He was same age, grew up in that era. He thought like Reagan. He had a few basic principles. This is how life is and this is what you do, and don't confuse me with details of the changes or whatever. So yeah. I grew up with a conservative Republican background. So it took some adjustments in college. Actually, I remember… Funny things you remember. I remember reading in the newspaper in the spring before I went to Stanford that David Harris had been elected study body president at Stanford in the spring for the following fall for the year that I would be entering it. And it was a newspaper clipping that my mother had found or whatever. And I remember having some, you know -- he was a protest leader. And so it was a little, I remember thinking that was a little strange or a little weird or whatever. So that would've been 1966. And so things were just starting, heating up then. And then I forget exactly what happened in what years, but yeah. There were a lot of, a lot of protests. And in fact, I chuckle because one of the leaders of these activities, especially in the engineering era, was John Shoch, who is now a trustee of the Computer History Museum in which we-- <laughs> I look at him now and I look at him, "But John, I remember when…"

<laughter>

**David Laws:** I remember arriving 1968 and I think there wasn't a ground level window in Stanford that wasn't broken.

**Fairbairn:** Right. Or had a--

**David Laws:** Or had a plywood--

**Fairbairn:** --piece of plywood.

**David Laws:** --go over it.

**Fairbairn:** Yeah.

**David Laws:** Yep.

  

**Hsu:** <laughs>

**Fairbairn:** Yeah. It was… There were-- it wasn't as bad as Berkeley in terms of shutdowns and that sort of thing, but there were a lot of protests. And John Shoch and his brother were <laughs> some of the leaders of that activity. And so I became an anti-war person, not in protest, but the only, actually, it was the only time that I've ever walked a precinct for a candidate, and that was for Paul McCloskey, who was a anti-war Republican. And he was actually the founder of the law firm, which Larry Sonsini eventually joined.

<laughter>

**Fairbairn:** None of this I knew at the time, of course. But it was McCloskey, Something and Something.

**David Laws:** He was a congressman, wasn't he?

**Fairbairn:** And yeah. He became a congressman. So I was walking precincts for him as a congressman. And he was elected and then unelected and he sort of went back and forth. Anyway, so he was one of the original anti-war Republicans. And so I became liberalized in my college career.

<laughter>

**David Laws:** Liberal Republican.

**Fairbairn:** Liberal Republican going to liberal Democrat somewhere along the way.

<laughter>

**Hsu:** Let's go back to the AI lab. So you met key people there that were instrumental in the next step. Alan Kay and Larry Tesler were there?

**Fairbairn:** Right. So Larry Tesler was there. Alan Kay was there and a whole-- Whit Diffie and, all these -- just a whole collection of people that would go on to do great things. But so Alan Kay was there. Alan was, had then, at some point, gone off to work at Xerox PARC, which I didn't know anything about. But he suggested that I apply for a job there. He knew there was an opening for a person with my background, and so he suggested that I apply for the job there. And not with him directly, but with Bill English, who was heading up the POLOS [PARC On Line Office System] project. And, which we'll talk

  

about in a moment. So the singular memory that I have about that was that, well, if Alan Kay works there, then I don't have to wear a tie to my interview.

<laughter>

**Fairbairn:** I at least figured out that much. <laughs> But I was still pretty clueless about sort of… I had no idea what Xerox PARC was or what the importance of the people there were or what they had done in their past. And I was not a student of that work, if you will. And so yeah. So I interviewed and got the job and after graduating from Stanford in June of '71, I took six months off. Oh. I went to work for-- I took three months and went to England and worked for ICL, International Computers Limited. Again, a kind of components testing group or whatever. Not in architecture, but I just wanted to work overseas or whatever and somehow I got this job. It was an exchange job of some sort. So I got to work at ICL's facility in Manchester and I lived in a dorm at the University of Manchester. And every weekend I would, on Friday afternoon, I would go down to the Manchester train station and get on a train and go somewhere. Every weekend, I went off and traveled all around Scotland, Wales, England. Just had a fabulous time and took the train to wherever I was going and hitchhiked around the countryside and camped out and stayed in hostels and just great. And then… So that job lasted for the year, for the summer, and then I joined a friend of mine who had been a roommate back at Stanford and he had been at Stanford's campus in France. And also had a car. That was good. And so we spent the next two and a half months driving from Calais to Athens and Istanbul and back through Eastern Europe. And so we went into Berlin in 1971, and that was a pretty grim, that was a very grim place. <laughs> East Berlin. We got into East Berlin in 1971.

**Hsu:** Wow.

**Fairbairn:** It was very grim. That was-- that's when the Cold War really <laughs> hit home. It was… And then we were in Prague and it was just, you know, you had to get special permission to stay every night and it was raining and awful and we said, "We got to get out of here." So we drove south through the border with barbed wire fences and machine gun border guards and all that sort of thing. And then it was a classic, you know, you cross the border, you head up into the hills in Austria, and the sun comes out. All the houses are beautifully painted white and they have flowers in their garden. And it was like literally leaving night and entering the daytime. It was just as soon as you crossed the border, the world changed. So the Eastern block was a very grim place to be at 1971.

**Hsu:** Hm.

**Fairbairn:** So I came back in January of '72, I started working at Xerox PARC.

**Hsu:** So why were you recommended by Alan Kay?

  

**Fairbairn:** I don't know. I guess they just liked what I was doing and he liked me. And I didn't have any particularly close contact with him, but I guess I had developed a good enough reputation that people thought I was a good guy It's not that I'd worked on some major project and had some major accomplishment. But I'd worked there for several years and had been involved in a number of different things and so it was just good fortune. The right place at the right time. I do remember-- yeah. The other thing I remember is they were doing the early experiments in computer vision and <laughs> autonomous vehicles. They had the, you know, what is now in our--

**Hsu:** _____?

**Fairbairn:** --in Revolution exhibition [In the Computer History Museum], there is this cart on four bicycle wheels with a camera on it. That was the thing which these AI researchers were doing early experiments in computer vision at the Stanford AI lab. That's the kind of work that was going on. So I'd look at that and say, oh, forty years from that to self-driving cars is a pretty direct but uneven path between those two. Pretty remarkable.

**Hsu:** So talk about sort of what you first started working on when you started the POLOS product.

**Fairbairn:** Okay. So, again, I can't believe how clueless I was at the time about what was going on and what had gone before. So Bill English was the right hand guy with Doug Engelbart at SRI [Stanford Research Institute]. And they had built their system on which they had done the "Mother of all Demos". So that was clearly, at the cutting edge of computer, interactive computer research. So Bill English was hired by Xerox PARC to basically take the ideas and momentum that was established at SRI and put it into the next generation of hardware and computers. And so Bill English was putting together a team to build the next generation of NLS the oN-Line System which had been implemented at SRI. So we had to basically take and refine everything that had been done before but bring it up to date. And so we did a lot of experiments with mice and in this case with wheeled mice. And we did experiments with how big the mouse should be and everybody thought, the mouse should be big, sort of fit into your hand and be able to move like this. And then we realized no, because you want to be able to actually control it with your fingers because you want fine control. This is rather gross control. If you can control it with your fingers, you can get finer control and finer motion control. So the mouse evolved from a hand sized thing to a smaller thing because of the human experiments that we were doing. That was one little aspect of it. Another little aspect was we were just incredibly focused on the idea that if you let go of the mouse it couldn't move because it would move the cursor on the screen. And so you better-- the cord that connects the mouse to the rest of the equipment better not have any memory to it. And it seems incredibly anal looking backwards but I spent weeks, months, trying different kinds of cords, different materials of cords to figure out what kind of cord. In fact, the best one were cords that had fabric insulation because they had absolutely no memory. You'd move them and they'd stay. But they were impossible to work with. If you have ever tried to strip a cord, a wire with fabric insulation, this is not anything you want to work with. And it was like oh, God, the things we spent time on there. So that was

  

one little aspect. The major part, just to give you a flavor for sort of all of the pieces that had to be put together, the major thing was to develop the system. And the general architecture was defined by a network of mini computers in this case, Data General Nova Computers. And Data General had a networking system between the Novas. I don't remember what they called it, but it would allow you to gang together sixteen of them so you could have a pool of sixteen computers that were operating somewhat, that at least could communicate over a network between themselves. My job was to put together that network, assemble all of the computers. And then design and build the terminal that was going to sit in everybody's office that would then come back through cabling to the central room. So it was still the idea of a centralized computer room. But instead of having a single large processor, it was a network of mini computers. That was the incremental step. And the program was called POLOS. It was PARC Online Office System. So this is clearly to develop an experimental office system that could be deployed around PARC to experiment with ideas about the office of the future. And so the terminal was a dumb terminal. It had a CRT and keyboard and other electronics part of which-- but there was no computational power. It was sort of engineering merging of data coming in. And then that was connected back to the central computer room with a cable which I believe was seven twisted pair and two coax [cables]. So it was a big cable. And had a military style push/pull connector on it. And that was a major engineering job to figure out this whole cabling thing because that was the only way we were going to be able to do it because we needed to get high bandwidth video from this central computer room to the offices, which might be hundreds of feet away. So maintaining signal integrity and that sort of thing was important. We also had to have lots of twisted pair for the keyboard, the mouse, the keyset, and anything else that we might dream up. And there were two coax because the idea was that you would have a camera, the ability to have a camera in the office. We didn't have embedded cameras in the computer. But we'd set up a video camera so that you could actually experiment with two-way video communication. And the other major development that had to take place was that, you know, the goal was to generate high resolution characters on these screens. And so you couldn't do that with a processor at that time. So there was another guy named Roger Bates who was hired to build a hardware character generator which was a very complex-- at that time a very complex beast to generate high resolution multi font characters from multiple TTL, very complex TTL boards that were all then plugged into racks and then you would have multiple racks that would hold 16 to 32 character generators. Each one would then generate a video stream which was then piped out to the office. And the idea was that you could then merge video and text so that you could actually have-- somewhere I have a picture. It's a black and white polaroid picture of a video box being merged into a screen with high resolution characters on it. But it was all coming from a central location. There was no smart-- you know, the merging and that sort of thing and serialization of data was handled at the terminal but there wasn't very much intelligence there. But it still had to be all custom built, custom power supply. We had the cabinet that it was put into, I gave Hansen a copy of the design document. And then this huge cabling project, to route these cables, inch-thick cables, to every office that we thought might want to use a terminal in Xerox at PARC. And it all had to come back so there maybe, I don't know, 100 cables because I think we only had 32-character generators. So you could have 32 offices active at any one time. But we knew people would be moving around. So we had let's say 100 offices that had to plug into 32 character generators. And so we had to have a patch panel. So not only you have all of these hundred cables coming in and cables coming from the computer, you then had patch panel cables to connect those two together so that you can connect this character generator with this. And that was all installed and operational. And I've never discovered what actually happened back

  

there but that was-- so that system got up and running. But by the time it got up and running, the Alto had been thought of and created. So I was working on the POLOS project, I think, from-- well, I arrived in ’72 so ’72, ’73, ’74 timeframe. I don't know how long we continued it. The Alto became operationally in about ’73 and then started to proliferate. We did work on both for a period of time. And at some point, PARC decided Alto is the future, POLOS is not and the POLOS project was shut down. But what survived was that terminal that was for the POLOS project was taken as is as the head end for the Alto. So what you see is the terminal for Alto was actually originally developed for POLOS. And they had to change some of the guts internally. They did some electronic, but the physical design and the vertical orientation of the screen and all of that engineering work was all done for POLOS and was just transferred directly to the Alto.

**Hsu:** How much did you work with the Alto team on that?

**Fairbairn:** I didn’t really work with the Alto. I was working on POLOS. They [Computer Science Lab] were working on that. And I think it became fairly clear to people pretty quickly that the Alto was the future. And I describe sort of the detailed, you know, challenge of the POLOS thing. You’re trying to make it look like the individual terminal but in a centralized computing location. I mean the other legacy was that since we had all of this code for POLOS on Novas, the Alto runs the Nova instruction set. So they took that instruction set and implemented it. I don't know whether it’s completely implemented, but it’s basically that.

**Hsu:** I think Marc [Weber] had a question.

**Fairbairn:** Marc, do you have a question

**Marc:** Two questions about POLOS. I’ve interviewed Bill Duvall and Bill English. Can you talk about the roles of the different people who were involved, sort of what you saw? And also, POLOS did have hypertext links, is that right? Those got dropped into the Alto, if you know anything about that?

**Fairbairn:** Yeah, so there were two people working on the hardware aspect of the POLOS, Roger Bates and myself. Roger is a very, very bright engineer and did a great job in terms of implementing that character generation system. And he and I worked together, although his work was largely separate from mine. We sort of had a clean interface and went from there. Bill Duvall I think you too mentioned was somebody who had worked-- I don’t know exactly what his role in NLS was at SRI but he was clearly the heart and soul of the POLOS software, all of the operating system software it was all his. So I was working with-- since I had responsibility for the Nova’s and networking and that sort of thing I was working pretty closely with Bill Duvall because he had all of the software. And there were other people involved but Bill Duvall was clearly the central character in all of that and he was a very, very capable, very high performance programmer. I told the story many times of people looking at the mouse and the keyset. And

  

you can say the mouse survived, the keyset is this five finger thing on the side. And they said, “Well, what’s that?” And all you had to do is look at Bill Duvall leaning back in his chair moving the mouse and keying in commands and characters with the keyset and you think, oh my God, I get it. Because he and other people who had worked at SRI had become very facile with the use of the keyset as you could generate 32 different combinations of keys with the five keys there. But you could then combine those with the three buttons on the mouse to generate many more combinations of commands and characters. So if he was going to type-- enter code or that sort of thing he would go back to the keyboard. But when it came to editing and making changes to the code or entering short bits of string he would do everything from the mouse and the keyset. And he could do it like a virtuoso pianist. It’s like watching a virtuoso playing a piano. And you think how can their fingers move that fast? And he could make the screen just dance with those two. And Doug Engelbart had this goal of augmented intelligence. And you’d say wow, that’s it. That combination really augmented-- you know, created huge productivity gain for people who took the time to become facile with the use of that because of the productivity in that environment was really quite remarkable. So I get a little hazy with the other people that are involved. I know there must have been-- but there were people crossing over between different programs and that kind of thing. But I can certainly say that Bill Duvall was the central character in that.

**Marc:** And Bill English, though, talk about his role.

**Fairbairn:** Well, I mean he was the boss. And he ran the thing and sort of managed all of the interface with management and that sort of thing. He was not-- I mean I think he set the architecture and sort of set the program guidelines. I didn’t have a lot of choice in saying, well, we’re going to do Nova’s or we’re going to do this or we’re going to do that. It was more like this is the system, this is the architecture, now go make it happen. So Bill English he is a fine boss and all and you would go to him with questions but he was not hands on in doing any of the work, as I remember, either design or software. I think if you went to him with a hardware/software question he would have input on that but he was not actively involved in doing either one.

**Marc:** And do you remember whether hyperlinks…?

**Fairbairn:** I have no memory of hyperlinks. I don’t remember any real significant application of POLOS coming to life. It got to this cross over point where it was clear that the Alto was the future. And I don’t remember exactly how that happened or exactly when it happened. But we did not get to a point-- well, it would be interesting to find out what we really did because I’m sure that we got-- you know, we had many terminals built. And we had things deployed. So it could very well be-- I just don’t-- I’m hazy on that. You’d have to get it from Bill or Bill or whomever. I don't know.

**Marc:** And was there a feeling of competition?

  

**Fairbairn:** Well, we were part of what of what was called the Systems Science Lab and Bill Gunning was the guy who headed that up. He was a wonderful man. The Computer Science Lab was headed by Bob Taylor and Jerry Elkind. And Bob Taylor had come from ARPA and had done some important things in the past and had his fingers on the army of people who he then recruited to Xerox PARC people like Butler Lampson and Chuck Thacker and others who did this wonderful work. But Bob Taylor was a political guy who was difficult to deal with. And Bill Gunning and Bill English spent a lot of their time managing the politics between resources in the Systems Science Lab versus resources in the Computer Science Lab. And Bob Taylor was not an easy guy to work with. Very nice guy if you walk into his office, all very nice. But he was kind of an ass.

<group laughter>

**Marc:** Even though <inaudible> Engelbart had a reputation.

**Fairbairn:** Yeah, but Bob Taylor was for Bob Taylor and his group. Whatever his group was doing, that's what he was for. And so, you know, they were on to the next new thing. And they did the right thing. I mean there's no doubt about that. And it was the right thing to shut down the POLOS program. No question about that. But there is also-- it wasn't just that, it was an ongoing kind of thing. And Bob Taylor was difficult to work with. He was not an easy guy.

**Man 1:** What was your view on the POLOS vision going back to the NLS vision versus the Alto and why POLOS was ultimately unsuccessful vis-à-vis the Alto?

**Fairbairn:** Well, I think POLOS had all of the right functional vision. The implementation was just wrong. I mean Alto was just a better implementation of that vision. And, in fact, POLOS had a much more grandiose vision of the future in terms of all of this two-way video communication and merging video and text which you couldn't do on the Alto. So POLOS was potentially a more capable system but the architecture was old. It was just not the right-- it wasn't the future. And when the Alto came along especially with Ethernet that was-- even though from a functional point of view it didn't have necessarily all of the bells and whistles [of POLOS], it did provide the basic capabilities and it was the right platform in which do future experiments in terms of office of the future. And so that in that respect it was right. But there was -- it started from a very different kind of thinking, that is -- what's the most that we can put into a self-contained personal computer? As opposed to this is what we want to do, what is going to take to implement? And whereas-- so POLOS was this is "what we've got to be able to do". And it was a long list-- just the video stuff I mean we not only-- God, now, that I remember we had to put video switchers in the computer room. I went up to Grass Valley Group up in Grass Valley who was doing the high-end video at the time. And talk to them about video switchers and that sort of thing because we invested a lot in video, analog video stuff, along with the digital character generation things. And getting that merged into the computer so that you could have both digital and analog video displayed on the same-- that was unique stuff. So it was very exciting. I loved doing it. And it was a great job and PARC was just fabulous place to

  

work. I mean everything you've heard about PARC is true. It was just a wonderful place to work. And so it was-- I loved the vision, the POLOS vision was a great vision. And it was a challenge at the time because even what we were doing with POLOS, even though it got outdated by Alto, it was still state of the art for the time. And it was state of the art for quite some time to come. But it was just not the ideal. It was the wrong compromise. We were trying to do too much and that forced you into an architecture and investment that was beyond what was really necessary. So it was too grandiose to implement effectively. And so the Alto turned out to be-- even that was 20 years ahead of its time. And so it was-- but it was interesting. So the transition between the Alto and the-- I'm sorry, between the POLOS and the Alto is fuzzy in my mind. I don't remember sort of stopping one. And I mean we got POLOS up and running. From a hardware and basic software point of view it was running. But what the applications were in terms of what could run on it and so forth I don't remember. The other important thing that happened at the time that I was not involved in but it needs to be understood is that the work that Roger Bates did in terms of the hardware character generator for display turned out to be central to the laser printer. Because Gary Starkweather had invented the laser printer back at Rochester Labs in Rochester, New York with Xerox central research. But there was nothing to drive it. It was built on a Xerox copier that was a page a minute, a page a second printer. And so it defined the speed at which you had to write bits and if you were going to write bits at 300 dots per inch that told you exactly how fast you had to deliver bits and there was no commercial equipment that would deliver bits fast enough to drive it. So he had this wonderful printing instrument that you had no way to drive it. And so his project was transferred out to Xerox PARC. And Roger Bates' work in terms of hardware character generation was hooked up to the Xerox page-a-second copier to be able to generate high resolution graphics and text on a page at a page a second. And so that was a major sort of capitalization. So there was definitely value that came out of the POLOS project in terms of the investments made. But the architecture was just not-- and the tradeoffs in terms of functionality versus investment was just not-- I had forgotten. We spent a lot on video. We spent video switchers, video merging stuff. We were going for absolutely-- because that was the vision that Bill English had brought. That was definitely what-- because they had analog video in the NLS system. Right? So you weren't going to go back from that. It had to be that plus. And so that was-- yeah the POLOS project was pretty aggressive especially given what the computing power you had to work with at the time.

**Marc:** I had just one quick question to make sure I was understanding correctly, Doug about the POLOS computers. These sixteen mini computers all hooked together in one room. But it sounds like it could support more than 16 concurrent users.

**Fairbairn:** I believe so. I have this number 32 in my head and that was driven by the number of character generators. But it was-- and I believe we were time sharing the computers. I'm not absolutely certain, but I believe we could run more active users than there were computers there. I don't remember for sure. But we had sixteen Data General mini computers in racks in the computer room at PARC. And in the same room we had these multiple racks of character generators and video switchers and everything. So all of that was in one big room, right next to this big patch panel where we distributed this incredibly high bandwidth material out to the rest of PARC.

  

**Marc:** Thank you.

**Hsu:** Does anyone have questions about POLOS before we move on?

**Fairbairn:** See is there's any other major thing?

**Marc:** Alan Kay was around but the Dynabook was not particular relevant <inaudible> later on with the NoteTaker right?

**Fairbairn:** Yeah, so Alan Kay's group which is called Learning Research Group, LRG, was part of the Systems Science Lab so it was part of the group that I was in. Alan Kay was the spiritual leader. Adele Goldberg was more of the operational leader. And they had a number of people there. You know, most of the work that I remember has to do with the work that they did on the Alto. And I don't remember exactly what was going on or what Alan Kay was involved in. I'm sure that he was-- both Bill English and he, I think, were both sort of parallel reporting to Bill Gunning, I believe. And so I think they were coordinating their activities. But I don't remember active talk about the Dynabook until the Alto came along and we talked about interim Dynabook and that sort of thing and then the NoteTaker later on which we'll cover later. But I don't remember when he first created that cardboard mockup of what his vision of the future personal computer was like. But there absolutely was, you know, the one that's down-- I think it's downstairs is the cardboard mockup. He absolutely had that at Xerox PARC at the time and said, "This is our target. This is what we're going for."

**Marc:** They actually made that mockup downstairs for our exhibit. So it's a mockup of a mockup.

**Fairbairn:** Right. I saw that, that it was a copy but I was just assuring you that, in fact, such the real one did exist back in the early seventies at Xerox PARC. I recognize it as being a good copy of what I remember seeing back then.

<group laughter>

**Fairbairn:** So the Alto came along in '73. And I at some point, probably in-- I really don't remember what I did in that '74-'75 timeframe. But in '76 is when I made the transition to working on the VLSI project with Lynn Conway and that's a major step. As far as the POLOS project if you have questions I'm happy to take them but I don't-- I can't remember other relevant information.

**Marc:** I guess the only one would be what was the reaction of the two Bill's when it was cancelled?

  

**Fairbairn:** Yeah, I wish I could tell you. I cannot tell you. I wish I could. That would be a very important thing. But I don't remember it as being a major point of controversy in the sense of it was pretty clear, especially by the time you had an Alto and an Ethernet and a printer, which-- and even a file system by '74 or something. It was pretty clear that that was the direction. And so there may have been some arguments about continuing to do certain things on the POLOS system. And I don't remember the dismantling. It seems that I would have been involved in dismantling but I flushed that from my memory. <laughs> I don't know what happened. We may have kept it going as a computing resource for quite some time because it was a good development resource in terms of computing resource. The other thing that was done in parallel with that before the Alto was born that doesn't get as much nearly as much publicity was the MAXC Computer. I at least ought to talk about that to make sure that that's known. So these people that Bob Taylor had hired came from Berkeley Computer Corporation. And they were builders. They were people who built computers. And they did research but people like Chuck Thacker he was a builder. And Ed McCreight was a builder. Ed McCreight is sort of the other guy who doesn't get nearly as much credit as Chuck Thacker. But Ed McCreight is an extremely smart, important contributor to that whole thing. And so long before the Alto came along and in order to get CSL, Computer Science Lab, under Bob Taylor to do the research that they were supposed to be doing, they needed to be part of the ARPA community which means they had to run a PDP-10 or PDP-20. And Xerox would not allow them to buy that. They wanted them to buy the Sigma 9 which was… Xerox, a year or two before had bought Scientific Data Systems and turned it into Xerox Data Systems and Xerox was not about to allow them to do that [Buy a DEC machine]. So that [Sigma 9] was worthless to them. They couldn't participate in the DARPA research community using a Sigma 9 as the computer. So they just said, "We'll build our own." And they built a PDP-10 emulator called MAXC, Multi-Access Xerox computer. And it was one of the first computers to use the 1K 1103 Dynamic RAM from Intel. And because they were such brilliant engineers they could actually make the 1103 work in a very large scale configuration. The 1103 was a very, how shall we say?

**Laws:** Tricky.

**Fairbairn:** Tricky chip. But these guys were very good engineers and they engineered the system to make it work. And, in fact, Xerox got up and running and it was a full PDP-10 emulator and ran all of the PDP-10 code. And had, at one point, held the record for up time for PDP-10 on the ARPA Net. So it was an extremely reliable computing resource. It was not a flaky build it your own kind of thing. It was central. And so when they finished that it was like okay, what are we going to build now? And so then the Alto came next. And they had then built up a capability for doing prototype hardware development at a production level quality. There was a two or three technicians that were also very capable. So between the designers, and the techs and outside people, they had a small team that was very productive and could build very high quality hardware. And so they were the core-- they weren't the ones doing research so to speak. They were the ones building the core engines on which all of the research was later done. And then there were a whole bunch of other programmers who were hired to do that. But the people you hear a lot about, McCreight and Thacker and Lampson did both. He could do everything. But there was core set of people that were responsible for building all of the hardware that PARC became famous for. And that was small but very productive team. And so the Alto came along as the next thing that they built.

  

And getting back to the other thing I believe that this massive resource that we had of sixteen mini computers connected by a network - I'm sure got used as a computing resource for a period of time even if it wasn't for the development of the POLOS project itself. But CSL, computer science lab, was I think almost completely on the MAXC computer because it was part of the DARPA community for which they were heavily embedded with. Did you have another POLOS question? Or are we done on that, Marc?

**Marc:** No, POLOS I'm done. This may be a little bit off but that was-- it was the Nova network that they connected to Ethernet to do the first router. Right?

**Fairbairn:** No. I don't think the Nova's were ever on the Ethernet.

**Marc:** Because POP was used to connect Ethernet to some sort of more local minicomputer.

**Fairbairn:** Maybe that was done. But the first-- the Ethernet was done by Metcalfe and David Boggs to connect the Altos together. They realized that a standalone computer was not very interesting. And so as soon as they had the Alto working they knew they needed a network. And so they hired Metcalfe and Boggs was already there or came on. I don't know. He joined in and did a lot of the more hardware oriented stuff. Metcalfe did more of the high level protocols and that kind of thing. Yeah, that was the first-- all of the first work was done on the Alto. And we may very well have been later created an Ethernet interface for the Nova's. I mean I'm sure we didn't just throw them out. Maybe it's a good question to find out what the heck did we do? The person who would know I'll bet and who seems to have the best memory is Larry Tesler because Larry Tesler was involved in a lot of these different projects.

**Marc:** Great. So that's it for me.

**Fairbairn:** Okay.

**Hsu:** I had just one very quick question about POLOS, my last one, did Doug Engelbart every come and see it?

**Fairbairn:** I never met Doug Engelbart. I don't think I ever met Doug, I mean other than when he came here or whatever and I shook his hand. But I don't remember him ever being at Xerox PARC. Now, he may have been but it was not a major thing. I hardly even knew who he was.

**Hsu:** Yeah. I have two last questions. One was sort of how many different groups or projects were under sort of the SSL banner. And what was the organization of that group like? And also what did Bill English and Bill Duvall and the rest of the POLOS team move on to after the POLOS was cancelled?

  

**Fairbairn:** I'll answer the second one first. Bill English left, I think, after the POLOS program and the timing and exact method I don't know, but he was not around later on. And Bill Gunning also left at some point in the middle there. And as far as the other programs, I'm trying to remember, I believe somewhere in there I believe Lynn Conway was hired not to work on VLSI. She was brought in originally to work on speech recognition. And also Dave Liddle was brought in-- I forget whether he-- I forget what he was working on. He and I worked together. I have to think about this one. I was thinking he was working on speech, but he wasn't working with Lynn. So there were some other sort of hardware oriented things like that going on. But the major activities, as I remember them in the early time was POLOS and Alan Kay's group. Oh, I know, the other major one was Dick Shoup and the graphics group. Dick Shoup was-- I forget what his background was. Have you talked to him or anybody talk to him? He built up-- do you even know the name?

**Man 3:** Yeah, SuperPaint.

**Fairbairn:** Yeah, SuperPaint. So he built a set of hardware to do graphics animation and so forth. And that was another sort of a-ha moment for me. Again, it was all out of special purpose hardware because the computers at the time were not capable of doing it. But he gave an in house talk where he used his own hardware animation to illustrate the architecture and inner workings of his hardware engine. And I looked at that and said, oh my God, this is important. And just the idea of being able to have color graphics, being able to demonstrate in an animated fashion the flow of things in a system. So that was another sort of a-ha moment, I thought, okay this is another important thing that's coming along. And so he did a lot of special purpose hardware. But, again, that kind of-- I don't know exactly what happened. I mean there was a lot of interesting work. He brought in a lot of graphic artists and so forth and he did a lot of very early work. In fact, Alvy Ray Smith came in. I think he was working on Dick's system. And other people later went on to other things either New York, NYIT and later Lucas or whatever. So there was some very early important graphics, color graphics work being done on that system. And at least experiments. I was an observer and chitchatting and so forth, but I was never directly involved in that. So that was one other significant program. And there was a speech recognition thing and there may have been some other smaller programs. I just don't recall at this point. Then there was a whole other lab, the Optical Systems Lab and a General Science Lab. There was optical stuff, doing optics related things. And General Science Lab was more materials research and that kind of thing. But I had very little contact with them. We were on the same floor and right next to each other between CSL and SSL. And so there was a lot of back and forth and a lot of conversations. Alan Kay worked both with the SSL people as well as with the CSL people. He'd work with anybody who would deliver his vision of the future.

**Hsu:** So then how quickly did you move to the VLSI work after POLOS was cancelled?

**Fairbairn:** So what happened exactly in the shutdown between '74-'75 I don't remember exactly. The spring of '76 is the other marker and that's when Carver Mead came up and taught a three-day version of the VLSI class that had he developed at Caltech. So he had been working on these ideas having to do

  

with VLSI design for several years, I think, back in the early ‘70s, ’70, ’71, ’72. So ’76 he had a lot of things going on and had done-- had gotten some chips done at Intel and others. So he had sort of gone through the whole cycle of actually getting chips made based on the work of his class. And the connection was that at that time Bert Sutherland was the head of the-- had taken over as the head of the Systems Science Lab. I don’t remember exactly when the transition was. I guess he had had taken over from Bill Gunning. And his brother, Ivan Sutherland, was head of the computer science department at Caltech. And so they talked.

<group laughter>

**Fairbairn:** And they [Ivan and Prof. Carver Mead] had been working on this vision of what the future of architecture of VSLI was because he had come from a graphics world. He had come to Caltech and the computer science department, which is very different from the world that he was working in. But he got introduced to VLSI through Carver. Carver was not the guy to be the head of the computer science department. So they brought in Ivan. Technically, Carver worked for Ivan. But I don’t think Carver works for anybody. But Ivan had developed this theory about interconnect being the problem and that, you know, wanting to work on architectures of systems that took advantage of VLSI as it was to progress in the future, which is exactly the right vision of the future but far before anybody really appreciated it. So I think he had come to Caltech in ’74, ’75. And so in ’76 the Sutherland Brothers arranged to have him [Carver Mead] come and give a three-day version of his course. And there were a bunch of people from CSL Chuck Thacker and Butler and all of those people were in the course. As well as a bunch of people from SSL, myself and Lynn Conway and a number of other people. It was meant to be an introduction for as much of PARC could be introduced. And so literally I mean he boiled his one quarter course, two quarter course down into three days. And so the CSL people kind of poo-poo’ed it, you know, interesting but not ready for primetime. We build real hardware right now. At least, that’s the way I interpreted it. Lynn Conway was the one who grabbed it and she thought this was something that she could build on. And so that was the spring of ’76. And given that I had a background in both computers and in solid state stuff this was also pretty interesting to me. So I joined up with Lynn Conway and by this time POLOS had gone. I don't know what I was doing in between time but this was a new interesting thing to work on. So this was April/May. So we said, well, the first thing we need is we need to be able to do IC design on the Alto. By this time, the Alto had established itself as the thing on which you did all of your work. So if you were going to do IC design you and to do it on the Alto. And so we needed an IC layout program on the Alto. So Carver said, “Okay, I’ve got just the guy for you” and one of his graduate students, a Ph.D. student was a guy named Jim Rowson, and he said, “You need to hire Jim Rowson, for the summer.” And so he came up, Jim Rowson came up and lived in my house. And I was a bachelor at the time. I had a couple of extra bedrooms so I was more than happy to provide housing for wayward Caltech students. And it was very fortunate that became a collaboration between Jim and myself that lasted for twenty years. So it started with the summer of ’76 he came up and we wrote the first version of ICARUS [Integrated Circuit ARtwork Utility System] which is the program that is being demonstrated on the video downstairs where I have this big amount of hair. So we wrote the first version of that. I did the easy stuff. I did all of the user interface and a bunch of other sort of housekeeping stuff. He wrote all of the hardware algorithms, interconnect. So we developed a program where you could interactively lay out a chip on the

  

screen. And it was the first IC layout software on a personal computer - as anything done on the Alto at the time was the first done on a personal computer because there wasn't anything else, certainly of that power. And so that was a very important thing. And then we used that to design some chips. So I designed a couple of chips myself. I think I designed a content addressable memory somewhere along the way. And we took it through the whole process to prove that you could actually build a chip and make it work and that kind of thing. And by this time, somewhere along in here, I don't know whether '76 or '77 or '78 Dick Lyon had come in. I forget exactly when he joined, but it was a little later than the very beginning. But he was also using it for designing the optical mouse chip. And that was summer of '76. And we continued to work on that and refine it. And then summer of '77, Jim Rowson came back and we did another around of work on ICARUS. And those are the two major efforts, two, three-month efforts. And the rest of the time was just bug fixing and that kind of thing. So during the '76 to '78 timeframe I was mainly working with Lynn and helping to refine this methodology and figure out what works and what doesn't, designing chips, getting them fabricated, figuring out how you're going to make mass, how you do multi project chips. Another guy, Alan Bell joined at the time. So Lynn started building up a real group around this whole activity. And then right in there, I don't know exactly when they started, but both Lynn and Carver started collaborating on the book "Introduction to VLSI Systems." And so everybody asked, well, did Carver write it? Did Lynn write it or whatever? Clearly, the core ideas all started with Carver. Lynn's background was in computer architecture. But she could see that the-- she could see the future of what VLSI promised in the same way that Ivan Sutherland saw in terms of how you could map certain computer architectures into a very high density, high performance VLSI circuit - if you thought of them in terms of VLSI architecture as opposed to normal gate level architecture. That was what the real driving force was to get computer and system architects familiar enough with the world of IC design so that they could be as we called them tall, thin men, go from architecture all the way down to physical design. And that you would then come up with architectures that were far different but far more efficient both in terms of area, layout, performance, than if you took them through the artificial embodiment of gates and transistors. But if you just envisioned what needed to be done from an algorithmic point of view and mapped them down to a VLSI circuit, that's where you were going to get the ultimate payoff with VLSI especially given the vision that in the future wires were going to be the problem, not transistors in terms of delay and area. And that you needed to solve the wiring problem from the very beginning at the architectural level as opposed to at the end at the layout level. And so that whole concept was way ahead of its time. But that was the vision with which people like Lynn and Ivan and others got excited about it. And so there were all sorts of other things. We came up with the "Sticks" methodology where you could draw red, green and blue lines. That was a way to envision how the chip could be implemented. And then the other thing was to get people not only in architecture, but also software people to contribute to the world of IC CAD software because the IC CAD software was basically non-existent in 1975. You had CALMA. You could do digitization and hand layout. And there were a few odd logic simulation programs around. But automatic DRC [Design Rule Checking] and that sort of thing was rare, if not nonexistent. And so the whole world of IC design was very-- coming from the world of computers it was considered very primitive, because the people involved in it were coming from a circuits background. They weren't coming from a computer background. So to me the greatest impact of the whole VLSI movement as started by Carver and then Lynn and others was to suck in the architects and the programmers to help address this major problem, not that they all become IC designers themselves. But many of them became CAD programmers and went to work, eventually, at startups like Daisy and Mentor and Valid and others

  

in the future. And many of those people got their start in chips through courses taught as a result of this program that first Carver and then Lynn had done.

**Man 3:** Now, you had to reduce the thing eventually to gates and transistors from a conceptual logic function. Who was writing the code that took you…

**Fairbairn:** We bypassed gates sort of. There was a lot of focus on gates as they apply but not designed in terms of gates, in terms of flows of data from one step to another. And a lot of "pass transistor logic". And so in the end, you needed to do that. And people generated cell like things and so forth that you could utilize.

**Man 3:** So there were libraries of cells?

**Fairbairn:** Eventually, there were libraries of cells, but in the ICARUS world things went directly to the transistor world. For example, I'll show you later a chip that Jim Clark did which was his first Geometry Engine chip using icarus that he used at Xerox PARC while he was teaching a course at Stanford. And I don't think he ever crated any logic diagram. I think he envisioned functions, he envisioned pipeline kind of structures. And he would create at the transistor level, The whole idea was that you could create basic building blocks and then replicate them. But those building blocks were not necessarily named gates and flip flops. They were VLSI structures which you would design at the transistor level and then replicate. So in there you could identify gates but I'm almost certain he never did a logic diagram. He took an architecture diagram and implemented it at the layout level. And the work that he was doing was particularly tailored to that because it was a graphics pipeline kind of processing. So there were certainly application specific solutions that were-- certain applications that were much better oriented towards that. But if you look at a typical data path, the-- I don't remember seeing-- although, if you look in detail, yeah, there are gates in there but they weren't drawn as logic diagram gates. There wasn't a logic diagram beforehand. It was what is the flow of the data? And what is the LSI structure layout?

**Laws:** But at some point it had to be turned into gating functions which in many cases it was transistors.

**Fairbairn:** No. It was turned into transistors. It went from flow to transistors without going through gates. Now, in that layout you could say, well, there's a gate and there's a gate. But there was not a gate level diagram in between. It was sort of a direct map of how do I want the thing to look. And so for the-- like an ALU unit. It wasn't designed at the gate level. It was designed at the transistor level. But it was designed given the layout of the transistors and what layout best suited it from a layout point of view. And then once you had one then you could replicate it. But it wasn't gates to a layout. It was idea. It was function to a layout. So that layout was typically much more efficient than if you had gone through a gate level diagram and said, okay, here's a gate, here's a gate, how do I size that, how do I do that. It was not a direct translation. Now, when it gets to IO pads and that sort of thing, yeah, there was more typical designs

  

done and you had to worry about ESD [electro static discharge] and other kinds of things and we typically had libraries of those that were sort of certified safe things. And sometimes I think in concept people would maybe do gates, but it was never gates to transistors. And there was typically not-- I can't remember any sort of gate level logic diagrams created. There was block diagrams. And then those blocks were implemented at the transistor level. So yeah, you had to get down to the transistor level. And ICARUS is a physical layout program. I mean it's actually drawing the polygons and everything. But the whole idea was what can you do-- how can you lay it out so that it's just replicated because you can't be laying out every one by itself. Right? So there was a built in-- given that you were going to do it all yourself and you weren't going to hand it off, there was a built-in drive to regularize the structures wherever you could. So people, given that they understood how basic functions could be created at the transistor level, and in a way that the layout was very efficient, then that worked well and that's how it was designed. But there were-- so there was no one way. You know, people did it all sorts of different ways. At PARC we had ICARUS so we laid it out that way. At Caltech and other places, they had a software program which created layout. So you actually had to write code which created the layout. And that's how all of the worked at Caltech was done. It's how all of the work at MIT was done, all of the MPC chips and so forth. They didn't have interactive computers. They did-- it was all software to layout. And they created actual layout. Then they had to plot it. They had to run the program, plot it and see if it was real or not. But everybody involved in those early days of creating experimental chips or more than experimental chips it was all done from software and to the layout level. And there was not-- and then given that it wasn't developed as logic, logic simulators weren't helpful so they needed a switch level simulator. So we created special software. We created switch-level simulators that would simulate at the transistor level because where the gates were, you know, we didn't have gates. We didn't have a gate level description. So you had to have a transistor level simulator but Spice was, of course, too slow so you had to have a functional level simulator that simulated at the transistor level. And that's what all of these switch-level simulators which became also very popular down the road as well. Then they realized that oh, then we make mistakes with DRC so they wrote DRC software. And Lynn had gone-- so let me go back to the thing. So I think this was an incredible story of technology transfer and explosion. Lynn collaborated with Carver on the book. Lynn physically wrote the book. I think every character in the book was typed by Lynn. But most of the high level ideas came from Carver. So Carver was still teaching at Caltech. He'd come up one or two days a week. They would sit and talk typically in Lynn's office. And Lynn would type away because she had an Alto and she was typing. And with the Alto you could draw diagrams and pictures and all of this stuff. So she created that book, physically created the book and contributed, I'm sure many of the detailed ideas along the way, ways of saying things and that sort of thing. She's very detailed oriented. And so it was very much a collaboration. I mean there's no way the book would have happened without either of them. Carver would have never written it. Lynn would never have had the idea. So it's a perfect example of collaboration. And then all of the rest of us in the group were contributing. I wrote a sub-section of the book on CAD software and other people wrote other sections on other things. And so there were contributions from elsewhere. But it all went through Lynn and Lynn created the final thing. So in order to see whether this idea could be-- whether this concept could be spread or transplanted to another organization as of this point, it was Caltech and PARC were the two places it was happening. So we did a deal. Lynn, Ivan, Bert, whatever, did a deal with MIT for Lynn to go back to teach a version of the course, the fall quarter of 1979, I guess, '78, '79; I keep forgetting which year it was. I think it was '78. And so by then the book existed in draft form and actually was going to be--

  

the first drafts of it were being printed by McGraw Hill, I guess. Anyway, but she could print out book quality copies from Xerox computers. Right? So she went back and taught his course. And since she's so paranoid and anal oriented she wrote out detailed class notes for every class that she taught. Not scribble notes, but very carefully crafted notes for every class. She had this class of bright MIT students, including a few professors who would then later teach the course themselves. And out of this course, eventually, you know, the book then got published. She had this set of class notes, which were handwritten, but she copied those and bound them into a book. And anybody that had-- could understand the basics could then teach the course from these notes because they were word for word what you needed to teach in that particular class. And in parallel with this I created a set of videotapes. I forget, I know we did some at PARC. We created some videotapes that I did. So those became another resource. So there was the book. There were Lynn's class notes. There were some videotapes. And there were some other supporting material. And by this time, we had also worked out this whole thing of how you do multi-project wafers, that is getting chips from multiple places, merging them on to a single chip, processing through a fab, and returning them to the students within about six weeks. And that actually worked! And so then Lynn devoted the next period of time to evangelizing this course. And there was just this stream of professors from universities around the world who would come to visit Lynn and get indoctrinated. And she would then hand them a kit from which they could teach a course. And so these were all young professors because young professors were all looking for ways to establish themselves as doing the new thing. And by this time so now we're talking 1978, '79, '79-'80 kind of timeframe. And so, you know, VLSI was becoming or IC design was coming a thing. And being able to teach courses like this, by this time. Berkeley, I guess, Berkeley had gotten on board and Stanford had gotten on board. So it started to spread. But when Lynn had all of these pieces together, she just made it her job. And I think it was within a couple of years it was being taught at 200 universities around the world everywhere. And it was-- I sort of looked in awe. I thought, wow, this is an amazing happening. I mean forget the technology, just the way you spread technology, the way you spread a new idea and to have this kit which you then give to often young professors at universities around the world who then churn out students and it's very exciting stuff. Right? It was easy to get people on board with this. And so those students-- I mean I can't tell you how much-- what an impact those students had on fueling the IC design and CAD revolution of the eighties. You had all of these CAD startups, you know, the Daisy, Mentor, Valid, all of the ones based on workstations, personal computers, moving out of the Calma and Applicon world with digitization and hand drawn layouts and that sort of thing to this new world of design. And so many of those people even if they didn't become IC designers became contributors in some way or another to that spread. And they may have gone to work for Intel. They may have gone to work for any of the established companies. But it was an army of hundreds or thousands of students coming out with an understanding of what VLSI was and what the problems were and what software was required to support the design of it was and that sort of thing. And that was an amazing kind of eruption of technology. So that was-- I mean there's another thing about NoteTaker here, but let me sort of complete the VLSI story. So I'll just say when I got started in '76 and I worked mainly on this in '76 and '77. And then in '78 I was talking to Alan Kay about the next generation computer and building a portable computer. And originally I had a vision of designing a custom professor using this VLSI technology to create the next generation Alto. Alan Kay was always the visionary for the future. Right? And he said-- once we had the Alto for five years which is about 1978 he says, "It's time to throw all of these away because we're now stuck in five-year-old technology. And the only way we're going to advance to new technology is to throw this away and start over again." And, of

  

course, we didn't do that but that's his mindset. And so that's where the genesis of the NoteTaker was, was to generate the next generation Dynabook. The Alto was the first, if you will, the first personal computer that had any significant power. And then it was time, okay, it looks like technology has moved along. Let's do a portable thing. And so the first idea was to do some custom VLSI chip. And then it was like, well, this going to take a lot of time.. And then in the summer, spring or summer of '78 the 8086 was announced; I think in May and June of that timeframe. And it was like well, we could probably build-- so this is when Dan Ingalls became involved. Dan Ingalls had been around. So it was in the summer of '78 that the idea of the NoteTaker became formalized. And that's a whole thing by itself. So I'm going to come back to that in terms of timeframe. But I want to finish the VLSI story since that's the one we're on at the moment. So Lynn primarily-- in the '78-'79 timeframe I was mainly working on NoteTaker but I was still involved with Lynn. I was still, I think, technically part of her group. And so I was working some on the VSLI-- continuing to work on the VLSI stuff. And Lynn was all about evangelizing and spreading the word, and getting it to everybody. And so it was clear, okay, by '79 this was a course was being taught in at least tens of universities. I don't know. At least 10 by '79. And so there were people coming out of it and people involved and others that were interested. And it was like well, how do we support this community? How does this community communicate? And the publications of the day the EE Times and Electronics magazine and so forth might periodically write an article or whatever but it wasn't going to be the thing. And so in the fall of '79 some combination of myself and Lynn I think it was me but, whatever, was like "we need a newsletter". We need a magazine that will be the collector and publisher of ideas around this whole new wave because it's a whole different set of people involved in this wave of technology versus that involved in the traditional IC design world. And so we need get those together at some point but this group needs a way to communicate because in all of the publications of the time were not set up to support that particular group that was now growing exponentially because of Lynn's work. And so I had this idea, okay, we're going to do a magazine. And I had never done anything like that before but it seemed like a cool idea. <laughs> And so we said, we'll publish four issues over the next year, once a quarter. And then that will be cool and we'll see-- and, in fact, then we found a group in Pasadena that had connected an Alto to an optical typesetting machine, so you could actually type stuff on the Alto and have it come out in typeset form that could then be pasted in and published a magazine from. And they said, "Oh great. We need a real world thing. We'll support you in doing this magazine." Great. And Lynn, of course, thought it was a great idea. She jumped on board. She's a great cheerleader for anything involved in this. So then we went to Bert Sutherland who is the SSL head. The one question I remember from him after explaining [the idea]. He says, "Well, what happens after the four issues?" And I said, well, if it's a wild success we'll know what to do. If it's a dismal failure, we'll know what to do. And if it's somewhere in between, we'll have to decide.

<group laughter>

**Fairbairn:** And so he said, "Okay." And, you know, this is a good example of PARC. I mean you could just go off and do things. I was careful not to ask anybody else, because I knew that I could find-- it was my first lesson in I'm sure I could find somebody who will say no. So I have cover at the lab manager level. I'm done. I'm just going to go do this. And the people in Pasadena were excited. It turns out that I ended up teaching Carver's course at Caltech in the fall of '79. And so I had reason to go to Pasadena

  

also. And by this time the NoteTaker was actually getting into production and we were getting people down there to build it-- going down there [Xerox El Segundo facility]. And so during the fall of '79 I spent three days a week in Pasadena, in Southern California where my parents still lived so I stayed there. Anyways, so I taught this course but also started putting this magazine together. So in the first issue of the magazine we, of course, went to all of our friends and got them to write articles and that kind of thing. And Xerox, I forget which group, I think it was the group in Pasadena agreed to pay the printing cost. They were not only going to help put the thing together, they were going to pay to print it. And we said, well, we wanted-- I have the first issue here. We knew that we were only going to have 32 pages or whatever so we said, well, we need to make sure that it feels substantial. So we had it printed on really expensive thick paper.

<group laughter>

**Fairbairn:** And so there was no advertising or whatever because all of the costs were being covered by Xerox.

**Laws:** Why don't you hold that up to the screen.

**Fairbairn:** So I'll explain the cover in a bit. So we got the people in Pasadena to do the typesetting for us. We got the articles from various people. And I wrote one article on this new startup that Carver Mead-- Carver Mead is the orchestrator of everything. Carver said, "Well, you ought to go talk to these guys over in Los Gatos. They're starting up a new foundry. And this world that we are creating needs a foundry. We need to separate the world of design from the world of fabrication. And there are other foundries around but we need a company that's really dedicated to the idea of serving people like yourself." And so this was the company called VLSI Technology. And so I went and interviewed them and got their story on why their foundry was cool. So this in November I interviewed them and by January I was working for them. So also in January was when this appeared. I mean literally almost the same day I resigned from Xerox, and the first of these printed-- we printed a few thousand of them. I think a 2000, 2500, or something came off the press. So I had the situation where I was going around telling people isn't this exciting and oh by the way I'm leaving. And it was very interesting. I told you the idea that I had asked just enough people to get permission but not anybody to say no. So I went into the guy who is sort of operations, the HR guy and he was livid. He just thought this was a terrible thing. I was using Xerox and blah, blah, blah, and this was terrible. I went into George Pake's office who was the head of PARC and he thought this is the greatest thing. Again, it was a-- it characterized the philosophy of PARC of people coming up with crazy ideas even if they weren't central to whatever and going off and just doing them. And George Pake thought this was a great idea. Not everybody did, but George Pake did. Okay. I got the head of the lab that's all we need. Right? But all of this type was set out. It was laid out. It was typed in on the Alto and printed on an optical type setting machine. And so it came out in strips. And then it had to be laid out in a magazine format with everything. So it turned out the people in Pasadena, said, "Oh, I know somebody who does magazine layout." So they hired somebody who was expert in magazine layout and they did all

  

of that for us. And we have this nice picture of myself and Jim Rowson. Jim Rowson also was collaborating. He was still at Caltech so this was my hairdo at the time. So these were are-- this is the next stage of collaboration between Jim Rowson and myself. So we did this magazine. I left. I walked out. I was working for VLSI. Now, okay, so I guess I have to finish this story because we'll have to rewind to the VLSI because they overlap. Let me finish the proliferation story. So now I had a magazine but I no longer worked for Xerox and people were saying, "Oh, this is cool." And so I quit but VLSI at the time was a startup. It didn't have funding. They were still out trying to raise money and I'll backup the story in that when we get to that. But basically, they needed me as a person talking about what we called "User Designed VLSI". But there wasn't actually very much to do because whenever there was a presentation to make to a potential backer or funder, then I would go out and do that. But the rest of the time there was nothing to do. So I said, well, I'll continue working on the magazine. That's what I was going to do. And for whatever reason Xerox, in general, the same people in Pasadena agreed to print-- put together and print the next issue which was this issue here. And this one was-- I was just reviewing some of the contents. One of the articles was by Jim Clark who was the founder of Silicon Graphics which is whose building we occupy [at the Computer History Museum]. There was one by Lynn Conway and so forth. There was a guy Martin Newell who was a very close collaborator with Chuck Geschke and others in the sort of whole world of Adobe and that kind of thing. But it was still pretty preliminary. Jim Clark hadn't yet designed his chip but in the next issue he actually designed his chip and he wrote another article about that. This was more about the architecture. And actually, maybe it was here. Yeah, we actually have a photo micrograph of the chip up here. And so he had designed this using ICARUS while he was teaching a course at Stanford in the office next to mine at Xerox PARC. So there are a lot of, you know, important people that did important things that contributed articles in the very early days to the magazine. And so we got the second issue out in April or something. And I was working out of my home. And then it was-- then Xerox said, "Well, we aren't going to do this magazine thing anymore." And it was like okay. And then I said, I still don't have anything to do. I was still trying to raise money for VLSI which was going to take another six or eight months. So I figured well, how am I going to get this magazine? So I went to a conference in Anaheim, the Anaheim Convention Center, this huge magazine conference. One of the tutorials at the conference was "how to start a magazine" and it was given by this guy who started traditional magazines many times or whatever. He was the sort of the Mr. Guru consultant in the world of magazine startups. So I went and learned about what you do to start a magazine. And so then I said, okay, I'm going to follow his advice. I'm going to do this the traditional way. So I went to his apartment in New York City in a very elegant high rise apartment. And he gave me, "This is what you do. First you've got to do test marketing. You've got to go to these people and blah, blah, blah and all of this sort of stuff." And you know the mailers you've gotten about magazines with all of the foldout stuff and letter. There's a science behind all of that and there are people that do this as a living. So I actually went to Madison Avenue on this guy's advice and spent $20,000 of my own money to-- this is in 1980, it's a lot of money. And they put together this glossy test market [material] for my magazine, including the letter with the blue signature. The signature has to be in blue. And then you have to buy the mailing list and send it out to all of these people. But you can't just send it out any time of year. We did this during the summer, but you really can't send it out until September because you've got to send it out in January or September because in between people are on vacations and that sort of thing. So we're waiting until September. So now I really didn't have anything to do. I was waiting for this. I didn't have any information. And I was working at my office at home and I get this call from a guy at Harris Semiconductor down in Melbourne, Florida. And he

  

said, “I want to put a recruitment ad in the next issue of your magazine.” He says, “When is that?” I said, I don't know. I’ll call you back. So I said if I can sell 15 pages at $1000 a page I can cover the printing costs. So screw the other thing. And so I called him back and I said okay it’s going to publish in X, fourth quarter. He says, “Okay.” I said, $1000 a page. And he said “Okay.” So in the fourth quarter we published this magazine with his ad on the back cover. So I spent six weeks calling up all of my friends trying to-- people that I knew in the industry to get ads, and I think you will find exactly fifteen pages of ads, you know, for Applicon. And so in this was-- and then, of course, my own company VLSI Design was going to publish an article or VLSI Technology and published. So Sperry Univac. And so spent six weeks just dialing for dollars raising money to do this. And it was-- so I thought, phew, we made it. We got all of these articles together. I forget how we got this one printed because Xerox wasn’t helping. Anyway. So we printed it and it was-- that seemed to gather new momentum. And meanwhile we went ahead with this test marketing thing in September and October and the results were dismal. If I had listened to those results [I wouldn’t have published the magazine] . it was like okay, well, we’ll put that aside. We’re off and running.

<group laughter>

**Fairbairn:** So that was a big waste of money. But it was so weird to go to literally Fifth Avenue, these people that do magazine advertising and the way you do that and exactly you’ve got to have so many pieces of material and you’ve got to have a fold out. And you’ve got to have color. And you’ve got to have black and white. You’ve got to have the blue signature. It’s all scientifically tested and the return rates were terrible. <laughs> So I said screw it. I’ll just get on with it. And so that’s the way I proceeded. So then I published the magazine until-- so it started in ’80, throughout ’81, throughout ’82. And January of ’83 I woke up one morning and this is when VLSI was really underway. And I had two jobs, two startups. Right? And fortunately, I wasn’t married. I was exhausted. I said I can’t do this anymore. It’s like I had hired people to do it [the magazine] but I was still-- I didn’t used to know what a publisher meant. The publisher is the guy who pays the bills. So I was still losing money. I put a lot of money into the magazine. And I lost I mean it was not profitable because I had hired people and we were selling advertisements but it was an expensive operation to still be giving away copies and trying to do subscriptions. And I had borrowed money from my parents. I had mortgaged my house. I did all of the normal startup things. But I was young. I was not married. And I was absolutely convinced that this was the right thing. I was totally-- between VSLI Technology and this I knew that this was the right thing. So I just plowed ahead. And I didn’t worry about the future. And I didn’t worry about the money I was spending. And I did all of the classic startup things. And I put a lot of my-- I can’t even figure it out how much money-- where did I get all of that money? Part of it was I was earning money from VLSI and putting into this. And living cheaply. So in January I woke up and I thought I’ve got to sell, I’ve got to sell it. I’ve got to get rid of this thing. And then boom, I started getting calls, people, “I’m interested in buying your magazine.” Perfect. The suns and moons have aligned and I figured out that I needed to sell and people started calling. So there were two serious buyers, both of them in New York. One of them was CMP Publications. And so then I also learned the advantage of having two bidders instead of one.

  

<group laughter>

**Fairbairn:** And I flew back to New York and negotiated with them and used one against the other and sold the magazine to CMP in May of '83 for $650,000 or something like that and made some good money. Got my money back and made some money. So that was my first startup. That was all my own money, my own everything just laid it all on the line. So that became the vehicle through which-- I mean I still run into people who say, "I remember getting your magazine." It had a real impact. It did what we intended it to do at the time in terms of sort of spreading understanding and knowledge about this thing. And if you look at Jim Clark's article it's all about block diagrams and chip. It isn't about logic diagrams. And the same thing with Ron Rivest, who is a professor at MIT, now in cryptography he did his first work in cryptography here and did a cryptography chip. So all of it was taking high-level concepts and boiling them down to the VLSI level. And in the end you needed more expert designers to really get the most out of the chip. But getting people at the architectural level connected with the layout level was an important step. Even if they weren't physically tall thin men in terms of doing it all themselves, being able to link the methodology from top to bottom turned out to be an important thing and then involving so many other people in the CAD software. To me those were the real impacts, the real advantage or fallout of that work.

**Man 1:** How connected were you to Jim Clark and his <inaudible>?

**Fairbairn:** I really wasn't-- I was only connected in the context of when there was a bug in the program or he had a question or whatever. He was literally teaching the course at Stanford on a computer architecture, but he says, "That's not what I do. All I do is I go in and tell them about what I'm doing on the chip the night before." Because Jim was focused. He was going to do this chip. He was going to do this company. He was going to show Evans and Sutherland that they had their head up their whatever. And that you could do this stuff on VLSI. And you could do it at a much lower cost than what they were doing. He was down at the University of Utah. He knew the graphics world. He knew what Evans and Sutherland was doing in terms of aircraft simulators and that kind of thing. And he just felt they were on the wrong track and the he knew how to do-- now that he understood the world of VLSI he understood how to do it better. So he did this chip and that became sort of the proof case to get Silicon Graphics funded and off and going.

**Man 1:** This is probably a good point to rewind and move back to the NoteTaker.

**Hsu:** Yeah, I just had a couple of quick questions about ICARUS to make sure that-- well, just to understand it better. I think other people might have similar questions. The output of ICARUS, was it a file from which then masks were made?

**Fairbairn:** Yes.

  

**Hsu:** How did you get from okay, I clicked save on ICAURS to I've get a process waiver?

**Fairbairn:** Icarus was a physical layout tool and generated literal layouts. And it generated a file I don't remember the exact format. But it then was converted to GDSII, the universal-- which was Calma's standard layout that they used to-- you get masks made from a Calma system. So we just wrote into the same interface the Calma or any other CAD system did or still does. I mean we're still generating GDSII files 50 years later, 40 years later. And so we just generated a file. Somebody wrote a converter from that to GDSII and from that you could just take it to any mask-making shop and they'd make it from the GDSII.

**Hsu:** And who was doing the fab for these earliest VLSI?

**Fairbairn:** It was a combination of people. Hewlett Packard was an early sponsor and fabricator. In that same period, actually, one of the ways I made money during 1980 was I went to Hewlett Packard to their TV studios here in Palo Alto and taught the full course on VLSI design to HP engineers; not only the ones there but they had their own in house network of remote learning so people from other divisions of Hewlett Packard would listen in. And Hewlett Packard had rights to use the tapes internally and they circulated those tapes internally. And VLSI-- this was when VLSI-- I was working for VLSI Technology but it was not yet funded. And VLSI had the rights to sell the tapes themselves or use the tapes. So Hewlett Packard had their own internal rights but VLSI had the copyright and the ability to duplicate and sell to the outside world. And I had a deal with VLSI that what HP paid me to give the course went to me, which I then put in the magazine because all of the money I had was in the magazine. <laughs> But out of that came a whole set of videotapes which was three-and-a-half-- inch-- not beta max.

**Laws:** VHS.

**Fairbairn:** No, no.

**Laws:** Unimax?. One-and-a-half-inch tape.

**Fairbairn:** Yeah, one-and-a-half-inch tape. And I actually have one of those tapes around some place maybe. Maybe I donated it. I forget. Anyways, so we had those tapes and we used those in teaching courses at VLSI Technology. So Hewlett Packard had bought in and wanted to proliferate this technology throughout all of its divisions. And we had a relationship with their local fab - at the time they had a fab. And so some of the early chips were through them. And I don't know if Intel-- I forget who the other-- I think AMI did one. And we basically-- we used multiple fabs at different times to get it. But I know HP. I know we used HP in the very early days. And I forget the later ones. And, of course, out of that, once that whole thing became wrung out and productized so to speak, then the whole-- then MOSIS, the MOS implementation service, that DARPA funded that was down in Marina del Rey was started based on taking all of the software and tools that had been developed at Xerox PARC for merging chips and

  

handling it and converting it to GDSII and sending it out to fabs and getting it back and packaging all of the chips and sending them the chips out. So the students at universities around the country could [send their designs via ARPAnet to MOSIS, where] there was a team that would merge all of the chips together on to multichip wafers and get them fab'd, get them back, slice them up, package them and send the packaged chips back to the student for testing.

**Laws:** Wow, and these were at where? Physically where were this people who did all of the work packaging?

**Fairbairn:** They were down I believe-- I mean they had it subcontracted-- I don't know-- when MOSIS got started I don't know where that physical work was done.

**Marc:** Wasn't it ISI with Danny Cohen.

**Fairbairn:** Yeah, I think, but I don't know whether ISI did it themselves or whether they sub contracted it out. But, you know, every chip was different.

**Laws:** Yeah, there was a lot of logistics making sure the right people got the right chips.

**Fairbairn:** There was a huge amount. Also they had a lot of software that they built to make that all manageable. But they were doing hundreds of different chip types per run. And it as a major undertaking. And it required a lot of automation to make it possible. Otherwise, in the very early days we did it manually when we had a few chips. And then we said, well, we can't do this. And so we had to develop software to do all of that merging. And test chips were put on to the wafers and that sort of thing. So you could make sure that the wafer was fundamentally processed so you knew that at least the transistors were within spec. So once it got transferred to ISI, in fact, even when it was up here we didn't do any packaging at PARC. So we must have subcontracted it to a local place. It wasn't a mass production thing you that could ship overseas. We must have done it locally with like at Hewlett Packard or somebody that was willing to do that. But we got actual packaged chips back and plugged them in and tested them.

**Hsu:** One last quick question if I could just about the ICARUS. What about the specific silicon fabrication process, those parameters for just the physical details of the process? How did those…

**Fairbairn:** So the whole idea here was that we were not going to push the technology. We were going to use-- not optimize every little micron. And that we were going to get density out of architecture rather than by hand pushing the polygons. And that was another part of the philosophy. And so out of that came the set of Lambda rules that were developed in conjunction with fabricators that says, okay, if we follow these rules we can just scale.

  

**Hsu:** Safe.

**Fairbairn:** You're safe and you can just scale within a certain domain. And you had to have-- do you have buried contacts or not ? was one of the fundamental questions of the process. And single level metal or double level metal. In those days, we were only doing single level metal and poly. And, I guess, I was just thinking about it well, I guess, ICARUS only handled single level metal. And I don't think at least in the time that I was doing it…

**Laws:** And this was NMOS or CMOS?

**Fairbairn:** We did NMOS.

**Laws:** Silicon Gate?

**Fairbairn:** So polysilicon gate, definitely silicon gate. So you had to have a basic process. And then we would scale lambda. When you output it from ICARUS you could just say what lambda you wanted and it would put it out to the right geometry for that. So as long as you had the basic process right we weren't pushing every design rule so that you could be fairly confident that it was-- and the chips were not huge, although some were really complicated. So that was the whole idea was that you would make a somewhat fab independent design rules. But we would have to work with a set fabs and say, okay, given all of these rules what's a common set that we could do? And so Carver helped with that and he had relationships with Intel and other people. So we kind of figured it out and made it work. But yeah, that's how it was handled.

**Man 2:** Thank you.

**Man 1:** I think are we good?

**Hsu:** I think Marc had had a question.

**Fairbairn:** Marc, did you have one more question?

**Marc:** Just with MOSIS - did you have many dealings with Danny Cohen? Was he the main face of that?

**Fairbairn:** I was out of it by that time. I was-- that got transferred, I think, in the '80-'81 timeframe when I had moved over to VLSI Technology. I think up through '79 Xerox PARC was handling all of the merging

  

and so forth. And then through Lynn's team. I mean her team supported this activity for a year or so until they could get MOSIS up and running because it was becoming such a big thing I mean we didn't-- PARC didn't want to do it anymore. They wanted to hand it off to somebody who could handle it on a much larger scale. But it was, again, another example of Xerox-- I mean one of the things that made PARC so successful and so impactful was that it built things, whether it was building Alto's or chips or whatever, NoteTaker's. We built stuff. It wasn't just theoretical papers. And that was a very key element of the strategy of at least the Systems Science Lab and the Computer Science Lab at PARC -- there was software research but they built real things, real software systems as well as hardware.

**Hsu:** So let's go back to talking about the NoteTaker. So I guess you had mentioned before you were on the VLSI project and you were talking about how Alan Kay wanted you to maybe create a design for a VLSI chip for his NoteTaker project. Was that how you ended up on that project?

**Fairbairn:** Well, he wanted an interim Dynabook whatever. And so my idea of building such a thing was to design a custom processor. And I did some architectural design for that. And then decided well, this really is going to take a long time.

<group laughter>

**Fairbairn:** And the 8086 appeared and Dan Ingalls, among others, probably Larry Tesler did some performance analysis in terms of what core algorithms and core loops could be. And thought that the 8086 would be adequate to run Smalltalk. The whole goal was to run Smalltalk. This was not meant to be an Alto replacement in terms of all of the things that Alto did, but in terms of-- it was driven by the learning and research group and Alan and portable Dynabook, next gen, an interim Dynabook, if you will. And so somewhere along the way we coined it the NoteTaker. And I set about-- you know, I was given responsibility to create that.

**Man 2:** Where did the name come from?

**Fairbairn:** I don't remember. It seems like maybe I came up with the name but I can't tell you for sure. I remember deciding that it ought to be capital N, capital T. So I had some role in that. <laughs> Well, I must have done the whole thing, I don't know. But Dan Ingalls was a very very close collaborator in terms of determining the specifications of what it had to handle. And we also-- and we wanted to put into it all of the kind of user interactive features that we would envision for Dynabook kind of thing. So it had to have a minimum amount of memory which we decided by this time was 128K bytes and the 8086 processor. And, of course, it had to have an Ethernet interface. There wasn't any Wi-Fi at the time. It had to be battery operated because it had to be somewhat portable. It had to be freed of connections to the power. And we had had to deal with things like video and touchscreen, audio-- audio and video and I think video. Maybe only audio. You certainly had to be able to take audio in and audio out. It had a touchscreen. So

  

then it was a matter of, okay, how do you cram all of that into a portable box? And we worked with the same design group that did-- that worked on the Alto, Clement Laboratories. And they came up with the basic configuration of the box and the keyboard that fit on the front of that which also had the handle. So there was a lot of time just spent in figuring out what that looked like. The basic other things were the screen size. The standard screens at the time were five inches and nine inches. We decided that seven inches was optimal, nine was too big for the box and five was too small for the application. So we had to work with the monitor manufacturer to do a seven-inch monitor. I think they sort of had one but it wasn't standard product. It wasn't generally available. So we had to do that. The power supply had to be custom built so we went out, contracted with a custom builder to-- because the power supply had to be able to handle the various voltages required as well as the size requirements, the total power requirements and be able to switch between batteries and so forth. I mean everything about the power supply had to be custom designed. You couldn't use a standard power supply. So there was a lot of engineering that went into that. I didn't do that directly but I worked with the subcontractor who did the custom power supply design for that. Then in order to get the memory density 16k memory was the standard. 64K wasn't available at the time. And we needed at least 32K basically in a package. So we worked with Mostek to put two surface mount 16K RAMS on I believe an 18-pin DIP package. So they were surface mounted to the top of ceramic dip packages. So you essentially had 32K density in the same space as a 16K. So that was that part. The custom-- the touchscreen was done with a special film that we put across the display. It wasn't integrated with the display but it was a separate piece of resistive film that you could put X, Y voltage across to determine the position of a pointer, whether it be a finger or whatever on the screen. And then it had to have the audio in and out. The Ethernet, I think, Larry Tesler did the design of the Ethernet controller. I did most of the processor board, to handle all of the other stuff. But I think Larry did the Ethernet controller. I was trying to think if there were other important features. I don't have any diagrams of the detailed architecture design of it. It would have been somewhere at Xerox. I don't know what would have happened to it. But we developed wire wrap versions of it to debug it. And then printed circuit board versions to actually produce it. So the Alto, the initial ones, had been built at Xerox PARC. And then since they were building so many of them we transferred production down to the-- a special operations group at Xerox El Segundo. And they had developed the Alto-II from basically the design. And then put that into a sort of mini manufacturing production line at Xerox El Segundo. And so when it came time to do the NoteTaker we did the same thing, although, we didn't do any-- I think we just did the prototypes at PARC. And then we transferred the design technology down to Xerox El Segundo and they did the design of the PC boards and sort of prototyping and making it into a real thing. So they were then in a position to build many more of them if we wanted. But I believe there were only ten of them built, which is why they are so difficult to find. There may have been more built, but ten is the number that sticks in my mind. It wasn't tens and it wasn't hundreds. It was some small double digit number. I ended up leaving Xerox at about the time that it was finished. There was definitely Smalltalk running. One of the books about PARC describes it as being the first personal computer booted on an airplane. Larry Tesler and I made a trip back to Rochester to demonstrate it. So we had Smalltalk up and running. It did all of the things that it was expected to do. But it was a bit of a dead end in terms of not becoming something that was replicated as a general purpose tool, throughout the organization like the Alto had been.

**Man 1:** Why was that?

  

**Fairbairn:** Well, I think, for-- maybe the answer comes back to a little bit like the tablet. For the-- it was certainly a luggable device. I mean it was 30 or 40 pounds probably by the time you crammed everything in there. It was similar in weight to what the Compaq became or what the other-- but it was damned expensive. Everything was special about it. I mean it had special display, touchscreen, special memories, packaging, special power supply. This was not a cheap thing. And nothing Xerox PARC did was cheap but it was meant to be a prototype of things for the future. So I guess the bottom line is partly I left and there wasn't that push to do. And there wasn't a compelling application in terms of what you could do with Smalltalk to do that you couldn't do on the Alto. And so the Alto was much less expensive, much more-- it was already proliferated everywhere. And the cost to proliferate the NoteTaker was going to be significant. And in the end it could demonstrate some of the advances of portability and that kind of thing and make people get started on that. But much of what I was going to say like tablets, there were so many tablets made before the iPad and it just didn't hit the sweet spot in terms of price of technology and everything. Obviously, when the Compaq IBM compatible PC came along it was a portable version of the PC, it had a compelling price and offered some compelling advantage. But that was five, seven, eight, ten years later or whatever. And so it-- I think it was just a combination of factors that people-- there was a lot of demand for higher performance at the time. So things like the Dorado were being built. And people were looking for more and more performance. And I would say at that time, the luggable-- a little noisy there, Marc. That's very noisy. So it didn't hit a sweet spot in terms of the advantages of portability versus the disadvantages of performance. I couldn't tell you what the performance-- of it was running Smalltalk versus the Alto running Smalltalk. I have no idea. I don't remember it all. Somebody like Larry Tesler or Dan Ingalls might be able to comment to that. I mean I think it was usable. It wasn't like well you could show it and it dragged along. But I do remember as we were all familiar with especially in the early days of personal computer performance was everything. You jump on the next generation thing because things were just not fast enough. Whereas, today, it's like well they're all pretty fast. And I don't necessarily need the latest and the greatest to do my day to day work. So I think it was a combination of cost and compelling advantage and performance and so forth. But it certainly-- it was a real device that really worked and offered the ability to run. I don't remember how long the batteries lasted. I don't think it was-- it wasn't a huge amount of time. It was probably an hour or two you'd get off the batteries. Because we were on the edge of technology. We were just pushing everything and it just was not the sweet spot in terms of-- I think these were lead acid batteries. We didn't have nickel metal hydride. We didn't have more advanced lithium ion than we have today. So memories have always-- they got a lot of denser than-- you know, processors have gotten a lot faster. But I know that Dan Ingalls and the others did some very clever algorithmic, very low level programming work on the 8086 to get performance out of what was not necessarily a very high performance processor. And so that I think the performance was actually decent.

**Marc:** So what were the greatest, at the most optimistic, what were the greatest hopes that it would lead to?

**Fairbairn:** You know, we just need to do the next generation thing. There wasn't-- you know, there was never a grand plan-- there was never-- like the Alto when it was done people didn't know what would happen with it. And in the end it hit a sweet spot and became widely used at least within the Xerox and related communities. In this case, it demonstrated the capabilities that we envisioned but the advantages

  

were not-- and it was a good thing to point to and it was a good thing as a precursor of what's to come but for whatever reason it was not in the sweet spot of what people were looking for at the time. And it did not grow beyond its prototype stage, shall we say.

**Marc:** Right. But you didn't have a particular vision of what-- if I had worked out.

**Fairbairn:** I think we would hope that it would be more widely used. And that people would use it at home and that sort of thing. There was not a lot of talk about that. I mean there was personal ideas about what we would hope to happen. But there wasn't grand plans and there wasn't strategies around that.

**Hsu:** Was Larry Tesler going around to try to get management interested in the NoteTaker?

**Fairbairn:** Well, we would both go around to demonstrate it and to show them what was happening at PARC and what the latest and greatest technology was. And I think we certainly created some wow. But it was clear that this was-- you couldn't even reduce the Alto to a cost effective tool as a desktop device. You certainly couldn't make the NoteTaker a cost effective device because of all of the special-- Alto was built out of standard components. Everything was off the shelf kind of thing. I mean it didn't have a microprocessor in it. So everything was off the shelf commodity devices. But even that was a $10,000 in raw parts kind of thing in the mid-seventies, and would have had to sell it for $40,000 to $50,000 probably. So the NoteTaker was going to be, because of the custom aspect of so much of it just like portable things are typically more expensive today, you know, because they've gotten down to the place where there isn't a big differential. But in the early days, portable devices you paid a lot for portability. And in this case, you were certainly going to do that because everything was custom in terms of all of the components. Pretty much nothing was off-the-shelf. There was a lot of TTL that was off-the-shelf but there was a lot of non-off-the-shelf technology in that machine. And it had more than people needed. And so it was just the wrong thing-- it didn't provide a compelling advantage. And it wasn't what people were looking for at the time. People still hadn't caught up with the Alto in terms of its capabilities. Right? I mean that was still-- Xerox at the time was trying to productize I mean the early eighties-- the late seventies, the early eighties Xerox was trying to figure out how to productize the Alto, how to take it to the market. People don't really understand and they say why didn't they take advantage of what the Alto had to offer? You know, they did. They developed a whole new division. They had the System Development Division, SDD. They invested 80 to $100 million of those types of dollars in creating the Star product and it was just too much too early. And this gets back to my thing about Xerox and Xerox PARC and what could it have done. Within PARC we were clamoring to get this technology out. Why is Xerox dragging its feet? And they don't understand and that sort of thing. But, you know, the idea of windows on a personal computer came twenty years later. Twenty years later after the Alto was working. And in the form of Microsoft Windows. And the world wasn't ready for it. And the price wasn't ready for it. And why did the iPad succeed when it did? Well, because it was the right thing at the right time. There were dozens of pad-type computers done before that but didn't go very far because they were the wrong thing. They were too early. The Alto was too early. The Xerox technology was too early. And Xerox would have been better to

  

rather than even try to market it in the early eighties to sit on it and nurture it internally, sort of continue to refine it but not try to take it to market, until many years later. I mean people say well look at what Apple did. The Macintosh was not a big success. It was interesting but it was too expensive and too underpowered and so even in 1984 it was too early in terms of a mass market kind of device. The IBM PC was the sweet spot. And so there was-- I learned an important lesson in terms of the timing of technology. And there was just no way that Xerox could hold on to everything that had been created there. I mean they did do a reasonable job of getting Ethernet established as a standard. They had a role working with Intel and DEC to establish Ethernet as a standard and against viable competition at the time. So that was in fact a successful thing and maybe they could have made more money at it, I don't know. But the whole world of personal computing and Windows it may be better licensing agreements or whatever, but there was just no way that Xerox as a corporation set up the way that it was or even transformed into another company could have capitalized on all of the technology. The thing that I think they made the biggest mistake on was the laser printing. They had Gary Starkweather's laser printer hooked up to a character generator generating these high resolution digitally generated documents in the mid-seventies and that's what they didn't capitalize on. That's what they didn't-- they were in that market. And it took IBM coming out with a laser printer that was a replacement for a computer output printer basically a replacement for their big line printer. You know, it was this huge device. It looked like a Rube Goldberg thing. And it was not an office output device. It was a computer printer device. And when IBM came out with that and Xerox said, "Oh, shit," and they then I think came out with various forms of their-- but they could have certainly done a much better job of coming out with laser printers and taking better advantage of that and being a first mover in that space because that's the business they were in. So plenty of responsibility, guilt, whatever to go around.

<group laughter>

**Fairbairn:** But it was not anywhere as easy as people think. And they made a major effort to productize in the late seventies, early eighties and even then it was too early.

**Hsu:** What sort of dictated the shape of the NoteTaker?

**Fairbairn:** Well, the key component, you start with the display. I forget what the combination of things was but five inch was just too small to get whatever we-- I don't know whether we wanted 80 characters or whatever. But if you did the calculations of how much you wanted to be able to put on the screen, you wanted to make it as small as possible because that was going to dictate at least one of the dimensions of the machine. And nine inches was bigger than you needed and was going to make the whole thing too big. And so we settled on seven and had to stand on our head to get a seven-inch display. So that set the height of it. And that also worked-- the other critical component was the floppy disk was new at the time. I forget exactly what the timing of that was but it was a five-and-a-quarter inch floppy. And that was also turned on its side with sort of the right size there. And then once you put in-- that sort of set the height of the thing. And then the width of it was-- at least the keyboard width and then you had some place to put

  

the mouse. So there was a storage place to put the mouse. And then it was sort of a compromise between how small can we make that and then how many boards do we have to put in and how big is the power supply and we had to cram everything we wanted to get into. And I think one of the criteria was it had to fit under an airplane seat. So those things all came together to that's how big it was. So it was a classic engineering tradeoff problems of all of the cramming more-- you'd like to cram in more but it has to be smaller and it has to fit under an airplane seat, I think, was the-- because that was the major portability. If you couldn't take it on an airplane, then you were going to miss one of the major aspects of it. But we did actually put it on a tray. I was a little worried putting it on the tray. It was really heavy. <laughs> I wasn't sure that the airplane tray could support it. It was back when the seats weren't quite as tightly packed as they are today. But we really did put it on a tray and boot it up on the airplane. So that part really did happen. But it was pretty heavy on the tray.

<group laughter>

**Marc:** How about the idea of putting the keyboard in the cover?

**Fairbairn:** I think that was just sort of-- you know, it came in very early on in the-- talking with the industrial designer it's like where else are you going to put it? It's got to be separate. It's got to be separable. Right? And so I don't know that there are very many solutions to that problem. And so I don't remember that as being a significant point of controversy. I think that came out in the very earliest of concept drawings. And, plus, you had to have a cover on the front. You had a display and other things to protect. So you're going to have to put a thing there and your display had to be opened up. So you had to take off the cover to use it. The cover might as well have the keyboard on it. And where else are you going to put it kind of thing?

**Man 2:** Was that the first computer that you were basically the designer…

**Fairbairn:** Yeah, that was the full computer that I-- well, the only actual real computer that I designed. Right. I mean the POLOS thing was an interesting engineering problem. It required a lot of peripheral stuff but it certainly was not a computer design problem. And even this included a microprocessor so it was more of okay the processor is defined. I needed to define the architecture. I needed to define the bus. Because it was not a standard-- it wasn't like a standard 8086 bus because we had to do certain, I think, memory transfers and stuff that were higher bandwidth than would otherwise-- so all of that configuration was custom-- was unique to that machine.

**Man 2:** I think it's interesting maybe this was, again, dictated by the form factor and the other constraints but I mean we were noticing how similar the Osborne one later looked. Were there any direct influences from the NoteTaker to the Osborne?

  

**Fairbairn:** I certainly do not know of any links. There may have been that I was not aware. There was no Steve Jobs incident of people coming and being shown this that I was any part of. Xerox was a relatively open place. There was all of this stuff about Steve Jobs coming in. But quite frankly, there was a parade of people, whether it was the Alto or NoteTaker or whatever, there was a parade of people coming in and out from a variety of places that information could have leaked out through any number of sources. Even in the Learning Research Group they had students coming in-- I mean they were really interested in how students, how like middle school and even elementary school kids learned how to program computers. And so they had a room full of kids brought in from who knows where. And I invited my brother in to write his thesis and anybody I knew I would come in and show them all of this cool stuff that we were doing. There was thousands of people that must have paraded through Xerox to see that and possibly could have gotten-- on the other hand, as I said, the configuration given the constraints of the standard technology at the time, I mean the Osborne is a five-inch display, I believe. Again, that's a cost thing. I mean you're going to get a smaller thing. You're going to get a much lower cost thing with that. I don't think the Osborne had batteries did it? I don't think so. I think it was just-- like the compact didn't have batteries either. This was all…

**Marc:** I think the Osborne did but I'm not positive. [ed note: There were no batteries]

**Fairbairn:** Anyway, that would be an interesting thing to check but as I remember they were just luggable. They were not meant to be plugged in as a true portable device, or unplugged as a true portable device. And it had a five-inch screen and a lot of-- no touch screen, no audio, no-- I'm sure it didn't have the memory [ed note: it had 64K bytes of memory]. It ran CP/M, much less demand on the processor than Smalltalk. So, that was a-- and it was later on, just a few years later, but you had 64K or 256K, at least 64K memories to work with. We were working with 16K doubled up. So, it was-- it could take advantage of a couple of generations of technology later. It probably had a later generation processor also. I presume the 286 was out by then. [ed note: the processor was the inexpensive Z80] So, but again, as far as the basic configuration, you only pick a couple of things. And that's the configuration you come up with. I don't think-- he wouldn't have had to steal the idea from me or from us to come up with that idea. We may have patented it. But we didn't--

**Laws:** And as a journalist, he probably knew what was going on everywhere anyway.

**Fairbairn:** Yeah, I mean we made-- we didn't make any great effort to hide it. And I don't-- couldn't tell you all the people that saw it because Xerox was a remarkably open place. I do laugh when I talk about people, the whole Jobs thing and whatever. And it's like wow. It's amazing that we took as much care as we did because everybody else was getting free demos.

<laughter>

  

**Brock:** Were you there when-- during the Jobs--?

**Fairbairn:** Oh yeah. I was there from ’72 to ’80. I wasn’t part of that [Jobs demo]. I wasn’t there physically when he came in, but--

**Brock:** Like you weren’t there that day?

**Fairbairn:** I wasn’t there that day. But I was certainly-- well, I might have even been there that day. I just wasn’t in the meeting.

**Brock:** Right.

**Hsu:** Could you talk a little bit about why the Dynabook inspired you enough to want to get involved with--?

**Fairbairn:** Well, I think if we hadn’t been involved with Carver Mead. And the idea that technology was going to continue, ICs were going to continue to shrink, and the power and performance was going to continue to go up, that was a very-- the idea that what was not possible today was going to be possible tomorrow was clearly in our head. And we were not constrained as any product organization would be by actually coming up with a product that could sell that day and what the tradeoffs. Our tradeoffs were it had to fit under the airplane seat and run Smalltalk. That was about-- and run on batteries. That was about what we had to start with. And it didn’t matter how much it cost. And so, we could do all sorts of things that-- and we know it was not going to be a product. We knew it was not going to be viable as a commercial device. But we knew it was a necessary step along the way. You had to just keep building prototypes of the future in order to keep experimenting with how do people use it. Xerox learned a huge amount by having the Alto as a prototype of what the personal computer was going to be like in the future. And the hope was that we would learn similar things from the NoteTaker in terms of what’s it going to be like to have a portable device that you can carry around with you. And for whatever reason, it was not-- I wasn’t there. It wasn’t cost effective. I don’t-- I can’t answer the rest of that question. But there were other portable devices like the Com-- well, the Compaq came along in-- the PC was ’82, so they must have come along in like ’84 or something?

**Brock:** Yeah, ’83/’84, I would--

**Fairbairn:** So, within two or three years, there were portable devices that, although they weren’t running Smalltalk, they were at least things that you could look to as being portable computers. So, from that point of view, it was not that far ahead of-- it wasn’t nearly-- as a portable device, it wasn’t nearly as far ahead of the rest of the game as the Alto was, for example. So, the Alto, you had a lot to learn from before

  

anybody else was on that bandwagon. The Alto-- or the NoteTaker, I'm just sort of thinking about it now, was, if you were strictly looking at what is portable computing by you, not worrying about Smalltalk, within three or four years, you had another portable device. Now, when we started in 1978, it wasn't obvious when those might come or what those might be and so forth. So, you just do the best-- but, you know, so I mean Xerox was an exciting place to work. And you were always pushing the technology and doing new, cool stuff that nobody else was doing. And you could show it off to people. And they'd say, "Wow." And what could be better? And it was just, as a place to work, just like Google is or whatever, we didn't have free food. But we had a great cafeteria. And we had an office on the hill. And we had great softball games in the afternoon and the smartest people in the world to work with. And what's wrong with this?

**Laws:** So, with that wonderful working environment, what prompted you to leave, Doug? What's the next step in your career?

**Fairbairn:** So, yeah, I don't-- there's not a lot more to say about the NoteTaker. It sort of reached a dead end. I mean it was an exciting program to work on. But it was not-- it didn't have the impact or the fallout we might have hoped or thought or guessed or whatever. But there were interesting things happening in that timeframe around '79/'80. There were other people that were starting to leave to do other things. And I remember the first guy to leave that at least I was aware of-- I can't recall his name right now. And I don't even remember the company. But it was like okay, there was-- one guy left, right? And it was from CSL. I'll remember name at another time. [ed note: It was Ben Wegbreit] But--

**Brock:** Well, Alan Kay left at some point, right?

**Fairbairn:** Yeah. But I think he was still around. I don't remember what his-- I had become-- the NotetTaker, I guess it was clear by '79/'80 that the NoteTaker was not going to be a magic carpet, shall we say. But on the other hand, this whole VLSI thing that I was still playing some part in and starting to do the magazine-- now, I was really totally bought into the magazine, right? I mean I was personally invested in that. It was-- I can't bel-- I can't believe how much money I put into that on just-- and people say, "What drives an entrepreneur and whatever?" It's like--

**Laws:** Your gut.

**Fairbairn:** You were so convinced that this is the right thing. And it does matter that you don't have a family to worry about, that you only have yourself. And if I fail, then I just got get another job. It was all those things that you hear about in terms of doing start up were all in play. I borrowed money from all the places you normally borrow from, friends, home, whatever. I cashed in my retirement account. But I was just so convinced. And there was a lot of excitement around this whole VLSI, the spread of that. And all these universities teaching the course. And so, although the NoteTaker was not taking off, so to speak, the VSLI program was taking off. And so, when I met these guys from VLSI technology, these guys, the

  

other three founders, were from old line silicon company, right? The CEO was from Fairchild. The other guys were process development and a manufacturing guy. And so, they were definitely old line silicon guys. But they bought into the future of foundries and user designed VLSI and that sort of thing. And they bought into the Carver story, right? And they were over here. And Carver was over here. So, Carver-- this is another orchestration of Carver Mead was to get me together with them. So, the thing was well, go meet them and interview them for a story. And that was in November. And by January, I was working for them because they were trying to raise money. But they also realized that they needed somebody to tell the user design story, that you could get systems companies. So, the world at that time-- can we move into this phase?

**Laws:** Yeah, let's make that transition.

**Fairbairn:** So, the world at that time was real men have fabs. And yet, there were some men that were just not big enough to have their own fabs. So, if you wanted to compete with Hewlett-Packard or IBM, who had their own fabs, then you had to do something else. And VLSI was going to market with the idea that they would be the fab for a system company. They would help them get started in doing their own IC design. And they would be their fabrication arm. And so, the goal was to raise ten million dollars, two and half million dollars from four different systems companies each. It was not meant to be a venture funded thing. In fact, it was viewed, by this time, there'd been I think AMD or whatever was the last venture funded semiconductor company. So, because of the amount of money required to build the fab even then, it was viewed to be too late for venture funding for a semiconductor company. And it was-- we needed to do a partnership sort of thing with systems companies. And Jack Balletto, who was the CEO, had come from Synertek. And he had seen Synertek get some financing from this kind of model before and had worked the whole VLSI thing so forth. And so, the idea was that we would get started with read only memories, which the Synertek people were familiar with and were hot items at the time for games and game cartridges and that sort of thing. And we would use that as sort of a cash cow while we got the whole VLSI thing going. So, the VLSI story was the headline. And the ROM story was the building block.

**Laws:** So, before you joined them, though, did they have a strategy for how these things were going to be designed?

**Fairbairn:** No, they had a foundry story. They did not have a design story.

**Laws:** Okay.

**Fairbairn:** And they were having trouble raising money. And they figured that they needed somebody like me to tell that story. So, they wanted-- that's how I got on board. I was somebody who could bridge the gap between the world of ICs-- because I knew enough about that world. I wasn't a fab guy. But I was-- I understood design. I understood the tradeoffs. I understand how that was done. I understood the world of

  

CAD by this time. And I understood the systems world. I'd been in that world. And I could talk to those people. And so, I was a good impedance match between the world-- and which was important. At that time, there was no impedance match. The world of people doing IC design, they had their own mindset, their own way. It was black magic. Only experience IC designers, circuit designers, could do this. Sorry, yeah, we can do it for you, but don't-- you can't make-- don't get your fingers dirty. So, we were going to tell a different story. And so, I joined them in January of 1980. They'd written the business plan in September of '79. They had been trying to raise money for a few months unsuccessfully. I joined them in January of '80. And we actually ended up getting funding in December of '80. So, it took a full year, a year and a half from when they started. They were doing some consulting, other things on the side. But basically, we were just sort of treading water, waiting to get money. And--

**Laws:** So, were you a founder?

**Fairbairn:** Yes. I consider myself--

**Laws:** You don't appear on the--

**Fairbairn:** I consider myself a founder because I was a year before the money came in.

**Laws:** Okay.

**Fairbairn:** And nothing came in for a year after I started. So, they wrote the original business plan without me. But I joined three months later. And it was another year before the money came in. And the money was put in on the basis of my story.

**Laws:** And who were the funders?

**Fairbairn:** So, this was another great example, learning lesson, in terms of how fundings get done. So, although our strategy wasn't to go to venture capitalists, we had talked to a bunch of venture capitalists. And everybody said, "Interesting," blah, blah, blah, "Maybe." But nobody stepped forward. And so, we did a lot of pitches to systems companies. And there was some that came close. And Olivetti almost came in. And there was a lot of things that almost happened but just didn't. So, the thing that finally tipped the scale was Dave Evans, founder of Evans and Sutherland, bought into the story because he was building these aircraft simulators that were literally a room full of racks of TTL logic to build a simulator. And he sold them for millions of dollars to the Air Force. And Evans and Sutherland, there's a Sutherland here. There's an Ivan Sutherland. He's all part of the story, too, right? And so, between Ivan and Dave, they became convinced that Evans and Sutherland needed to get onto the VLSI bandwagon. They needed to build custom chips. They needed to take all of their huge amount of literally racks and racks and racks of

  

TTL logic and boil it down into custom chips. So, Dave Evans says, “I’m in. I’ll put in three million dollars of the ten.” Bill Hambrecht is on Dave Evans’ board. So, this-- Hambrecht and Quist were still active at the time. Bill Hambrecht says, “If Dave’s in, I’m in.”

**Laws:** The first mover is so important.

**Fairbairn:** Once Bill Hambrecht was in, every was-- well, now we’re oversubscribed. So, a year and a half of knocking on doors, one guy, and then everybody jumps on.

**Laws:** And so, the other funders were--

**Fairbairn:** The others were all--

**Laws:** Venture?

**Fairbairn:** The others were all venture.

**Laws:** Interesting. So, very different from the original intention.

**Fairbairn:** Hambrecht and Quist and a bunch of other, yeah. So, we eventually did raise-- on top of that, we got like thirty million dollars with loan guarantees from Bendix of all places. And GE-- this is back in, remember the days when the head of Bendix was having an affair with--

**Laws:** Oh yeah, the lady.

**Fairbairn:** The lady.

**Fairbairn:** Right, yes. So, we got mixed up in that. Yeah, I forget-- I don’t remember the details. But that was an issue. But anyway, we ended up getting loan guarantees to buy fab equipment from them because they also wanted to be part of it because they wanted our consulting help to build their own fab. And so, that sort of got the thing started. And so, then we started going. So, then it was like, “Okay, what do we do now?” So, we raised ten million dollars, moved into an office on Scott Boulevard in Santa Clara where so many other companies have started, got it going in January. Q.T. Wiles was the chairman, difficult guy to work with, I guess. Bill Hambrecht was on the board, anyway. Dave Evans was on the board. So, the thing I started doing was started teaching VLSI design classes and using the tapes that we

  

had developed at Hewlett-Packard while we were raising money. And we hired Andy Haines. You may know Andy Haines?

**Laws:** Andy Haines, sure.

**Fairbairn:** As our first marketing guy to market our VLSI design courses. And I would-- we would get people signed up from various companies all around the country, even around the world, who wanted to get involved in understanding this whole world of designing their own chips.

**Laws:** So, you must about 1981 now then?

**Fairbairn:** This is 1981, yes. So, during most of 1981, we were doing that in order to generate-- that generated some money. But the whole VLSI thing was going to take a while to kind of buildup. I mean we had to get people up to speed. We had to design chips. We have to get them into production. So, this is known to be a long path. But in the meanwhile, the other founders of the company were very embedded in the ROM market, having been at Synertek, and had Atari and Apple and others were primary customers of theirs. And they became-- they were huge users of silicon in those days due to the game market. So, we hired a couple of the sales people that had been involved in that. And so, we actually started selling ROMs before we even had them through the magic of sales. And we hired a couple people from Synertek, a couple of the ROM designers from Synertek, who were guru ROM designers. And they churned out these ROMs. And we got fab done at Ricoh I think initially because we had a relationship with Ricoh as well. And we very quickly ramped into very high volume production on ROMs within months or first year or two. So, the first year-- let's see, it's '81. All I know is that by '83, we were doing thirty million dollars a year. I think we were doing like--

**Laws:** And that still had to be ROMs,

**Fairbairn:** It was all ROMs. It was all ROMs.

**Laws:** There's about three year designing cycle for some custom circuits.

**Fairbairn:** For other things, right? No, the other things are much longer. No, it was all ROMs. But the secret-- so, we built up the business all on-- in terms of cash flow, on ROMs. But it was a cash generator because you only need one or two ROM designers and a couple people to go with it. And then you have these huge volume from the game designers. I know Mattel and Atari and others were just, through very, very good sales connections-- there's a whole other set of stories there.

  

**Laws:** Balletto was a good salesman.

**Fairbairn:** Yeah, but he had this other guy Ron Casper.

**Laws:** Casper, yeah.

**Fairbairn:** Sat in the guy's office and wouldn't meet with him, wouldn't meet with him, waited for day-- sat in his office for like two days and then finally caught him between meetings and stories like that of you've got to know the right guy and be persistent. And it doesn't matter whether you have fab or not. And it's like sign. Okay, we've got an order. Do we have a ROM? No, we don't. But we will by then. And we did. And it took flying to Ricoh at Christmas time and getting things packaged over Christmas holidays. People flying over the holidays to-- all the classic start up things that you do. But it worked. And we got it going.

**Laws:** So, in three years, you've got to what in sales, any idea roughly?

**Fairbairn:** Well, I know that '93, end of calendar year '93--

**Laws:** '83, you mean?

**Fairbairn:** No, I'm sorry, '83, thank you, ended with like thirty plus million in sales and a loss because we were also, at that time, building a fab. But the reason I remember-- and we've got to go back and tell some-- there's another very important story on the custom side. We went public in February of '83 in a period of rampant overvaluation of companies.

**Laws:** That's the best time to go public.

**Fairbairn:** Yeah, exactly. So-- and the valuation, we went-- we had thirty mil-- I remember these numbers. We had thirty million dollars in revenue. We went public with a valuation-- well, that was future revenue. That was going public in February on a revenue at end of that year of thirty million on a valuation of three hundred million.

**Laws:** So, ten times sales.

**Fairbairn:** Ten times sales. And we didn't talk about where the money was coming from. We sold the VLSI design story and-- that that was the future of design even though the revenues from that part of the business were miniscule. And the reason I know that is because-- okay so, in March of '82, we hired Al

  

Stein as the CEO to replace Jack Balletto because Bill Hambrecht knew that the market was heating up. And we needed to have an experienced CEO at the head. And Bill Hambrecht said in August, “Go, in terms of getting your filings ready,” and that sort of thing. And in February, we hit the peak of the froth of the market. And LSI logic went out a month later or something like that. They did the same thing. But on the road show, it was Al Stein and myself. That was another great experience is going out on a road show where you get to go on private jets from European capital to European capital getting met by limos and all that sort of thing to get you to a presentation. So, I know what story was being sold because I was being dragged around as the chief salesman. And we weren’t talking about ROMs. ROMs were not a story that was going to sell. It sold a lot of chips, but it didn’t sell the markets. So, in the-- I didn’t look up the-- so, that’s sort of the early days and the story. And we were trying to get the VLSI design thing going. And we’re making some progress. But it was very slow.

**Laws:** So, you were, what, four-inch wafers, NMOS process?

**Fairbairn:** So, we got a fab-- yeah. So, when did the fab come up? So, we built our own fab right there on McKean Avenue-- Drive in Milpitas. And it was a four-inch fab initially, I think.

**Laws:** One micron sort of process?

**Fairbairn:** No. Oh, one micron. Yeah, it was-- yeah, around one micron, probably. Yeah, probably around one micron. And so, it was-- and the argument was you needed your own fab to-- by 1983, we called it user designed VLSI. By ’83, there was another term. It was ASIC. The term ASIC got invented in ’83. And so, we were one of those companies. And those were viewed to be-- the ASIC companies were viewed to be the companies of the future. And everybody wanted to jump on board. And everybody jumped into the market. I mean Intel even jumped in the market and Fujitsu and LSI Logic and everybody. And so, there is another story that most people don’t know is that I believe in 1982, meanwhile we had started developing a whole set of design tools because the only thing out there was Calma. And you couldn’t sell a VLSI design story on Calma systems. So, it was understood that we had to develop our own CAD tools because that’s the only way we were going to sell this story. So, the first group that we hired was a whole group of-- I hired Jim Rowson to head up the CAD group. And then he started hiring a whole plethora of people to develop CAD tools. And we started working on Apollo workstations, actually first on a VAX, and then on Apollo workstations. We were one of the first customers for Apollo. So, the big engineering group I was responsible for initially was the CAD group. And sometime in ’82 on into ’83, Steve Jobs came to us because Jack Balletto had a relationship with Steve Jobs, having sold him 6502s and other products from Synertek. And so, and in fact, we had a battle story gem that Jack likes to tell is that we, at VLSI, were trying to hire this guy, Bruce Horn, from PARC, who had been one of the guys working on the NoteTaker, on the software side of the Notetaker with Dan Ingalls. And we were trying to hire him at VLSI. Meanwhile, Jobs was trying to hire him at Apple. And he was, “Oh, I don’t know which to do.” And so, Jobs came to Balletto and said, “If you hire that guy, I’ll never buy another chip from you.” Jack said,

  

"Okay." It was actually best. I think Bruce was better suited for Apple than whatever. So, he was the one that developed the Finder in first--

**Laws:** Right.

**Fairbairn:** He was the author of the first Finder. His name is on the first-- so, we had a relationship, however it was, with Jobs. And so, somewhere in the '82 timeframe, and I don't know the exact date, when we were still developing design tools and they really weren't in any shape to do any chip design, Jobs came to us and said he's working on this new product called the Macintosh. And they couldn't meet the specs for the display driver with TTL logic. And they were wondering if we could do a custom chip that would replace all of the TTL logic in the Macintosh. And A, it would be a cost reduction because to replace all the individual chips, and B, a performance enhancement because they were having trouble figuring out-- they couldn't figure out how to meet getting enough characters across for the first Macintosh. So, we said, "Sure. Whatever it is we can do it."

**Laws:** We'll figure it out later.

**Fairbairn:** We'll figure it out later. So, we started out working on this. And it wasn't all that complex a chip. But for that day, and for that time, and for where we were, it was a big nut. And there was-- Burrell Smith was a designer for Apple. Do you know that name?

**Laws:** Mm-hmm.

**Fairbairn:** So, he spent a lot of time with us. He was the one trying to figure out how to make the logic work. So, he came over and worked with our designers to try to work out the LSI implementation of what we called the Burrell's something or whatever. It was the BAM or had some name with Burrell's name in it. And so, we started out with first some designers. Then we said well, we weren't making the progress we needed to make. So, it was pretty-- at some point, it became an all hands on deck. This was put all resources on this chip try to get it done. And in the end-- and this program was called Bagpipe. I don't know where that came from, but anyway it was called Bagpipe. And it obviously had huge priorities. We're going to be part of the next generation of Apple. And so, we actually completed the chip. The first one worked, although it didn't meet the speed specifications at temperature. But it was clearly possible. It was clearly okay, this was possible to do. And there's another guy I don't know if you've talked to or not, Martin Haberli. I may have mentioned his name. He was at Apple at the time. He was at PARC before that. And he's still around. And he was sort of the guy at Apple responsible for integrating the Bagpipe chip. So, he was the liaison and was the one. And, as I remember him telling the story, he says, "We could have made it. It could have worked." But Apple, the Macintosh team, was having trouble where both the hardware and the software were slipping. And Burrell had finally figured out a way to meet the display spec with TTL logic. And they needed to stop one of these things from slipping. So, the software guys

  

were using the hardware guys as an excuse and vice versa. So, he said, “We needed to stop. We needed to nail down the hardware so that the software guys didn’t have the excuse of the hardware slipping anymore.” And so, they said, “Okay, forget that. We’re just going to go with the standard product thing.” And so, that was a crushing blow. That was. We had put everything we could into it. We had almost gotten it. It would have changed the course of the company as well as Apple. I mean Apple would have had a different product. It would certainly have changed the course of VLSI to have a custom chip in the first Macintosh.

**Laws:** Even though the Macintosh took a long time to take off, in general.

**Fairbairn:** Yeah, but it wasn’t the volume of that. It would be the story that went along with that.

**Laws:** Yeah, the reputation that came from it.

**Fairbairn:** It would be the reputation of that. And a little too little too late kind of thing. So, that was a crushing blow. I was personally-- I was responsible for that. And it didn’t work.

**Laws:** Which is why I killed every custom opportunity tried to come into AMD.

**Fairbairn:** Yeah, it’s hard. It was hard in those days. So, over time, we built the custom-- what we were doing became known as-- the ASIC business became known as the cell-based business.

**Laws:** Cell library.

**Fairbairn:** Cell libraries, and LSI was pushing the gate array business. And so, we were competing against each other for market share. And we would try to sell people on the cell-based approach. They would try to sell people on the--

**Laws:** Gate array--

**Fairbairn:** Gate array approach. And they had a much better short-medium term strategy in the sense that you could ramp up the designs. You could-- they didn’t have to change their methodology much to get people designing gate arrays. Ours was a massive change in methodology, big training thing, big risk. They could get people designing gate arrays much more quickly and turn them more quickly as lower cost of entry, lower-- it’s an easier sell. And so, they were able to ramp revenues faster on their ASIC business than we were able to. We then realized, after a few years, well we really need to be in both. So, we got into the gate array business. And they realized they needed to be in both. So, they got into cell-based

  

business. So, we both ended up in the same ASIC business fighting each other. And the bottom line was that the ASIC business was supposed to be this cherry business that generated a lot of profits. But because of two factors, number one the competition, everybody trying to get into the business fighting for the design starts. Everything was about getting design wins. And you didn't worry about production or when it was going to come or whatever. All you cared about was getting a design win. And so, you would give away things, give away tools, give away-- do whatever to get design wins. And then sometimes the production would come. And sometimes it wouldn't. It always took longer than you would have liked. But it was faster in the gate array business than it was in the cell-based business. But it was more than that. So, in order to be in the ASIC business, you had to have the latest tools. So, it meant huge investment in design tools. You had to have-- they didn't want just the standard packaging. They were doing weird stuff. And so, you actually had to have some advanced packaging technology. And, oh by the way, three or four month turnaround time was not it. You had to have a wafer fab that would turn product quickly as opposed to long term and more cost-effective. And you had to have people holding their hands while they did their custom design. So, ASIC turned out to be a terrible business because it was a long lead time. It was very engineering intensive in terms of all the investments you had to make, tools, and that sort of thing, and tools, packaging, turnaround time, and-- so, although we were successful, and you could make money, it was not the cash cow kind of thing that we set out to be. And in fact, we all ended up straying from that in order to make money. I mean Intel got into it and then got out of it. Other companies-- it became more of ASIC design methodology as opposed to the ASIC business. You want to take the ASIC methodology and apply it to what then what emerged was the application specific standard product business, which was more of standard products designed with ASIC. So, it became a very clouded kind of business. And was this ASIC or is this ASSP? And both the VLSI Technology and LSI Logic developed standard products and developed cores that they could embed. The original ARM core was designed on our tools and fabricated at VLSI technology in 1985. And we actually had I think the first license to it to market as a core. And VLSI actually-- one of its strongest things was it became, due to the work of our European group, it became a leader in wireless and cellphone technology and chips for wireless because of the ARM core and because of our team that was in Europe where original cellphones were being developed. And so, one of our strongest suits was our standard products in the mobile and wireless space. We also branched out and created a division that was doing IBM chipsets, PC chipsets, much like Chips and Technologies and others. That group was started up in the Phoenix area. So, my progression through VLSI Technology was first running the CAD group and VLSI education group, and that sort of thing. And then I took over all of the design activity. And eventually, I took over all of what became the ASIC division. So, I had all of the product responsibility for everything happening in ASIC. We developed a whole series of design centers to help support the customers in the field in both the U.S. and in Europe. We had special packaging. We had special product engineering and all that. And so, it was a successful, profitable business. But it was not the kind of profits that you would like to write home about. And in parallel with the ASIC business, VLSI built up the ASSP business in certain targeted areas like wireless technology and the PC chipset business and all. So, as the ASIC business grew, and evolved, also what happened during the '80s was that at the beginning of the '80s there was nothing but Calma and Applicon when it came to design tools. But in '81 Daisy/Mentor/Valid all started. And by '82/'83, they all had some sort of products, first Solomon Design Systems, and then various other companies. But SDS merged with--

  

**Laws:** EDA? [ed note: ECAD]

**Fairbairn:** EDA Sys--. No, the guys that did the design rule checker, Dracula. SDS merged with ECAD. Anyway, they merged to form Cadence. And so, Cadence came to be in the second half of the ‘80s. And there were just all these companies, the proliferating design tool business. And we, as an ASIC company, were facing this classic problem of are you a chip company or are you a design tool company. Do you give your design tools away to get the chip business? And constantly struggled with that. And it was constant-- whereas, we were doing leading edge CAD technology in the early ‘80s. In the later part of the ‘80s, it was hard competing and recruiting people and being everything to all people, right?

**Laws:** And having to interface with all these different external systems.

**Fairbairn:** Yeah, at first it was just our own. And then you had to interface with external systems. And so, it became clear to those of us managing that group that we needed to do something different. And we still had some very attractive design technologies, some very unique design technology. But it was not going to-- we were not going to stay competitive. So, in the-- I don’t know when we started it, but the ’88/’89 timeframe, we started a conversation with Cadence and [Joe] Costello and reached a handshake to create a joint venture with Cadence where we would spin off our design tool business as a separate entity. And VLSI would hold part of it. And Cadence would hold part of it because they were still not anywhere in terms of routing. They were not experts in the physical design space. And so, they-- we really did have some good technology. And so, Al Stein, who was still the CEO [of VLSI Technology], said, “No, I don’t want to do that. I want to keep it--“ He still, I mean forever considered those the crown jewels of the company. I said, “Well, yeah they’re the crown jewels. But they’re kind of rusty. They’re getting kind of corroded on the sides. And we need to do something different.” But he didn’t want any part of that. So, myself and my key management team just said, “We’re fighting a losing battle if we keep it inside. The reason we want to do this is we don’t think we can stay competitive. We think this is a losing track.” So, if we we stay on this track, it’s like well, this isn’t the track we want to be on. So, we basically left in late ’89/’90. I forget exactly the timing.

**Laws:** ’90, you have here.

**Fairbairn:** Yeah, ’90. It was probably ’90. And so, I was at VLSI from ’80 to ’90, so to keep it nice and clean. But we could see the handwriting on the wall. We just didn’t feel that that was the thing. So, we just-- Al Stein was a difficult CEO to work with. And so, we decided he wanted to go a path that we weren’t on. And so, we left. We didn’t have a clear--

**Laws:** So, how big was VLSI when you left it, just a sort of frame of reference?

**Fairbairn:** The ASIC business was a hundred and fifty million dollars.

  

**Laws:** Okay.

**Fairbairn:** VLSI, I think, was several hundred million dollars. I don't remember. I think it peaked at seven hundred million. It was bought by Philips in '97. And I believe at that time, it was seven hundred million dollars. And the reason-- the primary reason Philips bought it was because of its capability in the wireless space, the work that had been started early on. And so, we left. And when I say we, myself, Jim Rowson, who was by then sort of more of chief technology officer type position, and Dan Yoder, who was-- headed up marketing. And then various other people left at other times. But we left and without a clear idea as to what we were going do. But it was like-- well, time to go. And we'll figure something out. And so, we then took some time off and then formulated plans for Redwood. And--

**Laws:** Were you still unmarried by this time, still?

**Fairbairn:** No, I'd gotten married in '84.

**Laws:** Okay.

**Fairbairn:** During VLSI. So, I had sold-- so, the killer years were '81 and '82 when I was doing both the magazine and VLSI as an ongoing company. So, I'd work all day at VLSI and then hop over to the VLSI Design office. And by then, I'd hired Jerry Werner, who as the editor for CMP, I think, or EE Times at the time. So he was doing all of the editorial work for VLSI Design magazine. And I had a little company going there. I had a business manager and we had hired reps to sell advertising and had Jerry doing the editorial work. And so they were a team of four or five people that I had to pay salaries to and other things. By then the magazine as generating some of its own revenue but it was still a losing proposition. So I was very glad to be able to from both a financial point of view and from a-- it's like I never was a magazine guy. I never really understood the publishing business. I mean I understood it well enough to get it started and so forth. But I said it was definitely time to hand it over to somebody who was better at it than I. And somebody who was willing to continue to make whatever investment and could leverage what we had done. So that was a pretty successful-- it was considered a good property at the time. And it suffered the same kind of fate that what it was pushing and became mainstream over time. And the challenge that later owners of it faced was in the beginning it was clearly differentiated from the other mainstream publications. But all of a sudden what it became was mainstream. And so then what it was publishing was, you know, how do you differentiate it from the mainstream publications? And so it kind of got merged in, got changed to VLSI Systems Design and become more of a mainstream publication. And then was embedded in EE Times. And it went through a various kind of iterations but it survived quite a long time in various forms but eventually sort of got swallowed in the greater world of VLSI; much like the ASIC business within VLSI Technology became swallowed within the main-- it became mainstream. It didn't become the thing, a differentiator. It just became one aspect of the business.

  

**Laws:** So how did you formulate a strategy at Redwood? What did you focus on?

**Fairbairn:** Yeah, before I do that let me see if there's any other VLSI stories that were-- we need to touch on before we do that.

**Laws:** Was Henri Jarrat at VLSI? There must be some stories there.

**Fairbairn:** Yes. So Al Stein was the CEO. And I think he kept trying to hire a president and he hired people that he knew and people that knew him from Motorola or TI. So the first one was Jim Fiebiger. I forget whether Henri Jarrat or Jim Fiebiger. Anyway, he hired one of them let's say Jim Fiebiger who was at Motorola, a high level executive, had worked with Al before. Came in as president, COO and left after a year or two. Couldn't work with Al. Al was too demanding and too-- wouldn't let go of the reins. So Henri Jarrat comes in or maybe it was the other way around. Comes in and same cycle, you know. And let me see Henri Jarrat was-- yeah, I think Henri was first because one of the things we did with Henri Jarrat was being a foreigner himself he was from Morocco. He was a French citizen, I think. But very charismatic but very European oriented and said, "We need to establish a design center in Europe." And so we were one of the very first people to establish a remote design center, software development center and we did it in Sofia Antipolis which is in the south of France, in the hills outside of Nice.

**Laws:** A beautiful place.

**Fairbairn:** It was a beautiful place and they were just starting up as a place to do this sort of thing. And it became quite a successful outpost.

**Laws:** IBM was there at some point.

**Fairbairn:** I mean it was a great place to be. And the idea was, you could recruit anybody to Sofia Antipolis. Right? People wouldn't come to Paris necessarily but they would go to Sofia Antipolis because you're outside of Nice. You're on the coast of France. You're on the Mediterranean. This was heaven. And it was true. We recruited people from everybody and we built up a remote development center there and for both originally software. And we had software configuration matching, going across the very primitive high communication lines between there and here. And so it was-- so we were on the cutting edge in terms remote development centers and how you manage those and how you joint develop software and that sort of thing. And it became both a software center and a chip design center. And was the primary reason why we became so successful in that cellphone space because that's where it was all happening. And that's where the ideas were. And that's where the customers were. Guess what, that's where it happened. And so it was a classic case of being with the customer developing things with the customer and things happened there that would never have happened in the U.S. alone. And so that was an important step along the way. And we did get a lot of grief about where we located it. But it was

  

actually for a good reason. It actually worked out. And that center is still there. I think whatever Philips has done, whatever, that place survived. And so that was one of the successful things. And the whole European operation actually became a very successful part of our operation. And, in fact, I did want to cover another thing was that so the guy that was running Europe, was a guy named Dieter Metzger and German, obviously. And he did a very good job. And he managed it and developed it. And then when we left, Al brought him over to the U.S. to spin out the design automation group as a separate organization. So we weren't willing to do that. We thought it was too late to spin it out as a separate thing. If we had done it two or three years earlier, maybe, but doing it on your own we thought was a mistake. So Al said, no-- he agreed that spinout but he wanted to have a wholly owned subsidiary of VLSI Technology. So he brought Dieter Metzger over to do that and they established Compass Design Automation. And they spun it out. And it survived for three or four years and it did okay but it was too late. If we had done it earlier-- so eventually that folded. It got bought by Synopsys, I think. So I think we had the right strategy but didn't implement it that way. So that's what happened with that. And so I think that's the-- the important thing is the ASIC business became sort of mainstream. It turned into ASSP. What turned out to be valuable was earning-- was owning IP [Intellectual Property], owning building blocks and owning intellectual property. In the pure ASIC business, you didn't own any intellectual property. That all belonged to the customer. And you had no leverage with the customer. And all you were was a-- they were just buying silicon by the nanometer. And it became a price per area kind of business and it was not a very-- plus it had this high engineering overhead. So that's sort of what happened there, some interesting developments in terms of the whole evolution of the methodology. The design methodology sort of morphed into a mainstream kind of approach. Pardon?

**Laws:** A commodity business.

**Fairbairn:** Yeah, and became back into a standard product business but in a more targeted standard product business, what became known as Application Specific Standard Products (ASSP), where there was more specialization, more focus. And all of these companies, Broadcoms and other people have built huge companies based on very targeted things. And I think most of those you could go back and find roots going back to these same days. Right? So anyway so we split. And I took a few months off. And Jim Rowson-- I give all of the credit to Jim Rowson in terms of coming up with a strategy in terms of the next-- you know, for the strategy of Redwood. I came up with the name.

<group laughter>

**Fairbairn:** Redwood Design Automation. Do you see a pattern here? <laughs> And I remember the discussion. They weren't necessarily bought into it [the name] but Jim and Dan Yoder, the other two founders, they weren't bought into it. But it's like just use it now, we'll change it later. Right? Of course, you never get around to changing it. <laughs> And it turned out to be pretty good. It's not a bad name. But yeah, that name came from the same place as Redwood Systems Group which is the publisher of

  

Lambda Magazine. It had all sorts of nice connotations in terms of straight business that last forever and resistant to fire and all sorts of things that you could…

**Laws:** It wasn't shrub automation.

<group laughter>

**Fairbairn:** Yeah, exactly. Stood tall. Anyway, so we started Redwood. And the goal was to move up the design technology space. And we coined the term system level design methodology as opposed to RTL, registered transfer level. We were going to go to the next level. That was the overall goal of the company. And the first product was to be a functional-level simulator, that could read VHDL or Verilog code but simulated at 10X or faster the performance. And so be able to simulate things much faster, much more easily and be the first step in terms of doing real system level design methodology kind of stuff. And based on the work that we had done at VLSI Technology and the fact that design technology although it hadn't been necessarily commercially successful it was widely recognized as being sort of technology wise very good. And the people there knew what they were doing and we had built successful businesses and so forth. We were successful in raising venture capital to start the company pretty quickly. I don't know how long it took but it was pretty fast.

**Man 3:** Who from?

**Fairbairn:** Well, the two lead people were Mohr Davidow and U.S. Venture Partners. So both Irwin Federman and Bill Davidow were on the board. And Sequoia. Sequoia did not have a board seat. Mark…

**Laws:** Yeah, Mark Stevens.

**Fairbairn:** Stevens, who was a young guy at the time. He's now gone through his whole career and retired. But so Irwin and Davidow offered wise counsel but were only there at board meetings. Mark Stevens wasn't so buried with other things and was more of our go-to-guy when we wanted to get a board level input. He was a board observer. But he was more available and more involved in the business and all. So he was our chief-- he was our main go-to-guy on a regular basis in terms of getting board kind of guidance. So but Irwin and Davidow were both very-- Irwin especially was very wise counsel. Didn't take very many words but he did-- so we got going. We built a substantial operation. We took the lead in one of the first companies to locate a software company in downtown San Jose. We were on the third floor of a building above Gordon Biersch [brewery]. So that was pretty unique. Now being downtown is a common thing whether it's San Francisco or here, but then it was completely-- you know, we looked at a lot of places and said, a software programmer wouldn't walk into this place, these lawyer type places and that sort of thing. So we had to find a place where we felt that programmers would feel at home.

  

<group laughter>

**Laws:** There's a brewery downstairs.

**Fairbairn:** Well, the brewery helped. Right. But even so you had to have the right thing. So we built it out in a very nice place and people were very happy with it. It was a great location. So it was fun and it was a good way to attract people. It was a good unique thing to be doing. And we got a lot of talented people and built a nice organization. The product was a little too little, a little too late relative to the competitive products [which] moved ahead more quickly than we might have anticipated. Our product wasn't quite as good we would have hoped either in performance or ability to absorb all of the elements of the VHDL or Verilog we wanted to be able to simulate. And unfortunately in some cases it became a style thing. Well, if you write it in this way you will get a lot higher performance which was true. It also turned out that you get a lot better performance using the design tools they already had. <laughs> so it was sort of a win-lose proposition. So it was-- you know, we got a product out. We sold the product. But it just didn't-- we did raise another round of venture capital. We raised $5M in the first round, $5M in the second round. But not too long after the second round it became clear that this was not going to be a long-term success. So we ended up selling to Cadence. And that turned out to be an incredibly wise move for reasons that were not obvious to us at the time. In '94 we sold to Cadence. So we ran it for about four years, from '90 to '94 and we announced the sale at the '94 Design Automation Conference at which I was the keynote speaker. And so that was when we were rolling out that story. So Cadence did the wise thing-- a year before they bought Redwood they bought Comdisco Systems. Comdisco Systems was a company focused on very high level design for digital signal processing algorithms, high level design digital signal processing, which is a great tool by itself but didn't lead you anywhere. Once you got done doing the design and getting the algorithms right for wireless things and so forth, you still had a big gap between them and implementation. And the people there didn't understand anything about IC's and implementation. So what happened was Cadence and Lucio Lanza, who was the chief strategic officer there at the time thought that putting Comdisco together with Redwood, who were high level people that understood the implementation space, but we were close enough to these guys who understood the algorithmic space. If we could just put those together, maybe we could provide a whole chain from very high level down to very low level. And that turned out to be a great strategy. And it turned out timing is everything. So this '94, '95, '96 and this was when wireless was really taking off. Cellphones were taking off. Wi-Fi was taking off. Everybody wanted to do wireless design. And so the stuff that Comdisco was doing was great. And Joe Costello, the CEO at Cadence, at the time did an incredibly wise thing. He says, I don't want you to have anything to do with Cadence." He says, "You've got a different name. Because people associate Cadence with physical design and whatever. They won't understand this space. It's a different set of customers, different language, different everything." So for almost two years we ran as what was called the Alta Group within Cadence. When we went to the Design Automation Conference, we had our own booth. We had our own sales force. We had our own order entry. We were a standalone unit. And in the end the numbers got pulled into Cadence but that was about it. So at first we were located where Comdisco was, which was up at Highway 92 right at 92 and 101, on Hillsdale Boulevard or whatever. And the weird thing about that was those of us coming from Redwood thought this was just too weird. This was so far out of Silicon Valley. How could you possibly do anything technical in this area? And the coup de grâce was you could

  

not get a subscription to the San Jose Mercury News in San Mateo. So we were divorced from Silicon Valley!

<group laughter>

**Fairbairn:** Now, contrast that today as there has been an incredible change. So we were there for-- that's where Comdisco was and we [Redwood] moved into that space. Eventually, after a year, a year-and-a-half we moved into a space over off Maude and Matilda right at the corner there which were very nice buildings, relatively new. In the last year, it's been flattened and Apple has built this multistory thing there. The buildings that were there were fairly new but it was like well, but if you can build one building with six stories on it instead of whatever. But we remained a separate operation. Costello said, "Keep it separate." And we grew from a combination of about $15 million between the two of us to almost $50M in two years. And we were-- we learned from each other. We built bridges between the products. We had the right story to tell. We had our own dedicated sales force to tell the story. Great. We got to $50 million and the organization within every company that kills a merger is the sales organization. Because the sales organization says, especially the VP of sales, says, "I want control of the sales process. I need to own the sales process. You can't have them going into the same customer as I'm going into." And so Alta was merged into Cadence, you know, common sales force, everything else, common order entry. It also became-- well it never became specialists and all. But you know what, salespeople will not sell-- they've got a quota of $5 million. The ASP on the Alta Group products was $50,000, $100,000 whereas the product-- you know, the ASP on Cadence products was much higher. They aren't going to sell it. There's nothing you can do. You can beat them over the head. You can give them little incentives. The only salesman knows is that I need to meet my quota. The only way I'm going to meet my quote is selling this bigger product. I don't care what you tell me, "that's it". And so it kind of withered over time. I then moved-- Costello didn't want me-- didn't think I was the right guy to run this same merged group within Cadence, which is in retrospect the right answer. I would not have been the right guy. He had another guy he thought would do a good job. But it's just too hard. You can get the engineering group. You can keep them going but you cannot get a sales group to sell a product they don't understand that has a different ASP. They will not stand in front of the customer if they think they're going to get a question that they don't have the answer to. And they aren't going to sell a product that has an ASP that is radically different than theirs. So they did all sorts of incentives and orders and this and that and it didn't matter. Wouldn't sell it. And so it was a classic thing of I'm convinced that this is what happens in any new organization, a new product coming up, has a new sales process, has a new ASP, has a new set of customers, even though they were selling to the same companies it was a different group in the company. You were selling to the architects versus the IC designers. And they speak a different language. They are in different buildings. And the salesmen won't call on them. And so you can have specialists, you can have whatever, it doesn't work. So it was another lesson along the way about how hard it is to introduce a new product into an ongoing organization and why startups get stuck on one product and no matter how hard you try getting to the next generation always comes from another startup because you can't-- doing new product…

  

**Laws:** Yeah, occasionally you'll find an applications engineer who falls in love with your product. You find this one guy in the whole company that can sell it for you.

**Fairbairn:** Well, exactly. So there are ways but the sales organization is a much bigger barrier than the engineering. Engineering, you can have a separate group of guys. They go off and work on it, and develop it that's fine. Sales organization is one organization. And whoever heads that wants to own everything. And they've got one set of quotas and that's what they're working on and so it's really hard. And so it was a very successful thing. It was the right timing. It was the right merger of groups. We had a lot of a fun. We all learned a lot from each other. One of the guys that headed up was the chief technologist on the Comdisco side, Bill, I forget his last name, was actually-- works on-- I see him very once in a while, he works [at CHM] with the restoration team. And so I see him every once a while, "What are you doing here?" And actually that whole-- you know, those products actually got spun out and survived. There are still some people selling those products as a separate little group on the side. But it was a great ride from '94 to '98. So I ran it from '94 to '96 as the general manager of that group. And then in '96 I was taken off from there and I did another startup within Cadence, a little startup. By that time, they were working on-- they were saying, well, you can't make money selling design tools. It's a commodity business. We need to branch off into services. This is a major thing. Costello launched a major effort to get Cadence into the services business where they were just doing chip design for their customers. And so it was successful in some areas, and not successful in others. But it was clear, you know, chips were getting complicated and they were-- designing a chip not only meant hardware but software. And so Cadence had a bunch of people capable of doing hardware design, chip design but not capable of doing embedded software. So I said, we need to have a software services group. We need to have a group that can do embedded software for this sort of thing. So I did my search and went off and found a small company to buy that was doing embedded software and brought them into Cadence. And then separately Costello had another thing that he was starting that was the VSIA, Virtual Socket Interface Alliance. He wanted to launch a major industry initiative to develop standards for IP blocks, for IC standard interfaces for building blocks and IP which is a valid thing that we've since learned to deal with and have done. But in the meantime, we actually over a two-year period we actually took this VSIA organization from basically 30 founding companies which included Cadence and Synopsys and a couple of others, to over 200 companies. And we had meetings around the world. And so I was president of the VSIA and went around giving speeches and talking about the need for standardization of building blocks for integrated circuits. And in the meantime also doing this startup within Cadence. So those are the two major things that I worked on in Cadence from 1996 to '98. So I was kind of tired and burned out. In '98 my stock options were vested from when Cadence bought Redwood. It turns out that, you know, people really focus on startups but you can actually make good money on stock options if you get an established company at the right price.

<group laughter>

  

**Fairbairn:** Zero to $10 is just as good as $10 to $20 or $20 to $30. And so even though Redwood was not a good money maker. The stock I got from that-- there were a couple of other people that left Redwood and didn't join Alto Group and Cadence. They went off and did something flaky called Yahoo!

<group laughter>

**Fairbairn:** And, in fact, David Filo, one of the founders of Yahoo! was hanging around Redwood. He wasn't an employee of Redwood. But a funny story is that all I can remember is David Filo sitting on the chair with his feet up on the desk and I thought, what are you doing around here? What is this? And so well that turns into a $1 billion or multibillion dollars. Right? But two or three of the other people at Redwood signed on with Yahoo!, which was starting at the same time. Although Filo was not an employee, he was hanging around there recreating whatever. So lots of us found other ways to, you know, they turned out okay.

<group laughter>

**Man 3:** So you ended up retiring in '98 from…

**Fairbairn:** So I left Cadence in '98. And I sort of envisioned that I would retire and do some board level kind of stuff and that kind of thing. And the first thing I did was I took my family which was my wife and two kids and moved to Paris for four months. We rented a flat in Paris over the winter which was interesting. It's a negative in terms of weather, but it's like real Paris…[without all the tourists]

**Laws:** No lines at the museums.

**Fairbairn:** No lines at the museums. And dammit the holiday, all of these tourists, will you get the hell out of here? Those of us who live here find it rather-- so we were there until March and then came home. November to March. So it was interesting and fun time. And spent a lot of money doing that but it was a fun thing to do. So I came back and so this was now '99. It was startup fever and dot-com and so there are all sorts of companies starting up. And I got on the boards of two or three that failed. And I got on the board of one company Simutech which is doing VLSI related emulation stuff. And then they decided about a year later - the founder was Jim Morris - was too hard to deal with so they said, "Doug, why don't you take over as CEO." So I served as CEO for the company from July of 2000 to September of 2001. And the reason that's important is because it was an ongoing operation and generating some product and all but it was still struggling and trying to make a business of itself. And so we were trying to raise venture capital in the 2001 timeframe. And the last straw, last venture capitalist presentation was scheduled for September 11, 2001. And so I woke up that morning, and the company was located in Portland. So I was commuting to Portland two days a week and we had an operation down here and I would work here. So I had gone up to Portland in anticipation of this meeting that was to take place in Seattle. We were going to

  

get up early in the morning and drive to Seattle and do the presentation. And so I woke up in the morning and watched the airplanes fly into the towers. And so the other guy that I was traveling with said, "Well, probably not going to happen but we can't wait long enough to find out whether it's going to happen. Or it will be too late." So we've got to drive to Seattle. And by the time we got there, they said, no it's not going to happen. But we did have it the next day. So then we stayed overnight and drove by the next day. On the way back they called us in the car and said, "No, I don't think we're going to do this deal." And so then I was stuck in Portland because you couldn't fly anywhere. But we had to shut down the company anyway, so that company didn't survive. But I had my personal 9/11 shutdown story. A lot of other companies failing around that time in terms of being able access to capital. Subsequently I was on the board of a couple of other companies. One was Verisity, which was a public company. I served on the board, and chairman of the board of that for a couple of years. Moshe Gavrielov was the CEO of that, until Cadence bought that organization and removed me from that job. And there is a couple of other companies that either got bought or whatever that I served on the board of. So that sort of took me through the 2000s and I was sort of retired. And then about 2006, 2007 I got an introduction to the Computer History Museum. And actually I got a tour. A friend of mine and our wives bought a bid on a tour by Gordon Bell of Visible Storage. I think they paid $1000 or something for a personal tour of Visible Storage from Gordon Bell. So we got that and that's what got me started at the Computer History Museum. And shortly after that I started as a volunteer. David and I were talking about what's going on there. And when the Semi SIG started up, so I started as a volunteer with Semi SIG, and you were running…

**Laws:** I had the job that you have now. And it was either about 2006, 2007.

**Fairbairn:** Yeah, and John Toole was still involved at the time.

**Laws:** John was the CEO. And I did that for two or three years.

**Fairbairn:** And then you handed it to Rosemary [Ramacle].

**Man 3:** Rosemary, and I went more on the curatorial side.

**Fairbairn:** Right. So I was a volunteer for several years. And then in early 2012 Rosemary Ramacle, who was managing the group wanted to retire and she said, "Well, why don't you take it." So I took over staff director, Semiconductor Special Interest Group in 2012 - started that in 2012. Meanwhile I had started-- I had been doing photography for a long time but I took my first paying gig in photography in 2007. So I started taking my photography business seriously in 2007. Eventually, took over most of the photography at the museum. And then continued to do the Semi SIG stuff. And then John [Hollar] and a couple of other trustees were interested in starting the Exponential Group which was called the "Center for Entrepreneurial Company Building" (which is the original name )which is why it's not called that

  

anymore. <laughs> Nobody could actually ever say that. And anyway we got that off the ground and we got somebody to run that. So I continue in my roles in mainly oral history focus for both of those activities and doing my photography business on the side, which has become a major time activity as well. So that's what I'm doing. That's how I got from here to there.

<group laughter>

**Laws:** Long story, Doug. I appreciate it.

**Fairbairn:** I told people as long as the photography business was a chemical engineering problem I wasn't all that interested. Now, that it's an electrical engineering problem I could identify with it and make some contributions. So my goal-- actually, I tried to learn-- I guess, after retiring I had this urge to do something creative. I actually took piano lessons for two or three years. And I got to a certain plateau and then I just couldn't-- the input versus output was just not there. So I retired from piano classes and took up photography as my creative outlet. And that's turned out to a be pretty interesting business in terms of…

**Man 3:** Do you exhibit, Doug, in any kind of way?

**Fairbairn:** I don't exhibit. You know, there's the landscape business which lends itself to exhibits. And although I very much enjoy landscape photography it's very difficult to make any money in that business. And you do exhibits and so forth. So I've enjoyed that as a hobby. But I found out that you could actually make some money doing wedding and event photography. And I actually discovered that I really enjoy being part of activities that-- photography has gotten me into a lot of things that I would never have gotten into. And the wedding business is very different than the wedding business when I was growing up or getting married. And the different couples that I see coming together, and the families that I see coming together, each one is a fascinating story by itself. And it's very interesting socially and from a-- I enjoy people and I enjoy the stories. And seeing people come together and seeing families come together, some very diverse, some very different whether they be gay couples, or…. My favorite story is-- sorry to divert this to a photography story, but my favorite is the girl from Mongolia marrying the guy from Ohio. And they met in San Francisco. And they may seem an unlikely couple but they were very much in love and her parents are from Mongolia. And they were here for the wedding and they speak whatever you speak in Mongolia. But they were very much part of the thing and celebrating and passing around the milk that they have from yaks. And the father of the bride had done these paintings that were classic Mongolian landscape things and brought a Mongolian instrument whatever it is you call the string instrument that they play. And they were totally into it and celebrating. The parents from Ohio didn't quite know what all of this was. <laughs> Between San Francisco and Mongolia this was-- they were okay but just didn't feel at home. <laughs> So I thought, oh boy, this is…

  

**Laws:** Sure.

**Fairbairn:** …really-- and then the other classic one is two middle aged women who were getting married, who could get married, who had been together for a long time but who couldn't marry before. And got married in San Francisco. And her parents were from Texas, from Houston. And I thought oh this is a bad sign. How did this go? And he was the most-- he was in his eighties, I think. He could barely walk. But he was very happy to see his daughter happy and getting married. And walked them both down the aisle. And it was just such a– I mean these are all sort of heartwarming stories. And I get to go to all sorts of other events, also. I do event photography as well. So when the museum has events, when Netanyahu and Governor Brown were here I was the first one Netanyahu shook hands with because I was sitting at the door waiting for him to come in to get a picture with him and John and Len and so I was sort of standing at the side and John and Len were in front. He comes in looks around, looks at me, and shook my hand. And I said, well, I think these are the two that you want to be talking to. <laughs>

**Laws:** Obviously a trained politician.

**Fairbairn:** Obviously a trained politician. Jerry, another story. Jerry seemed very feeble and frail until he got on stage and then he was Mr. Energy! But I've gone to all sorts of other interesting events and things that I would not have been invited to or been part of. And I have learned a lot as part of this other vocation I have. So it's an interesting business.

**Man 3:** One more question, Doug. We've taken a lot of your time. What advice would you give a young person who is considering a career in technology today?

**Fairbairn:** Boy, you know, I've asked that so many times and I look at the situation now and, you know, the world is so different now than when I started. And I think of the-- when we started I was so naïve as a guy starting a company even into the VLSI days, I really didn't understand how the world worked and so forth. By the time I got to Redwood, that was fine, but I was already well into my-- I don't know how old I was, 40 or whatever. And so I look at the guys now in their twenties and I remember people coming in very young at VLSI and being somewhat wetter behind the ears than these folks. And encouraging them but a sort of wait and see kind of see how it evolved. And the aggressive-- you know, the age and aggressiveness and the way everything is happening now is so different. The VC world is different. The technology world is different. All I can say is that be prepared for multiple changes in your career. Meeting people is everything. I look at my-- even my world was pretty different but it still applies today is everybody, "Oh you went to Stanford." Well, Stanford was fine. I got a nice education. But it wasn't that. It was I met Alan Kay. I met all of these other people that I would never have met if I hadn't been at Stanford. And so it had nothing to do with the education. It had to do with the place and the time. And that was-- so being-- taking advantage and making use of all of the connections and the people that you can meet. And they're so farther advanced in terms of their understanding-- you know, the entrepreneurs today are so more-- are so much more prepared in many ways to take on the business and challenges

  

and still naïve in others. But be prepared for rapid change and multiple careers and don't get stuck in what you're doing. So that's about as far as I can get right now.

**Laws:** Thank you, Doug. I appreciate your time.

**Hsu:** Thank you.

END OF THE INTERVIEW

  