



## **Oral History of Nick Tredennick**

Interviewed by:  
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**Fairbairn:** So we're here at the Computer History Museum. It's June 4, 2019. I'm Doug Fairbairn, and I'm interviewing Harry L. Tredennick, otherwise commonly known as Nick Tredennick. He's played a major role in a variety of different computer and related activities over the past several decades, and we're here to discover the details of those. So Nick, welcome, glad to have you here.

**Tredennick:** Yeah, thanks Doug.

**Fairbairn:** So we always start out these interviews by going back to the very beginning. Where you were born, what your family life was like, who were they people or activities or things thought influenced you or steered you in a certain direction. So let's just start there. Where were you born, when were you born, and what was lifelike.

**Tredennick:** Oh my gosh. Okay, well I was born June 6, 1946 and <laughs>--

**Fairbairn:** Oh my gosh. We're coming up on a birthday here.

**Tredennick:** Yeah, two days I'll be 73. <laughs> So yeah, in Schenectady, New York of all places, and that's because my parents were World War II vets. They were in the army, both of them, my mother was a nurse, and my dad was a signal corps officer. They met in the Pacific and got married and had a bunch of kids, and came back to Schenectady, New York, where he worked for General Electric. He worked for General Electric from the end of World War II until he retired, 43 years, and so he's like, "You can't hold a job." <laughs>

**Fairbairn:** Yep, that's the way it was then. So what type of job did he have? Was he...

**Tredennick:** I'm not sure exactly what he did in Schenectady, but he was in an apparatus sales division eventually. He sold things like streetlights and turbines to-- he was an electrical engineer, he had a bachelor's degree from Cornell University, and then--

**Fairbairn:** So he was from New York? He was...

**Tredennick:** No, he was from Johnstown, Pennsylvania. In fact, we had a bunch of relatives that were killed in the Johnstown flood. And both my parents were only children and so they're like, "We're not doing that. <laughs> That was no fun." So--

**Fairbairn:** So how many siblings are there?

**Tredennick:** So I have four brothers and two sisters, and then we had two foster kids with us part of the time.

**Fairbairn:** Seven kids plus two, huh?

**Tredennick:** So yeah, we had plenty. I had an older sister and a whole bunch of younger brothers and younger sisters, so--

**Fairbairn:** So does that mean you had responsibility for looking out for these younger siblings? Did you drag them along?

**Tredennick:** Well, definitely, I mean we-- can you imagine, I mean the first one was born in June of '45, June of '46, May of '47, and October of '48, so when you have the fourth kid the oldest one is three years old, so yeah, I was changing diapers probably when I was six. <laughs> So...

**Fairbairn:** So what did you do as a kid? Did you just play outside and have fun and carouse? Or what was your life?

**Tredennick:** You know it's been too long since I was a kid but having all those brothers and sisters there was never any boredom for sure. Of course, my mom was an army sergeant, I mean I don't literally think she was a sergeant, but that's how she ran the household. So, we had a weekly work list and a daily work list and a rotation of jobs. Plus, she cooked out of an army cookbook, and there was nobody taking seconds, so I don't have any fat brothers and sisters. <laughs>

**Fairbairn:** You were raised in a military family, weren't you? <laughs>

**Tredennick:** Well, my dad was a really easy-going guy, but not my mom. <laughs>

**Fairbairn:** So how long did you live in Schenectady and--

**Tredennick:** We moved out of Schenectady in 1951. We moved to Oklahoma City, and we were there from '51 to '60, and then we moved from there to Abilene, Texas which is just about the end of the world. It's flat, it's dry, it's West Texas. I tell people you can see just as many trees there as you can in places around here, it's just that that one's 13 miles away, and that one's 7 miles that way. <laughs>

**Fairbairn:** So was your dad's job took you there?

**Tredennick:** Yeah, that was the reason. He drove all over Oklahoma when we were in Oklahoma City and then when we moved to Texas, I think he had West Texas, so he spent a lot of time-- because I think he sold primarily to the municipalities around there, anyway...

**Fairbairn:** So did the fact that he had an electrical engineering background influence you in any ways in terms of the path you took?

**Tredennick:** Well, yes and no. I've sort of bungled my whole way through life all the time. I never really knew what I was doing, and so electrical engineering was kind of just a... I mean, my science fair project was a radio one time, and a telephone dialer another time, but I don't think he cared what I majored in, and I didn't really know what I was going to major in. I didn't know anything about electrical engineering

or any of that stuff. Of all the siblings, I'm the only one that was even in any kind of engineering. So the rest of them went off and did other things like accounting or food service or teaching, but no more engineers. I think they figured one was enough, you know. <laughs>

**Fairbairn:** So going to high school or whatever, were there any teachers that you steered you in a particular direction or anybody that...

**Tredennick:** No. Like everybody, you can always remember your first-grade teacher and your fourth-grade teacher, and occasionally things like that, but I wouldn't say-- my geometry teacher was an interesting guy. He's a guy where you come into class one minute late and he says there are lots of reasons but no excuses. <laughs> So he was a very interesting guy, and he made-- I mean geometry was fun for me, I was in the math club. I was what they call number sense where you do these calculations for time and compete with other schools.

But now this is kind of an interesting thing too, and I think it was partly driven by economics and partly who knows what, but logistics I think. Actually, there are two sets of kids, right? There are the kids that are all bunched together and they're kind of a family, and then there are the late arrivals, and so the late arrivals are kind of special. So, I have one brother who's an only child, and one sister who is kind of an only child, and so they got different considerations from the rest of us, but the bulk of us...My dad-- if you go to his college whatever they call those yearbooks, he played everything. He played football, basketball, baseball. He was the consummate athlete.

Well, I think somehow that was enough for him. They didn't want any of us playing football or doing any of that stuff, and when he got old and had to use a shopping cart to walk around <laughs> I understand why, but I think it was more a logistics problem than anything else. And plus an affordability issue. Can't afford to sponsor all these kids doing sports, and then having to shuttle them all around. So you got seven kids you just can't do that, and so they basically said no. So none of us played any sports until the only children came along, and then one of them, we call her Buckwheat, but my sister's name is Mary, but anyway she played tennis, so she's the only family jock. Happens to be a girl.

**Fairbairn:** Buckwheat from the Little Rascals or something?

**Tredennick:** Yeah. And we still call her Buckwheat. In fact, my dad called her buckwheat. <laughs> So she signs her letters that way. I just got a birthday card from her so <laughs> anyway. So not much memorable for me through high school. I worked in the cafeteria at the school, because as I said, my mom was not a good cook, and actually one of the weekly rotating assignments was making the lunches for everybody for the next day. So I didn't want any part of that, so I worked in the cafeteria at school to get food.

**Fairbairn:** So it came time to go to college. Was it always obvious you were going to college? What was the--

**Tredennick:** Yeah, I think every single one of us, in fact all of my brothers and sisters graduated from college, and have at least one degree from college. So my mom's like well, yeah, you can. It was always just assumed that we can go to college or you'd be a ditch digger or something, <laughs> of course, I do more of that now than...

**Fairbairn:** You can do it by choice, huh?

**Tredennick:** Well, yeah, I mean it's part of the thing. Well, one of my hobbies is kind of recreational landscaping, but I live out in the middle of nowhere, and there's 10 families on the road, and we do our own road maintenance, <laughs> so I do as much ditch digging as I-- Anyway, we all decided to go to college, and so she said, well they said, get into a good college, we'll figure out how to pay for it, and so I applied to a bunch of good colleges and I got into Cornell for example, and I got the acceptance and they go, "How are you going to pay for that?" And I'm like, "You said.." And so they said, "Well we can't afford that."

And so my grandmother stepped up and said, well, I'll pay for it. And so they said no, that wouldn't be fair unless you're going to pay for college for everybody. So I couldn't go to Cornell, and so I ended up going to Texas Tech, which is where my sister had gone, and then after that one of my brothers went to Texas Tech, and another brother went to Texas Tech. And eventually another sister ended up there for her master's degree or her-- no, I don't remember. She was there for a while too. So I went off to Texas Tech, and basically-- this is my brother's line not mine, but he says, "You know, when I graduated from high school <laughs> my parents gave me a toothbrush and a suitcase, <laughs> you're on your--

**Fairbairn:** We wish you well.

**Tredennick:** So basically their attitude was we'll help the girls, but the guys are on their own, and so--

**Fairbairn:** Yeah, interesting.

**Tredennick:** They subsidized the girls, and we were on our own. So I worked my way through college. I went off to Texas Tech; I got a job in the dorm cafeteria for 20 hours a week and had another one at the student union for 25 hours a week, and I started majoring in electrical engineering. I'm going through school and I'm thinking, yeah, I kind of like math. I don't think I'm really an electrical engineer, and so I-- and then I found out about schools. There's like a school of engineering and a school of arts and sciences. So if I want to major in math I've got to go change into the school of arts and sciences, and I went over to do that, and it turned out there was a line like, well you can imagine. This was the fall of '64, '65, somewhere in there, so well everybody's going to college, and everybody dives out of engineering <laughs> pretty soon after they get there. So I looked at the line and I thought, well, I'll come back next semester, and I just never ended up getting back the next semester to do that. So, I ended up majoring in electrical engineering and graduating in electrical engineering.

And I actually had a plan. I wanted to go right through a PhD, I didn't want to stop. But, I wasn't able to do that. What happened was I got a bachelor's degree, and actually I should say I set the performance

standard for my class in electrical engineering. The department chair was a, well... who's a good dictator type guy? He was an authoritarian, and he taught all the freshman courses because he's like, "I'm going to filter this group out." And when I say I set the performance standard, I think he looked at me and said, "If you can't do it at least as well as that guy, you're not going to be here next semester." <laughs> So I kind of squeaked through the undergraduate program, partly I think because I was working a 45-hour week and--

**Fairbairn:** Yeah, you sounded like you had a full-time job anyway, so...

**Tredennick:** Yeah. <laughs> So then I stayed at Texas Tech for a master's degree, but my intent was not to stay for a masters, I was just going to keep going to school. In fact, I wanted to become a professional course evaluator. I liked taking courses, not that I did well at them, but just because I just enjoyed it, and--

**Fairbairn:** You liked learning, huh?

**Tredennick:** Yeah, yeah, I liked-- well, I can't really say I learned anything because my brain is just a sieve. So I do Audible... I listen to books all the time, and I was looking at my Audible. I've listened to, in the last 10 years, maybe a thousand books. And they're all, except for two, nonfiction. Science, astronomy, any topic. But I can't tell you anything from any of that. I mean it's just my brain doesn't work like-- <laughs> So that's actually my wife is wonderful, <laughs> and I married her because she's like my repository of all the... When we go to the doctor, the dermatologist for example, she can recite my entire medical history for the person, and so it works for things like-- and I take her to events, because she's like hey, that's Doug Fairbairn over there. <laughs> So I don't have to actually remember anything. So I actually graduated kind of on time. I mean, I graduated in four years, and the program at the time I went through is a 145 course hours. Nowadays they're like 120 hours, but it was a 145 hour program. They changed catalogs while I was there and brought it down to like 140 hours or something. But that was four full years and two summer sessions, and I had to go work in the summers. But I did stay for at least one summer, I don't think I stayed two summers, but I did manage-- well, I say I managed to graduate on time, but I had to take 21 hours some semesters which was a pretty good course load.

**Fairbairn:** That's killer, with a 40-hour work schedule as well.

**Tredennick:** Yeah, me working 45 hours a week plus the full-- and so it turns out sometime during that experience I had to fill out some kind of form that told how much time you were working and what courses you were taking and stuff, and I just filled it out. I'm a moron, I mean I don't understand what's behind all this stuff, so I just fill out the form and they go you can't be a full-time student and work 45 hours a week. So, okay, what do you want me to do? I mean, how many hours can I work and still be a full-time student? It turns out the answer to that is I think 43 or something. I don't know what the number is, but so I basically just had to say, because I couldn't afford to be part time, I had to get out, and anyway so I graduate, go-- but this is 1968, it's the peak of the Vietnam War.

**Fairbairn:** I was about to say this is Vietnam War time.

**Tredennick:** The Vietnam War time. So my choices are, I want a PhD, but I have to either get a defense related deferment by going to a Texas Instruments or some defense deferment place. So I ask, "is there any rule against joining ROTC as a graduate student?" It turns out no. So, I joined ROTC which got me two more years because now I'm in the two-year program for ROTC, and I'm the only graduate student <laughs> in the program.

But I know I'm going to get a commission because <laughs> I've already got the degree. So I'm trying to decide what to do and what service do I go into. So I go talk to the army because I think Corps of Engineers, my parents were both in the army, I should do that. So I go down to the, I don't know what they call them, the military science desk at Texas Tech. I walk into the army office, and I stand in front of the sergeant, and I stand there for like a half hour and he never even looks up.

I'm thinking well, maybe I don't want to go the Corps of Engineers. Maybe I'll go see what the air force is doing. So I walked down the air force office and I go, "I don't know anything about you guys, but you need any engineering guys," and the guy says, "No, no, we don't really need engineers that's-- actually we do, but it's competitive. But if you want a guaranteed slot, all you got to do is agree to become a pilot." I go, "I don't know squat about airplanes, I've never even thought about flying an airplane. Okay <laughs> I'll do that because of the guarantee." So it turns out that at the time I signed up for-- is this stuff okay?

**Fairbairn:** Yeah, yeah, this is good stuff.

**Tredennick:** So at the time I signed up for it, <laughs> they had discovered that if they paid for you to get a private pilot's license, it was cheaper to find out whether you're going to wash out of pilot training. So there were nine pilot training bases for the air force, and it costs a certain amount of money to move you from point a, wherever you graduated from school, to wherever the training bases are. At that time they had training bases in places like Lubbock, Big Spring, Del Rio, Laredo, Columbus, Mississippi, Randolph Air Force Base in San Antonio, Williams I think, I don't remember. Anyway, there were a bunch of them all over the United States, mostly in Texas, and there was one right there in Lubbock, but it turns out that it costs, I don't know, thousands of dollars to move somebody's family to a place like Laredo. Then if you flunk out of pilot training, they send you to supply school or something, and at that time the dropout rate in pilot training was probably, I don't know, for my class it was fifty percent or so.

They figure well, if we pay for private pilot's training lessons, then that's about at that time I think it was under a thousand dollars. The probability that you could graduate from pilot training if you could fly at all was much higher, and they could actually save money. So I was taking private pilot's lessons as an ROTC student, taking graduate courses, and I'm still working in the dorm cafeteria, and I'm working in the student union -- in the pool hall actually -- and it was kind of a good deal to work in the dorm cafeteria because I had no money, and when I say no money it's to the extent that I couldn't buy soap for example. I'd go into the shower and collect all the scraps--

**Fairbairn:** Put them together.

**Tredennick:** -- and make my own soap bars. <laughs> So because I worked in the cafeteria, I had access to cracked glasses, so I could take a cracked glass and fill it with soap scraps, and then I could break it out from around, now I have a bar of soap. And meals were a big issue for me too, because while I was living in the dorm, they fed us 20 times a week. So the only meal I didn't get was Sunday dinner, and it was fine for that. But when I became a graduate student I could no longer live in the dorm. I actually rented a room from someone for like thirty bucks a month, or I don't even know if it was that much, but I think it was thirty dollars a month, and then because I was working in the cafeteria I could buy meal tickets, and so I bought thirty-five cent meal tickets. I figured I could get by if I could eat one meal a day. There used to be people that would come to watch me eat <laughs> just because--

**Fairbairn:** Because you ate so much in that one meal, huh?

**Tredennick:** -- Tredennick's going to eat. <laughs> So come and watch me eat. Anyway, so I spent two years as a graduate student -- again working my way through. Then what happened at that time I kind of got caught up in the flying thing. It was okay, not that I'm a competent pilot or anything, but I liked the sensation, I liked sightseeing. So then I applied for a three year deferment because I wanted to finish a PhD, and the deferment came in and they-- Oh, I know what happened, I'm going to get the sequence right, or little maybe scrambled, but you'll get the idea in a minute. What happened at the end of that period is I was about to be commissioned as an officer with a potential to go to flight school. But I had to go take a flight physical, and so I went and took a flight physical, and I flunked the eye test. Well, at that time they were not talking anybody that didn't have 20/20 vision, and so they said, "Well, forget flying. You can have your three years deferment to finish your PhD, but you're not going to be able to fly."

**Fairbairn:** So they paid for your flight training before testing whether you could actually fly in the--

**Tredennick:** Well, I may have passed an eye test, but I don't think so, but I never wore glasses. I didn't know I couldn't see. Our parents didn't take us to the doctor. So actually, I hurt my knee one time when I was a kid, tore a ligament or something, and every time I tried to take a step in a forward direction I'd just fall over, and it was kind of painful. So I was walking around backwards for like three days. Finally they go, well I don't think this is going to heal itself. They took me to the doctor and end up wearing a hip cast for six weeks or something. Anyway, so we just never went to the doctor. I got to school not knowing whether I could see or not. <laughs> I just assumed everybody's vision was about the same.

Anyway, so I flunked the eye test, and I went to see the military science guy there and he said, "Hey, I think I can get you a waiver to get in pilot training if you'll dump the three year deferment and go in right now." So I said okay to that, I thought this shouldn't be a big issue because Reese is a pilot training base. I'm in Lubbock, why would they move me anywhere. I'll just go through pilot training at Reese.

So they accepted me, but they sent me to Laredo. Laredo is I think a thousand miles from Lubbock. I learned in the Air Force that the military service, and actually we'll get into the military service stuff because I think that's an interesting part of my career. <laughs> But we don't let judgment interfere with procedure. <laughs> And the procedure is you toss the dice and send this guy somewhere even if there's a pilot training base right next door. So, a thousand miles down to Laredo I go. You see Laredo in a lot



of Western movies, and I lived on a dirt street in Laredo, and I think the only misrepresentation there is that the streets aren't actually as wide in the real Laredo as they are <laughs> in the movies. But it's definitely out in the middle of nowhere. But that's good because if you're out with a bunch of student pilots, I was class 7108, You can always tell if somebody who went through pilot training, nobody ever forgets their class number. I mean it just doesn't happen. I think we started the class with about 90 people and graduated about 46, and it's a fairly rigorous program, it's 53 weeks.

**Fairbairn:** What were you flying?

**Tredennick:** Well, in pilot training you fly basically a Cessna 172 for the first six weeks or so--

**Fairbairn:** Oh, just light aircraft.

**Tredennick:** -- transitioned into a thing called the 6,000 pound dog whistle, it's a T37. It's a low wing Cessna jet, twin engine jet, and then you move into the supersonic T38. So you fly two and four ship formation aerobatics and all that stuff. Back in those days, now they may have changed pilot training since then. I was graduated from pilot training in 53 weeks. So I got there I think in May of '70 and I graduated in May or June of '71. I was the number one graduate academically but as far as flying not number one, <laughs> but it wasn't bad. I was about in the middle of my class, and so what happens, at least in those days, when your airplane assignments came out, the number one guy in the class got first choice of what to fly, and then typically the very top guys in the class, and the mix of airplanes could vary a lot class to class. But a lot of times the top guys, well, again, this is something that changes over time, but at the time I was going through the top slots went to either fighter guys, so they'd take a fighter airplane, the top guy in my class took an F106 I think it was. It's an air defense fighter. So the two choices for the top guys were either T707, which was the KC135 tanker, because we called it a T707 because that's what the airlines were flying. If you wanted to become an airline pilot, you go fly the multi engine KC135. Is that what they were?

**Fairbairn:** KC135 is what I remember.

**Tredennick:** Yeah, the tankers, and then the C141 transport. I kind of looked at two. One was what they called the bullshit bomber which was the light airplane that they flew over North Vietnam throwing pamphlets out telling people we were winning the war or something. Then the C130, and I chose C130. So my original assignment was a PACAF [Pacific Air Forces] C130 to Vietnam, but at '71 they were just starting to wind down Vietnam. So that assignment was changed before I left <laughs> for Vietnam. It was changed to a TAC, to a technical air command to Fayetteville, Pope Air Force Base, which is a suburb of Fort Bragg in North Carolina. So I went to Little Rock, Arkansas to train in C130s. I don't know how long. Then I went to jungle survival and sea survival, and so I've seen all the survival schools, and E and E [Escape and Evasion] and all that, and then went to Pope Air Force Base where basically we had a lot of pilots, but not too much flying to do, and because there were people coming back from Vietnam, well, actually this is a pipelining problem, right? I mean you've got a 53 week program training pilots and so you start a class every six weeks and they keep coming out of the pipeline at the rate you put them in until somebody says, hey, maybe we don't-- we're not killing so many pilots anymore, They're starting to

come back from Vietnam, let's shut this off, and so then they take fewer inputs but then you still got this huge output coming in. Plus the people coming back, and so it turned out the pilot squadrons were highly over-manned at that time.

**Fairbairn:** How long were you in the service before you went back? You finished your master's degree before you went into the service.

**Tredennick:** Yeah, and then when I went in the service, I didn't do anything but pilot training when I was in pilot training. Once I got out of pilot training, I started an MBA program night school, while I was in the squadron in North Carolina. I was only in for active duty for 25 months, and then they said, "Hey, we're doing this thing called Palace Chase, a Palace Chase program. If you can find a reserve unit that will take you, we'll let you out early with a two for one obligation." So at the time, and maybe this isn't relevant or anything, but at the time if you were just a regular officer in the air force or army you had a four year commitment, if you went through pilot training it was a five year commitment. Now I think it's six years or something, but from the time of graduation, and so from the time of my graduation I had a five years commitment in the service, and then they said, "Well, we need to get rid of some pilots so if you can find a reserve unit that'll take you we will let you out of the service now, and just we'll double your commitment in the reserves to a maximum of six years." And I'm going, well, let's see, I've been here a year means I'd normally pick up an eight years commitment in the reserves, but if I find a unit that'll take me, it'll just be a six-year maximum, okay. So I get out my encyclopedia, and I make a list of universities that I want to go to for a PhD, and I find the air bases close to them, and I start interviewing air base people and see if they need anybody. I found a ... University of Texas was pretty high on my list for graduate school partly because I'm a Texas resident, so I can get in-state tuition there. It was like fifty bucks a semester at that time for-- so it's like nothing.

Actually, while I was at Texas Tech I was a teaching assistant, research assistant, and I was maintaining a CDC 1604 there. So that was kind of my first hands on experience with computers. That was one that had mylar tape and the boot program was on mylar, <laughs> it was very--

**Fairbairn:** You had to reload it all the time, right? <laughs>

**Tredennick:** Yeah, yeah. We had tape machines that ran on vacuum pumps and stuff and had these big thyratron power supplies. We maintained all that, replaced transistors on the boards ... and so I got a little maintenance experience doing that.

Anyway, back to this pilot stuff. I looked at the schools I might want to go to, and University of Texas was right up there, and it turns out they were flying C130s out of Kelly Air Force Base in San Antonio, it's like 85 miles from Austin. I went down and talked to those guys, and they had been flying something else, C123s or something, and just transitioned into C130s and needed pilots. Well, okay, well they'd take me. <laughs> So I exited the service, got into the reserves. It turned out that it was a very nice time to do that because it turned out that the air force was moving all of its transport requirements to the reserve programs because it was like a fifth the cost of having active duty people hauling-- what we call trash hauling, hauling trash around the United States. So I got into the unit just as they were levying really

heavy requirements on the reserve units to basically haul cargo around the United States. So it turned out for the next 10 years I averaged 195 days a year of duty with the air force. That's a lot of--

**Fairbairn:** Yeah, I mean it's not like two weeks a year and a weekend a month like that, right?

**Tredennick:** No. Right. I mean, it's not two weeks a year and a weekend a month. Basically they sent out a schedule every month that said here are all the flights we need to cover this month. Just circle the ones you want, or circle the ones you're eligible for.

In that squadron we had three types of guys mainly. We had students, well, maybe it was four. We had students like me, graduate students, there was a guy who was working on a PhD in astrophysics or something. Anyway, and then we had guys that were lawyers, we had a lot of lawyers because they have flexible hours. We had a lot of airline pilots because again they work 10 days a month or something and draw a full paycheck and here's recreational flying for them. And then we had Guard bums, guys that just really didn't do anything else. <laughs> We had one guy who was a veterinarian, and he lived out of his car, he was a substitute vet. So when another veterinarian goes on vacation he takes over his office, and basically these Guard bums, as we call them, just spent their time flying pretty much full time for the--

**Fairbairn:** So do you get paid for this time in the--

**Tredennick:** Oh yeah, yeah, we did.

**Fairbairn:** And so what were you doing for the other 150 days a year other than--

**Tredennick:** Well, I was a full-time student taking courses as a PhD candidate, and I also had a--

**Fairbairn:** So what were you-- this is a PhD candidate in electrical engineering.

**Tredennick:** Yeah, I was in electrical engineering, and so <laughs>

**Fairbairn:** And so were you focused on any, I mean this is early 70s, so--

**Tredennick:** Yeah, so there--

**Fairbairn:** Any particular area that you were focused in or--

**Tredennick:** Well, it turned out if I look at the courses that I ended up taking, it was terrible because I had done the same thing at Texas Tech. I was trying to get into a PhD thing, and they say you need to take courses in four of these six areas, and so I'm taking computer courses and quantum mechanics and this and this. I get to Texas, and they go you need to take courses in four of these six areas, and I said I just did that over here, and they said yeah, but you're at University of Texas now, and you're going to have to take courses in four of these six areas... So, I ended up with way more hours than I needed. Unfortunately, I wanted to major in computing and logic design because in my opinion that's the simplest

of the electrical engineering disciplines because it makes sense. But I took more courses in quantum mechanics and these esoteric topics because I'm doing these four of these six areas things, and I had already done that once before. So I ended up-- I know nothing of any of those topics anymore, but antenna theory and quantum mechanics and-- but really my interest was digital logic design.

**Fairbairn:** So let's move on to the engineering side. So you were at that university. You didn't actually get a PhD, is that right?

**Tredennick:** No, I did get a PhD.

**Fairbairn:** Oh you did get a PhD.

**Tredennick:** Yeah, I worked for a guy named Terry Welch there. In fact I went into-- you have to choose an advisor, right? So I went in and talked to him, and he was an MIT PhD, and he was one of the guys that's looking at computing stuff. I go I'm kind of interested in-- I really want to get a PhD, but he says well, you're going to have to demonstrate competence in something, and I said well, how about incompetence, and he says been done already. I said okay, I kind of like this computer stuff, and we kind of settled on a topic. And I said okay, but I want the all-time rubber stamp committee, I want people that aren't even going to look at my thesis. Help me with that anyway." <laughs> And he was an excellent supervisor, I mean, I think he was, I don't know. I was the only guy that ever got a PhD under him, and he had lots of candidates I think, but I'm not sure-- I think I wore him down is what happened.

**Fairbairn:** So what did you get your PhD in? I mean, what was your thesis on?

**Tredennick:** My thesis was on the implementation of variable word length arithmetic, and I started out -- actually I was a research assistant as a graduate student, and I was flying with the military, and I was taking courses, and I was working on this PhD thing. I started out doing actually at University of Texas... The reason that Texas Tech had a CDC1604 was-- the University of Texas had bought a CDC6600. So the cast off then went to one of the second tier schools <laughs> from a money perspective. Because at that time the university available fund was one hundred percent University of Texas. I don't know how the Texas A&M managed to get in on that, but now those two schools kind of share that, which is--

**Fairbairn:** So what year did you get your PhD?

**Tredennick:** 1976.

**Fairbairn:** Okay, and you were still in the reserve flying a bunch and...

**Tredennick:** Yeah, and I--

**Fairbairn:** So what did you decide to do at that point?

**Tredennick:** Well, so I didn't know what I wanted to do. Like I said, I've never been a guy that knew what I was going to do. So I took a job as an assistant professor at the University of Texas. I thought it'll give me a year or so to kind of look around and figure out what I want to do. During that year, I'm teaching classes as an assistant professor and it's the biggest office I ever had. That office was larger than this room. I mean, I think it's the best office I ever had. <laughs> Partly I think it was because the way that the funding worked at the school was that they could buy buildings, but they couldn't-- some weird thing.

**Fairbairn:** You have capital equipment budget, but you don't have any operational budget.

**Tredennick:** Yeah, yeah, yeah, exactly. So they're paying me like \$14K a year or something as an assistant professor, and one day Tom Gunter walks into my office and starts talking to me about what I do, and I'm like well, yeah, I'm a computer guy. I like computer stuff, I've taught Fortran programming and logic design, and the physics of semiconductors, and things like that. He's like well, yeah, how would you like to work on a microprocessor design project and what do you think it would take to get you. Could you come over for like \$40K or something? I laughed out loud, because I'm just a naïve person and I'm making like \$14K and he says 40, <laughs> and I'm like you kidding me? So Motorola--

**Fairbairn:** I might even be able to buy my own soap bars at that point, right?

**Tredennick:** <laughs> Yeah, yeah, well actually, yes. I had actually glycerin soap at that time, because I'm signing up for all the trips to go to places like Puerto Rico and Portugal and Hawaii. I'm traveling all over the place for the military, and when you go into a place like Lisbon or someplace in Portugal you get glycerin soap for I don't know a nickel a bar or something. So, I'm buying cases of soap and-- anyway, I'm doing okay because I'm working like I say 195 days a year at the military and I'm a teaching assistant. I'm getting veteran's assistance because I qualified for the V.A. benefits, and so I'm actually getting by and--

**Fairbairn:** So was Tom there on a recruiting mission? Was he--

**Tredennick:** I don't know what made him come into my office and start talking to me. I think, yeah, I think he was recruiting, and so I signed up. I said sure I'll come over and work on the ....

**Fairbairn:** So University of Texas is in what city?

**Tredennick:** Austin.

**Fairbairn:** Yeah, it's in Austin.

**Tredennick:** Which is where Motorola was.

**Fairbairn:** Which is where Motorola was. Okay, so you just--

**Tredennick:** Yeah, that's where Tom was at the time.

**Fairbairn:** -- go down the street or whatever, yeah.

**Tredennick:** Yeah, yeah.

**Fairbairn:** So you decided to move over to Motorola, and it was specifically to work on microprocessor design?

**Tredennick:** Yeah, yeah, it was actually a project he was just starting and he called it MACS, Motorola Advanced Computer System. That was the name of the project when we started on it. My first assignment there he said, "I think we're going to have you do the on-chip cache." Well, if you know the 68000 it doesn't have an on-chip cache, and--

**Fairbairn:** <laughs> I was going to say that's--

**Tredennick:** You know at that time it was Tom's dream that maybe it would have on-chip cache, and then he says, "Well, but we're not really ready for that yet, so why don't you start looking at the logic design and the execution unit, and when we get somebody competent to take that over you can move off of that project."

**Fairbairn:** Well, how big was the team at this point?

**Tredennick:** Well, as far as logic designers or the whole team?

**Fairbairn:** No, I mean on the MACS program.

**Tredennick:** So, I don't know the real answer to that because I worked for Tom. When I got there John Zolnowski was there, he was a PhD in computational complexity from Stanford University, Skip Stritter was there, he had a PhD also from Stanford, and he had done a thesis on computer architecture of some kind. I think he brought Len Shustek's thesis with him. That was the basis for that, plus the I think PDP11 was the basis for the 68000 design. Les Crudele was there at that time, David Leitch, I can't remember the other people. Richard Crisp was there, but I didn't really mess with the circuit designers too much. And I think-- well, I don't know who was doing what. I mean I, so--

**Fairbairn:** That was quite a team between Skip and Les and yourself and you all went off and did amazing things.

**Tredennick:** Yeah, I mean he had a bunch of PhD guys there. Basically, I think Skip was writing the user's manual along with David Leitch. I worked primarily by myself and I shared a cubicle with John Zolnowski. John is just a wonderful guy. John is just a tremendous guy and he's really, really smart, and he was my go-to guy for anything. To me the magic of logic design is you take an English language description, I want this instruction to do A, B, and C, I want this instruction to do this and this and this. You take an English language description of the behavior of a machine and you turn that into physical

transistors, and you turn it into equations and transistors, and that's just a really gratifying experience for me personally. That was-- I really enjoyed that job, and I--

**Fairbairn:** Motorola was in competition with TI and Intel and others at the time. Was there pressure on this? Was this sort of a hobby? Was this a--

**Tredennick:** Oh, it wasn't a hobby. No, no, no. You--

**Fairbairn:** Was there a deadline that you were working against?

**Tredennick:** Well, so <laughs> I'm at a low level in this organization. So Tom was my interface to the world. He took all the arrows from the political fights and stuff, and he worked for a guy, oh gosh, his name's-- I'm drawing a blank on it right now. We were just talking about him yesterday, because this last weekend was the big car show at Pleasanton, and Keith Diefendorff and I always go to these car shows. It turns out Keith used to work for Les Crudele at Motorola, and Les is in town this last weekend. So I met with him, and the three of us went to look at cars, so I saw Les again.

But oh, god, what is that guy's name. I didn't like-- Gary Daniels. So Tom Gunter worked for Gary Daniels. Then Colin Crook was above him, I think. Colin was the guy that made the decision to go ahead. Inside Motorola the competition was more between the 6809 which was an advanced version of 6800, and the 68000. So we weren't really looking at-- I think at the same time Intel was doing that-- what was that crazy processor Intel did that was going to do floating point and--

**Fairbairn:** 432?

**Tredennick:** The 432, and we kept hearing rumors about the 432 and how it was going to do floating point, and we heard about the 9900 I think it was, or maybe--

**Fairbairn:** TI?

**Tredennick:** TI's 9900, and it was a memory-to-memory architecture, and Tom would come in and say, "should we be doing memory-to-memory architecture and should we be doing this and should we be" -- but we didn't really feel much-- I didn't feel much pressure on that. Now maybe he was talking to Skip or somebody about that, but basically, I was just doing the logic design. I was doing the what's the block diagram, what's the configuration of the execution unit, how do you make that thing behave the way it's supposed to behave. So, I was doing what we now call microcode, but really, they were a bunch of PLAs. So I did all the PLAs and transistor placement and minimization, and actually the entire instruction set map -- placing in the design space. I mean, the first time I look at the user's manual I'm flipping through the thing and the register files are moving all over the place, <laughs> wait a minute, you can't move the register designators, I got to have-- the registers have to be here, and the op codes have to be here, and so that was actually one of the things I had to negotiate through--

**Fairbairn:** Who did the instruction set?

**Tredennick:** So, I want to say that was primarily Skip and John, and maybe David Leech, but you'd have to ask them. I'm working from a document and I'm just trying to convert it into transistors, <laughs> and that was primarily my job. Now after I had been there maybe a year, they hired Colleen Collins who was just out of the University of Texas in electrical engineering. She was wonderful also. She's very smart, but she was-- I basically gave her tasks to do -- helping me with the logic design microcode stuff.

**Fairbairn:** So what year did you join Motorola to work on this project?

**Tredennick:** 1977.

**Fairbairn:** Okay, and you worked through the completion of that program?

**Tredennick:** Yeah, I worked through the end of that program till we had working parts. I can remember the first working parts that came-- well they weren't quite working. They came back and we put on the tester. Les put them on the tester. Les was doing a TTL implementation in parallel with the rest of the design, and that was a hopeless task because the changes that-- I could make a change pretty quickly and cause huge problems for him, and this was-- I think the Motorola 68000 was probably the last large pencil and paper design.

**Fairbairn:** So it was all hand layout, digitized and...

**Tredennick:** Everything. Well, I don't know about the layout. I know about the logic design, and the PLAs. I placed all the transistors, I minimized all the PLAs by hand; I did all of the logic equations were-- I had

**Fairbairn:** Did you have any simulation tools?

**Tredennick:** No. No simulation tools. I think John did a-- we bought a DEC machine for something during the course of that project and so we kept documents a lot. I kept some documents on that-- all my documents primarily were in pencil, but John did a program that simulated the multiply algorithm that I was using, and he found a loop in there that there was no way to get to. <laughs> So I helped optimize that a little bit, but basically the optimization techniques, the placement in the control store was all done pencil and paper. I had basically IBM cards with each of the microcode statements on it, and I shuffled those cards to try to optimize things. I mean it's going to sound unbelievable, but I had a 16 variable Karnaugh map that I used, and it was obviously truncated because there were don't cares in a lot of places, but you still had to carry it all the way to-- in whatever instruction could be defined by all 16 bits if you didn't have any register fields, and so I basically had a 16 variable Karnaugh map, <laughs> and I-- so this is just some of the--

**Fairbairn:** Was there pressure on to minimize logic or what--

**Tredennick:** Well, yes, I mean everything. The transistor budget was absolutely the issue. Could we fit it, could we put another register in? I mean it was right down to the last transistor, and <laughs> I



remember one time when Tom says, hey, we need to do X, and he just put a note on my desk. This has to change. Which meant I had to re-place everything in the control store. I remember we're looking at this note and Colleen's standing next to me and she's reading this note and she looks at me and she says, "are you going to kill him"? <laughs> Because any change-- one of the problems with microcode is that you can compensate for errors in the logic but that are much-- it's sort of your avenue of first resort if you got a layout problem, and so, yeah. I mean there was definitely an issue with minimization that was key to the whole project and being able to get it in there, and we were able to do that.

**Fairbairn:** So you got the thing done, you got it back, you were then involved in the debugging process?

**Tredennick:** Yes, yes. So yeah, I'm standing there with my flowcharts which are all on paper, and everything. So this was part of dealing with Tom, because the first time Tom came to talk to me he's pointing at something on one of my diagrams. And he touches this, and I see this little smudge. I'm like okay, Tom, that's the last time you're going to see a pencil document from me. We were doing bluelines at those times where you run it through and get this blueline. So that was the last he saw of the real documents. After then everything he saw after that was a blueline.

Les was running the analyzer and bringing up the chip, and we're watching the behavior, and I'm a little hazy on how we were watching the behavior, but I'm sitting there with my flowcharts and he's saying okay, this is what this looks like. Well that means we got here and then obviously it jumped over to here somewhere. So something went wrong right there, and so it was Les and me with a bunch of guys standing over our shoulders watching as we're running, booting the system up and trying to figure out what happened. We were able to debug it that way eventually. It was very close even the first time. It ran a lot of stuff. I think the C6 register was-- both of them were tied to positive or something and Tom said yeah, that was my mistake. I was here at three o'clock in the morning doing layout and that happened. So, we were very successful. I think the J5H was the first chip and R9M was the second one or something. I don't remember the generations of chips after that, but it was basically pretty successful.

I was there for a little while after that was completed because IBM came in and said you guys think you can reprogram this thing since it's microcoded to do the 360 instruction set? We go, we'll look at it. So I ended up working with the guys in Endicott, New York, to do a 68000 recoded to do 360 instructions.

**Fairbairn:** Yeah, so you ended the 68K as a successful program, and you went on to the next thing which was working with IBM. Did you actually go work for IBM or did you--

**Tredennick:** Well, I worked on that project with the guys in Endicott, but then--

**Fairbairn:** But still as a Motorola employee?

**Tredennick:** As a Motorola employee, but then my girlfriend at the time finished her PhD, and so the two of us were looking for a job, and so we went and looked at a number of places. I interviewed at IBM Research, Bell Labs, Carnegie-Mellon, Berkeley, Sperry Research, Motorola was on the list, and I forget, I think there were seven of them total, and they all made us offer, and so I'm looking at these offers.

Unfortunately, the university offers were like half of the industry offers. Oh, Intel was on that list, and I got offers from everybody, and so now I'm trying to decide what to do. Unfortunately, I didn't weigh weather heavily enough, and I interviewed-- this is something for any young people that might listen to this. If you're doing a spreadsheet for how to make a decision, <laughs> don't interview in the springtime.

**Fairbairn:** When everything looks good. <laughs>

**Tredennick:** Yeah, I'm driving the Taconic Parkway, and it's just a garden. I mean it's just beautiful driving up the Hudson River in April or something. It's just gorgeous, and I'm thinking, well you know IBM's the number one computer company, and T. J. Watson Research is the top of the pyramid, and it's all geniuses, and if I can sneak in there somehow maybe they won't notice. So, I accepted that offer, and ended up moving to New York State for what I say is three summers and five winters, <laughs> even though I know that's not possible. But that's what it felt like. So I moved to New York and started working at--

**Fairbairn:** With your girlfriend/wife or is this--

**Tredennick:** Yeah, with my girlfriend, and she was I think also, I don't remember, she was working for IBM too I think, maybe even in research division. But I'm lost on that one now. But I ended up working with a guy named Brion Shimamoto there. So when I got there ... I had seen a little bit of politics at Motorola, and I said okay, I'm through with microprocessors. I don't want to do that stuff anymore, and I worked on fiber optic serial channel for about a year, and finally--

**Fairbairn:** At Motorola?

**Tredennick:** No, at IBM Research. So I'm a research staff member at IBM, and I'm working for this little guy that I didn't get along with very well, and I'm working with this guy Brion Shimamoto. Brion and I got along really well, and I start talking to him about microprocessors and stuff and what I'd really like to do.

Let me-- I don't want to back up too much, but I have to here because it's part of the story, and that's that when I got to Motorola, you remember Tom said why don't you do some logic design until we find a competent person to do that? So I started looking around well how am I supposed to do this. There must be some books on logic design that tell me how to design a microprocessor, and there's nothing. And so when I'm interviewing at Bell Labs and IBM, I'm like you know what I'd really like to do when I come here is I'd like to think about logic design. I'd like to-- you know there's a big design automation conference every year, and what are those guys automating? I can't find a process that they're automating. So I'd like to come to a research place and document the design process that I use because I think it works pretty well. If I can document that process then I can turn that over to the design automation guys and they'll be automating the things that I need to do the design <laughs> instead of whatever the heck it is they're doing over there.

So I'm talking to Brion about this and finally we go, okay, we'll just write that down, we'll do a practice design, because I can't use the Motorola stuff, that's all confidential to Motorola. So we'll do a phony

design and we'll just choose IBM 370, and we'll do a 370 design from scratch just as an example so I can write a book. And so we start working on that project, and then we get pretty far along, and we go, "how much credibility are we going to have if this is just a phony design?" We probably ought to go ahead and try to make it a real design, so the project kind of grew from there. You asked for funny incidents, and so there are a few of those that I have for this. I'm basically a loner. I've-- all this diversity and teamwork stuff, I think they're people that work fine in that environment but I'm not one of them. I just want to go do something and--

**Fairbairn:** Give me a job and go do it.

**Tredennick:** Yeah, I just want to solve this problem, and then give me another problem <laughs> and I'll try to solve that one. So anyway, I'm plugging away at this design and we decide I need privacy. So I go to my boss, we go to my boss and we say-- I don't know if you know how Yorktown is laid out, but it's kind of a truncated doughnut. It's a-- well, you now Apple's spaceport, it's like what do they call it, angel food cake. Okay, so you take a slice of angel food cake, and the windows are all along the outside edge, and then all the offices are spokes that go back from that.

And we go to the boss and our manager, whoever that was, I don't remember now, and we said we'd like offices that are on opposite sides of the aisle, in other words his office is on this aisle and you have to go around this way to get to my office. And they're like well, that's a little weird given that you guys are working together on this project, but okay. So, they give us offices that are on opposite sides of the aisle, There's basically the offices are in pairs going down the spoke with kind of frosted glass windows on the outside edges and then lockers in the back, and so the lockers in the back are storage and that kind of thing. Well, we have offices on opposite sides, so I disassembled the back side of the locker and then I lock my office and put up a sign that says-- I got hold of one of those strategic air command signs that says people that enter this are subject to radiation death--

**Fairbairn:** Being shot or whatever. <laughs>

**Tredennick:** Yeah, I mean, we'll torture you and-- so I put that sign in the window, which is still readable through the frosting, and then I enter my office basically through Brion's office by opening the locker door and going through that and so nobody can find me. I'm working in the back room, he's the front office, except that one time he's in his office talking to somebody all of a sudden somebody comes out of the locker, <laughs> so-- oh, and

This is the epitome of you think of it as the pinnacle, IBM's trying to corner the market on the world's geniuses or something, right? But this is the epitome of conformance to qualifications. If you set your qualifications really high then you get people that are good at showing those qualifications, but Brion and I aren't really kind of like that. We're walking around and these people think pretty highly of themselves, and you look in their offices and here's all these awards and diplomas and stuff. So what do we do in our office? On our wall there's like nine high school diplomas, and they're all from Erasmus Hall High School in New York City, <laughs> but it looks kind of like everybody else's office until you take a close look at it. We actually had people come in and they'd go "are you really all from Erasmus Hall High School?" No.

But we did other things too. We had two rubber stamps that I can remember. One of them said for IBM external use only, and so IBM is very careful about control of—

**Fairbairn:** Yeah, documents and things. Yeah.

**Tredennick:** Yeah, I mean confidential information and all that. So we had a rubber stamp that said for IBM external use only, and if somebody starts talking to us, we ask “are you an IBM employee?” Because I can’t disclose this to you if you’re an IBM employee, this is for external use only. And we had another stamp that said library copy, do not remove. So all the trade magazines and stuff that we were throwing away we’d stamp them library copy do not remove before we put them in the trash because the trash cans had to be outside your office at night because of this document control thing they want all of the offices locked. People kept stealing our trash cans, and so what do we do? We chained our trash can to the door handle, which got us in big trouble because the cleaning people thought we had some vendetta against them. So they went to the high level people there and said, but look at what these guys are doing to us, and so--

**Fairbairn:** So did you get your book written?

**Tredennick:** Actually that’s part of the story. So yeah, we did. Yeah, it’s called *Microprocessor Logic Design*, it was published by Digital Press, and a part of the story is I took a sabbatical leave to go teach at Berkeley for a year. Actually I have to back up a little bit because there’s more to the story unfortunately. This was the RISC era. Dave Patterson and John Hennessy and all that RISC baloney was going on, and so I’m sitting in my office one day, and I get a call from Dave Patterson, and he knows I’ve done the 68000, and it’s kind of the antithesis of RISC. So he says why don’t you come out to Berkeley and give a talk? And I’m like, okay, I’ll come out and give a talk, but the title of my talk is going to be why the RISC chip is junk. And there’s a little silence on the phone <laughs> for a minute, And this is probably 1980 or 1981. And Dave’s a great guy too, I really like Dave. So Dave’s silent for a minute and then he says okay. I said you want me to send you an abstract for that? And he says “I don’t think I’m going to need an abstract for that.” <laughs> So then I have to go to IBM to get permission to give the talk at Berkeley. Well, it turns out that IBM 801 is being done at—

**Fairbairn:** I was about to say, what about John Cocke and Andy \_\_\_\_\_.

**Tredennick:** Yeah, John Cocke and Marty Hopkins and all of those guys are doing the 801 and Yorktown Heights. That building that we’re in is building 801, which is where that name came from. And so for IBM to give me permission to go out and give the talk at Berkeley, they want an abstract. So I write an abstract that’s absolutely in keeping with the title of the talk, and it gets rejected. This is unprofessional, you can’t say this kind of stuff. So I go round and round with them and finally end up with an abstract they’ll acc’pt, and this doesn’t have to go to Berkeley, this is just to get approval through IBM.

**Fairbairn:** Right, just to get you on the airplane to Berkeley.

**Tredennick:** Yeah, and so they go, okay, and then of course on my door I post the before and after abstract. <laughs>. Anyway, they decide you're going to have to give that talk here first before you go to give it at Berkeley. They originally schedule it in some conference room, but it's so controversial that by the time I give the talk it's now scheduled in an auditorium. <laughs>Not only is it scheduled in an auditorium, but they also actually send I don't know some kind of special representatives to my talk to see whether it's sufficiently professional that I shouldn't be fired. Did they have to fire me, or can I actually go give this talk.

**Fairbairn:** The topic police, huh?

**Tredennick:** Yeah, they're seriously considering whether or not I should be allowed to do this. So anyway, I give the talk. Marty Hopkins brings a couple of slides onto the stage and wants to-- <laughs> for rebuttal, and I'm like Marty, come on, let me just finish my talk.

Anyway, I went and gave the talk at Berkeley which was probably the first technical presentation at Berkeley to ever have protestors show up with signs, posters. So now I actually had picketers in the back of the room, and I don't know that I could dredge up the talk, but it was basically technical. It was, well, listen, I've written a lot of papers over the years because I wrote for Microprocessor Report, and so you go back to my original papers on the RISC chip. I think I wrote one entitled Year of the RISC, and maybe there was a second one entitled Year of the RISC Reprise or something. Anyway, that's basically the content of the talk. It says these guys make all these wild claims. <laughs> They're leading in two things, reported performance and publications, but if you look at who's leading in revenue it's the CISCs, and that's still true today. In fact, I did some consulting for some guys one time and they said we really have to do this RISC thing. I said no, all you have to do is put that label on your machine, you don't have to actually do the RISC thing.

So anyway, to get back to the original question you asked about publishing the book...Dave and the guys at Berkeley invited me to come out to Berkeley and spend a sabbatical leave. I also had an invitation from MIT. By this time I know something about weather, and so I'm going to Berkeley. <laughs> So I come out to Berkeley and teach for a year, and that was a wonderful experience. I really enjoyed that, and in fact Velvel Kahan came to a lot of my-- Every time I talked at Berkeley I think he showed up at my lectures, and I was flattered by that. But anyway I enjoyed it. I taught for a year, and I was writing the text--

**Fairbairn:** Were you teaching microprocessor design there also?

**Tredennick:** Yeah, I was teaching microprocessor design at the undergraduate and graduate level and working on this textbook. I finally finished the textbook, and of course I was still an IBM employee which is its own problem because Berkeley offers me a kind of a token salary, but they're sending me checks, and I send the checks to IBM because IBM is actually paying me. Well, of course Berkeley is reporting to the California tax authorities that they're paying me this money, but IBM's not reporting to California tax authorities that they're getting those check and I'm not actually cashing them, so I ended up having to fight that for years literally.

**Fairbairn:** Yeah. I bet.

**Tredennick:** Because I-- well, anyway, so--

**Fairbairn:** So you did that for a year and then went back and--

**Tredennick:** Well, I didn't go back. This is another piece of the story. The guy that was my second level manager at IBM.... I was actually managing the micro 370 project at that time, and I wanted to come out to Berkeley, and he's like well, what do you-- I said, yeah, I want to go to Berkeley, but I think if I get out there I'm not going to come back, and he says well, I can't approve of your going out to Berkeley if you're not at least going to say that you're going to come back, I said well <laughs> in all good conscience I can't say that I'm going to come back.

Finally he says okay, you can go, but somebody else is going to have to take over the project, and so fortunately Brion, the guy that I'd be working-- so Brion and I worked together, we hired a summer student named Linh Lam, and this is another one of those things where we're going through all these resumes of these prospective summer hires, and they're all top of the class, A plus everything, recommendation letters, and we run across this one that's Linh Lam. We don't know whether it's a boy or a girl, but it's not top of the class, not this or-- we go, I like this person, let's hire this person. So we hire Linh and she's just a sweetheart, and she's smart, and she's Vietnamese, she can't speak-- I mean she's just learning English, so of course she's struggling in school, but she's a great employee, and she's still there 30 years later.

**Fairbairn:** Is that right? <laughs>

**Tredennick:** So I didn't go to her retirement ceremony, but the rest of the project people did. I was on the West Coast and they're all on the East Coast, but all of those people went to her retirement party, <laughs> so she's still there. Anyway, so Brion--

**Fairbairn:** So did the micro 370 project become something?

**Tredennick:** Yes, yes. It actually booted VM, if you know what VM is, so it became a-- now unfortunately for political reasons it wasn't successful. Partly because it was done in research, and there were competing projects that were spending real dollars. <laughs> So "hey, we spent seven million dollars on this thing, and so we're not going to take that piece of junk." <laughs> So it was not-- it's one of those things... I think it should have been the maintenance processor for every IBM processor because of the compatible instruction set. I think their maintenance processors are some other instruction set. It doesn't make any sense to me. Anyway, that's what they-- we had parts, we had working parts, we booted VM, but it was a research project and so we didn't get to \_\_\_\_\_[commercialize???] it.

**Fairbairn:** So you went and taught at Berkeley for a year and then...

**Tredennick:** Well, and then what I did was I looked around IBM offices in the local area, and I said could you give me office space in your office, and I'll do something. I'll work for you or with you, whatever is necessary for you to give me an office, but my starting position is I don't want to do anything. I just want an office space. And it turned out that the Los Gatos lab gave me an office space without making me do anything, and so I had an office by myself to myself, basically working with the guys in New York, but working out here, and so I don't know when the project finished, but it was '86 or '87, in that range.

**Fairbairn:** What year were you at Berkeley?

**Tredennick:** '83, '84, and so we were mid-project, and so I was, again, I was doing all of the logic design and microcode. But this time we had Dick Hadsell was writing software for us, and he interviewed with us for about a year before he decided <laughs>- to join the project. It was the most rigorous reverse interview I've ever seen. He's like I'm not sure if I want to join you guys, and he literally-- he's writing simulators and doing stuff for us, and he's still not sure he wants to join the project. But after a year he decides to join, and so-- and then a guy named Bruce Gavril he also joined us.

**Fairbairn:** So you were in Los Gatos, you were working in the final stages of this Micro 370.

**Tredennick:** Micro 370, yeah.

**Fairbairn:** And that came to an end and you did what?

**Tredennick:** So the thing about being a research staff member at IBM, it's a wonderful position because you have a lot of autonomy. You can do pretty much what you want to do within some reason. But they have a kind of a tenure process, namely you're there for about a year and they decide whether or not you really belong there or not. By that time they had decided they were okay with me staying there, and so I was in a very comfortable position.

But then somebody started talking to me about a startup company and doing an X86 instruction set and a high performance implementation, and I got kind of interested in that and I thought well maybe I'll go do this startup thing, and I struggled with that decision for a long time. Again, I have some advice for young people here because in the course of trying to figure out what I wanted to do, I thought, okay, I'm going to look at what I've done in the past and where I made mistakes. Then I'm going to try to learn something from that about how to make the decision going forward. And I'm looking back and I'm going "I really haven't made any mistakes so far, and I go, but I know that's not true, there's just no way, <laughs> I know I've made mistakes, I've done really stupid things."

But my personality is such that when I look back I go, boy, I'm sure glad I did that, and so the upshot of that was that what I decided didn't matter, because whatever I decided by the time I got a little way down the path my brain would reconfigure itself and say, boy, aren't you glad you did that. <laughs> So the net of all that is if you're happy with what you did in the past you're going to be happy with what you do in the future, and so it took the--

**Fairbairn:** Good way to look at it.

**Tredennick:** It made the decision easy. So I went out and I said, okay, I'm going to do this startup thing. I was one of the founders of this company called NexGen Microsystems. We were doing a high end X86. We actually went and talked to Intel about that, and so they knew we were messing with that. They said you know -- we kind of wanted them to help us, and they're like if we wanted to do it we'd just do it.

And it turned out it wasn't going to be a multi-chip implementation at the end of the project. That's just what we started with because we thought we could do it, and I was the director of product development. So I hired all of the hardware engineering teams doing all the chip designs, and I managed those groups. I didn't last very long in that job it turns out. That was not my favorite experience of my whole career, because what happened there was the guy that was the CEO, and I'm not going to say who that was although I guess it's discoverable. <laughs>

**Fairbairn:** Atiq Raza?

**Tredennick:** No, no, Atiq is a wonderful guy. Atiq actually saved the company. So it was Atiq's predecessor. He was going around me to tell my guys what to do, and I'd go have these arguments with him and I'd say, "you can't do that." If you just leave these guys alone, they will kill themselves for you. He's like no, no, if you turn your back on them they're going to sit on their hands, and I'm like you don't understand these guys. The interference that's happening here is going to cause them to leave and you don't want them to leave. He's like we'll just hire another one, and I say "you don't understand, this guy's worked on this thing for a year. If he leaves, the guy that comes in is going to take six months to understand what was happening here, and by the time he understands it, he's going to want to change it. You can't afford to lose these guys." So I'm battling it out with this guy.

But of course, he's up here and I'm down here, and so finally I said, "we're losing engineers, this is going to fail, and so I go to a board member, I go to Marshall Cox who's on the board of directors, he's the chairman of the board." Marshall, I like Marshall a lot, he's a flamboyant guy, and I still-- he's a marine corps general, he was fighting in Korea at age 13. He was left on the battlefield for dead.

**Fairbairn:** I didn't get that part.

**Tredennick:** Anyway, he's a very--

**Fairbairn:** I did the oral history with him down at his--

**Tredennick:** Oh did you?

**Fairbairn:** Yeah.

**Tredennick:** Oh, in Los Angeles?



**Fairbairn:** Yeah, in Rio, no Del Mar or...

**Tredennick:** Yeah, Rio del Mar or something, I don't know.

**Fairbairn:** Because my wife was a neighbor of his, I mean it was just an interesting cross--

**Tredennick:** Anyway, so I went to Marshall, and I said, "Marshall, this isn't working. My recommendation to you is fire all of the founders including me and bring some people in here who are competent to do this." Because I was also having problems with the software guy who was a founder. There were five founders of that, and the software guy and I just didn't get along. I would do my planning, and I'd go to him and I'd say I need this, this, this, and this, and he'd go I'll give you ten percent of that. I'm like, you don't understand, this isn't that kind of negotiation, we're not in a marketplace where you do barter, this is-- if I don't get this, this, this, and this we can't do this. <laughs> So he and I were just like this the whole time. Then of course the CEO and I were the same way because he's going around to my guys saying do this, do that, do this, -- he was just destroying morale.

So I go to Marshall, and I go Marshall if you just get rid of all the founders then bring in some people, I think this still has a good possibility of working. And Marshall's like well I can't do that. I can't go around the CEO, but I'll bring it up with the board of directors and we'll try to resolve it. So it turns out that Vinod Khosla is on the board of directors. So he calls me up and he says "come and see me," and so I go and see him, and he's living in this hilltop. I mean, I go to his house and we're sitting there in this huge room, and it's glass wall over here, and I'm looking across the valley. It's like man, this is really a beautiful place you've got here, Vinod But it's a bummer that they're building a resort hotel right across the valley from you, and he goes "oh, no, that's my new house." They're going to tear this one down when I'm done with it.

Anyway, so I'm talking to Vinod, and I'm saying okay, Vinod, here's the story you're going to get, here's what I think the story looks like, and if you call these four guys they'll tell you exactly what I've just told you. If you want the other side of the story, call this guy and he'll give you the other side of the story. And about three weeks later, Vinod calls me up and he says okay I've done my due diligence. I called the four guys you told me to call, they told me exactly what you told me. I called the fifth guy, he told me exactly what you told me he was going to say. <laughs> And I'm sitting there thinking wow, my model of what's going on there is going to be confirmed and we'll get this thing resolved. Vinod says, "so I think the right thing to do is get rid of you." <laughs> So they got rid of me.

So I left NexGen, which by the way, and so Atiq came in after that, sometime after I had been there, and in my opinion he literally saved that project and that company. I am truly grateful to him, because when he said what do we do with founders' shares, I think Atiq said you know they deserve the shares that they had, and go ahead and don't dilute them to zero. And he gave me a compliment too. He said, "I came in and talked to your engineering team," and he said, <laughs> "I've never seen such loyalty from guys." But he made that project go through. He saved the company. He eventually became CEO, and Marshall brokered the-- the company went public, NexGen went public, and then AMD came in and bought the company, and I think that became the K6, K5--

**Fairbairn:** Yeah, yeah.

**Tredennick:** One of those two, and Atiq became AMD's largest shareholder at that time, and so--

**Fairbairn:** Yeah, and the CEO for a while, and--

**Tredennick:** Yeah, yeah. I like Atiq, I respect him; he's a very smart guy, and I think that--

**Fairbairn:** Yeah. He had actually worked for me at VLSI Technology, before going ....

**Tredennick:** Well, he's very, very highly organized, I mean he's just--

**Fairbairn:** Yeah. He was very bright, very...

**Tredennick:** Yeah, oh, and then another piece of the story that cemented my relationship with Marshall, because he said, "The CEO's telling me this, you're telling me this, you know three years later I find out everything you told me was just what you said it was." <laughs> And so I ended up actually investing with Marshall. He had a venture company for a while, and I found out a lot about-- and in fact he and I were part of a, what was it called, Pacific Fiber Optic something. Anyway, I had got involved in a whole bunch of startup companies, and I invested alongside him in a bunch of ventures.

It turns out that I am terrible at that investing stuff. The more I know about the technology the more I think I should be able to make good decisions about what's going to succeed. But it turns out that after being involved in I think in the neighborhood of 50 startups as either a founder, an investor, an advisor, a board member, a peon, out of 50 I'd say the 3 or 4 that paid off, other than NexGen, were ones that I knew nothing about. The ones that I knew the most about were probably the least likely to succeed. I did a whole presentation on that, and it turns out these startups rarely fail for technical reasons, they usually fail because some self-destructive behavior among the people that are involved in the thing.

**Fairbairn:** So you left NexGen. What year was that? What years were you at NexGen?

**Tredennick:** '87 to '88, and some of this is going to be not too accurate, but '87 to '88.

**Fairbairn:** So roughly '88 you left and--

**Tredennick:** Yeah, '88 I left. They--

**Fairbairn:** Now I had a question. You had gone to some length to describe your own personal style, and how you want to hide in an office in back of another office, and just let me do the thing I need to do. And here you were managing a team and negotiating with the board and other things and--

**Tredennick:** <laughs> Yes, yes, yeah. Well, it's not to say I can't do it, it's just I'm just no-- it's not--

**Fairbairn:** Not your preferred mode of operation?

**Tredennick:** Not my preferred, yeah. But I got a backhanded compliment from one of the board members at NexGen, and I've temporarily forgotten his name, but he saw me give a presentation, and he said, "That guy couldn't lie if he wanted to. He couldn't." <laughs> So, anyway, so--

**Fairbairn:** So you left Next Gen, went to--

**Tredennick:** I left NexGen and I started my own consulting company because a lot of the guys said, "hey, if you're leaving I want to go wherever you're going" Enough of those guys came with me that I got a letter from NexGen saying stop stealing our people. But I went off and did my own Tredennick, Inc. doing logic design and consulting, and we were doing consulting for market research kind of stuff, and patent litigation. Then I picked up-- I can't tell you the company -- but I was doing a design project, a microprocessor design project for that company in a clean room kind of operation, and I found out a couple of things about how to run your own company. One is, if you're going to do a logic design and consulting kind of business where you're kind of dependent on piece work, the right size for that company is one or greater than 25, but it isn't 10, which is what I had.

So this was like having 10 mortgages. You know, these guys will work themselves to death for you, but they don't know or care where the business comes from. So, if you have a design contract that's a good thing, until the company decides to cancel the contract, and then stiffes you on the receivables, which is exactly what happened to me. So I'm kind of struggling my way along with 10 mortgages and <laughs> it's not really-- but I have these great guys working for me. So I did that-- in fact I still kind of got the company, but it's got no employees now, because after doing that for a while and once this large company canceled its project and stiffed me on the invoices, I couldn't keep the guys. They had to go.

And there was this guy, John Pavan. He has trouble working with anybody, <laughs> but he's a very smart guy, and he liked working for me, and I have to give the guys the bad news. And he comes in and he says well, I talked it over with my wife, and I can work for you for a year and a half without pay. <laughs> John, I can't do that. <laughs>

So about that time Bob Hartmann came to see me, and Bob Hartmann was one of the founders at Altera, employee number one at Altera. And he says, "Why don't you come over, and why don't you work for us. I'd like to hire you." He originally interviewed me a few years before that to be VP of engineering, but I couldn't do that because I was-- I had all these employees, and so I just couldn't. I couldn't afford to go to work for Altera then, but he came back again and said, "Come to work for me." So I went to work for Bob, and he was I think at that time he had been VP of engineering, and he was trying to replace himself the first time he talked to me. That probably would have been a mistake. I don't know, but he found somebody else to do that, and then the second time he came back he was VP of business development at that time. So he and I were working on business development, and I worked for him, and I was-- they were struggling to find a title for me at that time. I didn't have any employees, so he couldn't make me a director, but I was reporting directly to a VP, and so what do we do So I said, "Well, I'd like to be chief

scientist,” and he’s like, “Okay, you’re chief scientist.” So I was chief scientist at Altera for a couple of years, and it was wonderful working with Bob because we got along well.

I don't know what he was doing besides talking to me, but he left me to do my own organization of what was going on. So my objective was I would like to support the companies that are going to be our biggest customers 10 years from now, or five years from now, and so I started working with universities, and I started working with startup companies. I had a one-page contract for startup companies that said we'll supply you with software, maybe give you parts, and in exchange for that the next time you do a funding round give us the opportunity to participate, and that's all it was. It was a pretty simple contract.

So I was working with like 300 people at that time, and eventually we designed a circuit board that fit in a PC that had a bunch of our chips on it that you could do-- I got into this topic called reconfigurable computing, and so I contracted with a guy named Dave Van Den Bout who was a professor at I don't know North Carolina State or something<sup>1</sup>, and together we designed a board that took a bunch of these chips and actually filed a couple of patents on that and--

**Fairbairn:** So what was the goal, what was the strategy in the reconfigurable computing? What was the target applications that you were looking at?

**Tredennick:** Well, anything that for which custom logic was faster than a CPU, and that was a lot of stuff. The problem with programmable chips at that time was that they weren't partially reconfigurable, you had to do the whole chip, but there were things where you could download an algorithm and run it in parallel instead of having to go through a loop. You could build a data flow structures. So it looked to me like reconfigurable computing would have a nice future in computing if we could-- and there were startup companies that wanted to do that kind of thing, and so I was building an organization to-- building an organization, there was one guy, but I was building a database of people that were doing that. And I was hoping that something would come of that.

But in the meantime I was teasing Bob because I'm like Bob, because we'd think up these things and we'd go to Rodney who was CEO of Altera at the time. He turned us down for everything, every proposal we took to him he said no. I'm like Bob, this is frustrating, you're a multi zillionaire. As employee number one at Altera, you're a multi zillionaire. Why are you doing this?

Well, it turned out that the reason that they were doing that was that at that time, and this going to turn into irony if you know the current history. Because at the time Altera was like a 50-million-dollar company, it wasn't multibillion dollar-- it was a little company at this time. This is '93, it's its 10-year anniversary -- and by the way Altera is one year older than Xilinx. Xilinx wins the P.R. stuff, but Altera's-- and they're an interesting comparison between Xilinx, but maybe we won't get into that. But anyway, back to this thing. So Rodney was turning us down on everything because he was negotiating at that time with Intel to buy Intel's FPGA business. So they closed that deal for like 50 million dollars, and then what is it, 25 years later or so, Intel buys Altera. Buys it back. <laughs>

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<sup>1</sup> [Editor's note] Professor Dave Van Den Bout was professor at North Carolina State.

But he was turning us down for everything, and so after about a year of this, I come into Bob's office and he says you know I've been thinking about this thing you've been teasing me about. I'm retiring. I'm like, no, Bob, don't please, don't retire, please because I like working for you. This is a fun job, you know it's great. He's like nope, I'm going. So he retires, and they give me to a guy named Don Faria. Well Don I think at that time is managing all the software for the Altera products, and I get along really well with Don. Don's a great guy, he's smart, he's just a prince of a guy. I like Don, and Don kind of likes me. He says you're the break in my week, I struggle with all this politics and software and stuff, deadlines all week long, and one day a week you come in and talk about all this <laughs> wonderful stuff and all the fun -- it's great. But I worked for Don for about a year, and I come back from the Christmas holidays and he's not in his office, and the-- where's Don? Well, Don left, he left. I'm like oh, great. So then they give me to the marketing guy.

Well, I sit down with the marketing guy and I start telling him what I'm doing, and it's like I'm speaking Greek. He's like no, no-- I had one conversation with him, and all of a sudden I'm assigned to the VP of engineering. So I go see the VP of engineering, and that was not good. This was mixing oil and water. We just did not get along, and it was-- I lasted about six more months with him, and I finally went into his office and I said you know it's time for a review. And I don't know whether you're going to give me a raise or fire me. I mean, I just don't know, and he looks at me and I think he said something that was equivalent of that, I don't know either. What are you doing-- the press is always calling you, people are always calling-- you're working with all these people outside. Why don't you take one of your boards, plug it into a system and do some experiments, and I'm like you want me to go take one board and experiment. I've got-- I mean, how much leverage do I have with 300 people out there? There's no leverage in doing this. So I'm like I don't think I want to do that. So then I decide I'm going to quit. So I left. I think I was only there two and a half years or something like that. But I liked the job, I liked working for Bob, I liked working for Don. It was great.

**Fairbairn:** So what year did you join Altera?

**Tredennick:** Where?

**Fairbairn:** What year.

**Tredennick:** What year, '93.

**Fairbairn:** And you left in ninety--

**Tredennick:** Five.

**Fairbairn:** Five?

**Tredennick:** Yeah. Sometime in '95.

**Fairbairn:** Okay, so we were at leaving Altera in 1995, but you said that you had some other jobs you left out. So why don't we briefly cover those.

**Tredennick:** Well, they're just-- yeah, okay, it's just a little thing. <laughs> I said I was in this reserve unit that was flying out of Kelly Air Force Base in San Antonio. Eventually I changed to a unit that-- they put a unit at Bergstrom Air Force Base right there in Austin, and so I joined that unit. I was also the plans officer for that unit. But I was still teaching at the University of Texas, both in electrical engineering and in the computer science department, while I was working at Motorola. Anyway, that was a piece I had just left out.

So when I went to New York for-- and another piece of the story I forgot to mention...When I moved to New York to work for IBM, I interviewed with the C130 units that were in the northeast area, and I chose one oddly enough in Schenectady, New York.

**Fairbairn:** Oh, your hometown, huh?

**Tredennick:** My hometown, because it turns out-- and so I'm looking at these C130 units, and I go I've already flown this kind of mission, but these guys in Schenectady have ski model C130s, they have wheels and skis, and they do arctic resupply. I don't know if you know what the DEW line sites are, but they're radar sites that were above the arctic circle that tried to--

**Fairbairn:** Yeah, watch for Soviet, yeah.

**Tredennick:** Watch for Soviet missile launches. Well, we did arctic resupply for those sites with that airplane. It was all done with reservists. Well, it's actually New York Air National Guard, so this is-- I was in the air force on active duty and then in the air force reserve when I was in Texas. When I moved to New York that unit was an Air National Guard unit, which is different from the reserves <laughs> for some reason. So now I've been in the air force, air force reserve, and the Air National Guard. But it was great flying with those guys. The thing that's different between the service and the Guard people is that the guard people are there forever. They've been in that same airplane-- some of their sons and daughters are flying those airplanes. <laughs> So anyway, it's a great unit, it was fun. We did arctic resupply and flying out to the DEW line sites on an icecap in Greenland. We flew up to Sondrestrom Air Force Base, and then flew 250 miles out to a radar site, and I mean it's like flying inside a ping pong ball.

**Fairbairn:** Yeah, it's white everywhere out there.

**Tredennick:** Because the whole horizon is white, the sky is white, everything is white, and you see a speck in the far-- and it's 90 miles away that's the dew line site you're headed for. And this is a big building. It's a six story building sitting on stilts, and the reason they sit on stilts is that they're on ten thousand feet of ice, and so they have-- But they're running a radar 24 hours a day that has to be absolutely level, so they have stilts and because of regelation, the stilts are sinking. So they put in another section and jack it up to keep it level. Pretty soon the legs get too tall, and so they have to-- during the time I was in the unit they had to move one of the radar sites, and this is a big building. It's a

six story huge-- probably bigger than this building, and then you need to move it. So what are they going to do?

Okay, well, basically what you do is you build a set of railroad tracks, you put wheels on the legs, and you cut off the old legs, and you push it over to the new site and you start over again. So I was involved in some of that while they were doing it. The radar site had to stay operational while they were doing that. Anyway, that's another part of the story but I end up flying ski model C130s which was its own interesting experience, and that was, again, that was at IBM.

When I moved out to California, I had to find another unit, and this is where my luck kind of ran out. Because it was '83 I moved out to California, and I stayed with the unit in New York until '84 is the last time I flew the C130. When I came out to California I said, I'd really kind of like to fly helicopters. So I started looking around at helicopter units and I go I'll-- whatever it takes, I'll go to helicopter school. I don't care. Send me to helicopter school. And it turned out there was a C130 rescue unit out here at Moffett Field that had both C130s and helicopters. The smart thing to do would have been to do hey, I want to fly C130, rescue C130s, and get in the unit, and then tell them I want to fly helicopters. But I said no, I want to fly helicopters, and they said no, we can't do that.

So I talked to a Navy unit, and they said yeah, we'll send you to helicopter school, sure! But you're an air force guy, you need to be a Navy guy, <laughs> You're going to have to do an inter-service transfer, and I go okay, I'll do an interservice transfer. What can I take? It's a little paperwork. No big deal. It took one year to do the paperwork to get transferred from the air force to the navy. But I finally get it done, and I go back to the helicopter unit and I go, hey, I'm in the navy, and they go you know, during that year that you were gone trying to do this paperwork, darned if the marine corps didn't throw out a thousand helicopter pilots, and we filled up the unit. We can't let you in. Well, okay. Bummer.

So I start looking at navy units that are flying something, and I find a DC9 unit that says oh sure, we'll take you in a DC9 unit. But then they go, your designator, there's a problem with that. If you were on active duty, this would be a flying designator but the designator that they gave you is aerospace engineering duty officer, in the reserve programs that's not a flying slot. So, you're going to have to get your designator changed. All right, I'm a year into this process, I go okay, no problem. I'll just go get my designator changed so I can fly these DC9s here. Meanwhile I'm the maintenance officer on the DC9s. So, okay, I start down that path, and they go no, no, no. We have plenty of pilots in the navy. We don't have very many PhDs in the navy. You're a PhD in electrical engineering. We need those guys. <laughs> You're going to be naval air systems command aerospace engineering duty officer, and that's what you're going to do, and then they had me go to--

**Fairbairn:** You were there all by your own choice. I mean, you didn't have to be in the reserves at the time. You could have just bailed.

**Tredennick:** Oh, no, no, I could have-- yeah, that's right. That's right. That's right. But it turned out-- another one of those things....So I go, okay, I'll join one of these aerospace engineering design units, and I ended up-- it turned out there's six people in the unit, two lieutenant commanders, two commanders, and

two captains or some number like that. Well, that's-- I don't know if you know about the rank structure in any of the services, it's pretty steep. Making O6 which is colonel or a captain in the navy, it's difficult. Making admiral or general is even tougher. So anyway, I ended up in an aerospace engineering unit going back to the Pentagon to do-- working for the C4ISR czar. C4ISR is command control communications, computers, intelligence, recognizance, and surveillance, and so he's in charge of all that stuff, and he's like a two or three star admiral, and I'm working for his chief scientist. I go in to talk to this chief scientist, and we just sit there and he says well, I got this and this and this and this project, and I go well, that one sounds pretty interesting.

So I take one of his projects, and these are things called UFRs, unfunded requirements. It's things that you have to have but there's no money for it, and so they have a bunch of those in the services, and the navy's got to try to figure out, well, we're going to have to rank these things to figure out which one-- if we ever get any money, where do we put it first. <laughs> So I'm looking at these, and one of them is on conformal antennas or something. And one of them is on what kind of computers are we going to do, and it's kind of interesting. I kind of like it. I talked to the guy for a while and I go I'll take that project and I'll go-- I'll come back in two or three weeks and tell you-- I'll write a two pages memo that a two or three star admiral that majored in political science can understand, what's the story on conformal antennas.

I kind of liked doing that, and so I ended up in that reserve unit and commanding it eventually, and making captain in the navy, and I eventually retired with 30 years in the navy. So now that's part of the story, and I was also on the army science board which happened in '94, so that was while I was at Altera.

And another piece of the story is I also do volunteer work for the IEEE in accreditation. So I'm looking at computer and electrical engineering programs at universities to see whether or not they should be accredited. I started that in 1983, and I'm still doing it. So in the interim, it used to be just the United States, now it's gone international. For the last 10 or 15 years I just visit international programs. I've been to Turkey, United Arab Emirates, Saudi Arabia, Jordan, Egypt, Indonesia. I go to all these countries and look at the engineering programs in those countries, and by and large they're very rigorous technically. They're good programs. A lot of the universities are-- it's a competitive hierarchy to even get in, and I mean it's impressive. I mean, you go to a place in Saudi Arabia, and here's a guy who grew up in Pakistan teaching in Saudi Arabia who's got his PhD from someplace in Japan. He's speaking to me in English, and of course the textbooks are mostly in English, and it's just-- I mean you want to be humbled, <laughs> go anywhere and talk to some of those people. So anyway, I forgot where I left off the story.

**Fairbairn:** Well, we're still back in '95 and left Altera, so...

**Tredennick:** Yeah, so then I went into what I'd call my blank years. I don't know, I was basically consulting at that time, so I'm involved in patent cases which is its own horrible experience if you haven't done that where you're an expert--

**Fairbairn:** So you were a technical expert doing the--

**Tredennick:** Expert witness so--



**Fairbairn:** An expert witness.

**Tredennick:** Yeah, I was a special master at one time which I think is a better thing. This is one where both sides agree that you're an expert on that subject, and you're hired basically-- they split the cost of paying you. But you work for the judge, and that was probably of all of the litigation experience I've had, that was the best and probably the least common, probably those are related. <laughs>

**Fairbairn:** This is a good paying job too, right?

**Tredennick:** Oh, yes, yes. So when I first got in the service I think I was getting paid \$435 a month. I make more than that per hour consulting on patents, and that's partly because it's sporadic and partly because it's--

**Fairbairn:** Specialized. It's rare.

**Tredennick:** Difficult.

**Fairbairn:** Yeah, difficult.

**Tredennick:** I mean testifying in front of a jury is difficult, sitting through a deposition where they guys are absolutely trying to trick you and destroy your credibility is a-- I won't say it's a skill, but it's definitely stressful. <laughs> You know because they're in there with a video recorder. They've got another expert or two sitting across from you who's whispering to the attorney. They've got to have three or four attorneys. They're taking every word you say and it's-- so I did that for a number of years, and I'm still-- other things I've forgotten to mention along the way. Starting in about 1988 that was the first microprocessor forum.

**Fairbairn:** Yeah, I was going to ask you about the Microprocessor Report. You worked with that.

**Tredennick:** Yeah. So that's Michael Slater's-- he started that whole business -- the Microprocessor Report and the Microprocessor Forum. I spoke at the very first Microprocessor Forum, and at the end of my talk people are laughing throughout the whole presentation. So after that Michael comes up to me and he says, "I want you to come back next year and drop the technical pretense and just do comedy for us." <laughs> So, I ended up doing the thing called the Microprocessor Report awards, and I did that for 16 or 17 years, every year. I think it was the highest rated session in the conference every year, and I also-- Michael eventually invited me to be in the--

**Fairbairn:** These are awards that you made up in terms of the--

**Tredennick:** Yeah, I collect stuff all year long, and then I just-- I mean it's pure satire, and it's pure roasting people in the industry, and I did one for example on the inventor of the microprocessor. I said, "You know how we used to argue about who's the world's best quarterback, and who's the best-- used to be big fights about who's-- "Is Johnny Unitas better than Sammy Baugh?" and that kind of-- back in the

old days. But that all died, and when did that die? That died with the NFL quarterback rating system. So why don't we have a, "Who invented the microprocessor rating system?" So I invented a bunch of parameters and things like-- and this was-- I shouldn't name names, but somebody's wife is his best advocate. You know, Ahlman Fulanchell's<sup>2</sup> wife. You know, how many patents does he have? You know, what did he do here and here and here? So I had all these parameters and this big, phony equation, and I present the results of that big, phony equation. Some of the guys are sitting in the audience out there listening to this presentation. In fact, after the presentation-- and so I show, you know, it looks like a horse race over the years with positions changing as things go along. I don't name names at the end of it, but at the end of the presentation one of them comes up to me and he says, "So did I turn out to be the inventor of the microprocessor?"

<laughter>

**Tredennick:** "You don't understand. This is satire."

<laughter>

**Tredennick:** So I actually wrote a paper about that called "Football and Microprocessors." Earlier I mentioned visiting Vinod about this whole thing on-- with NexGen. I wrote a paper about that too, and it's called "An Engineer's View of Venture Capitalists." So Michael invited me to be on the editorial board for Microprocessor Report in, I don't remember what year that was, but it was probably early '90s, after I'd given a few presentations and had been doing the awards ceremony for a few years. I got on the editorial board, and of course I'm writing for Microprocessor Report at the same time. So I'm writing all these pieces about RISC and workstations and, you know, all this stuff. I think over the course of my career I've written, I don't know, 60 or 70 papers. The first one that was very popular was one that I wrote at IBM called "On Systematic Generation of Systematic Papers," which told you how to take a no-content topic and turn it into something that any publication would accept. It went through-- it was satire, again. It was-- just how to turn plain language into gobbledegook that looked pretty good.

Oh, and I forgot, This may sound incoherent, but it's important, I think. You mentioned publishing a book, and I'll-- for that paper on scientific papers, we got requests from all over the place. This was back before the internet, and we got-- I got requests from Russia for copies of that paper and people wanting to know at the end of it, we talked about how we were going to automate the process and they--

**Fairbairn:** I was about to say, today you could just automate it, right? <laughs>

**Tredennick:** Yeah, and so our last paragraphs are talking about automating that process, and so we had people inquiring about, you know, "How soon is that going to be ready?" Anyway, so back to the book, which was another thing that I forgot to mention. We're writing this book about a design that's been done inside IBM, and the design process and all that, and we know we're going to have to negotiate with IBM's management about getting this book released. So we go, "Okay. Well, how are we going to do that?"

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<sup>2</sup> [Interviewee's note] I meant Federico Faggin's wife.

"Well, so let's write a red herring chapter." So we wrote an entire chapter on management struggles, and actually, it should've been in the book -- but we knew it wasn't going to be. <laughs> But we put it in the book and we turned the book in for publication release, and they don't say anything about the technical content. They want to negotiate that chapter, and, "Leave that chapter out, you can publish the thing."

<laughter>

**Fairbairn:** So you gave them something to focus on and say, "Okay. Sure. Okay. We'll take that out."

<laughter>

**Tredennick:** Yeah, yeah.

**Fairbairn:** Great strategy. You said for several years you were doing the consulting and that sort of thing?

**Tredennick:** Yeah, so-- yeah. So from about '95, when I left Altera, I was doing consulting. I was working with some startup companies. You know, board of directors or investor advisor, that kind of thing, and writing for Microprocessor Report a little bit. And, of course, I'm still in the Naval Reserve and taking voluntary duty there. But also about that time, which is about 1994, I get invited to be on the Army Science Board. That's a federal advisory committee that reports to the Secretary of the Army and the Chief of Staff, and so it's a nice assignment. You go study problems that the Army-- well, they do two kinds of things. They have internally-generated studies. In other words, if you think that micro-air vehicles are going to be a big thing that's important to the Army, but no general has requested a study on that, you can initiate a study on that and say, "Hey, Army, this is coming along. This might be really important. You ought to look at it."

The other ways those studies came down was when some general or admiral would have some problem-- well, since I was on the Army Science Board, it was a general-- say, "Hey, we want to know about is our comm system doing the right thing?" I ended up leading a study on whether or not the plans for the next-generation field comm systems were good. And that, it turns out, is a whole political mess. I ended up spending about 12 years. You can do 5-year tours, which turn out to be-- they can be 6 years and then you're off for little while and you can come back. So I did that, and just at the time my clearance ran out they say, "Come back." So I have to go through another clearance process, and these are top secret SCI kind of things, where you got special clearances for some for these projects. But it's very interesting. I mean, you can go anywhere and study. I went and I led a study on robots, for example. Or just go visit all the guys at MIT and iRobot and Red-- what's the one in-- go talk to Carnegie Mellon guys. You can talk to all the robotics guys. Yeah, just travel all over the place, talk to all those guys, and then you go summarize it for them and tell them, "Here's what's going on in robotics and what you ought to be thinking about," and it was very gratifying. I participated in 17 studies over a period of about 12 years and--

**Fairbairn:** Seventeen. Wow.

**Tredennick:** Yeah, it was a lot, and a lot of--

**Fairbairn:** You've been busy in your semi-retirement, huh? <laughs>

**Tredennick:** Yeah, yeah. Of course, it's all unpaid, but still, I mean, you're--

**Fairbairn:** All the work for Army is all unpaid?

**Tredennick:** Oh, yeah. They pay all your travel expenses. But I thought, "Hey, I'm working for you guys. Could I at least get retirement points?" You know, "Just give me credit for showing up." No, no, nothing. So you get nothing for that, but hey, you're meeting all these-- one, two, three-, four-star generals and the-- you're coming in at the captains of industry and you go watch the demos -- the A1 tanks firing depleted uranium rounds. It's interesting, because I watched a mock tank battle, and the rounds that they're firing are more like arrows than bullets. They have fins on them, and they've got packing around them and the barrel's smooth and the things depleted uranium and it's-- I don't know how long they are, but you're getting a lot of kinetic energy that's going to be dissipated in a very small point. It just destroys the thing, and you watch the trajectories, because you can see them because they're ionizing the air all the way from the source to the destination, and it's just a straight line. I mean, it's not like they're arcing over in any [ph?] table for that kind of thing and that's when they went to Iraq and started shooting those guys, they were hull down behind the sand dunes. They just shot through the sand dune. Who cares? I mean, it's just a straight line, <laughs> take out the tanks. So anyway, I worked on number of studies for the Army Science Board and I met a lot of really interesting people there and got to do a lot of interesting studies. But eventually-- and as I say, I was still writing for Microprocessor Report. I was also on the editorial board of IEEE Spectrum, which was kind of--

**Fairbairn:** You're doing a lot of writing.

**Tredennick:** Yeah, yeah. Well, I did-- yeah. <laughs> I guess, yeah.

**Fairbairn:** I mean--

**Tredennick:** Anyway, I--

**Fairbairn:** --Microprocessor Report. Well, IEEE you were just on the board, so--

**Tredennick:** Yeah, I was on the board.

**Fairbairn:** But all the studies that you were doing for the Army?

**Tredennick:** Yeah, yeah, I was writing those studies. I was also on a bunch of other editorial boards, Microprocessors and Microsystems, Embedded Systems. But eventually I got a call from a guy named George Gilder. This is in about 2000, so I go through the dark years there and about 2000 I get a call from George Gilder and I'm like, "I know this guy." He says, "Could you come and talk to us? We do this

thing called Gilder Technology Report, and the middle two pages are microprocessor -- what's going on in microprocessors." He said, "I've read a lot of your stuff and I kind of like the way you write. Come and talk to me about writing it, taking over the-- writing the middle page of that thing," and so I went to Framingham, Massachusetts <laughs> or something. He's in the Berkshires somewhere. I went to talk to him in his offices. At that time I think he had 65,000 subscribers or something. He was doing very well, and he had this conference called Telecosm. I don't know if you know who George Gilder is at all?

**Fairbairn:** Yeah, I know the name and I know a little bit, but I don't--

**Tredennick:** Okay. So he wrote "Wealth and Poverty," and he was the most quoted living author by Ronald Reagan and then he wrote "Life After Television," "Spirit of Enterprise," "Men and Marriage."

He has a current book out called "Life After Google," which is pretty interesting. Anyway, in about 2000, he gives me a call and says, "Come and interview with me," and so I go to his office and start talking to him about this stuff and he says, "I want you to write the middle pages of my newsletter for me. It's a microprocessor summary,"

I'm sitting there going, "You know, George, I just don't think that's really what you want for the middle page of your newsletter." <laughs> "I think there's a lot of interesting stuff going on in micro electromechanical systems, and quantum dots, and nanotubes, and microfluidics. I think you ought to broaden it and cover all these other topics, because there's just a lot going on. You're a technology newsletter," and at the time he was kind of focused in communications. He was like the first guy to say, "Hey, I think CDMA and Qualcomm are really good-- a good thing to do," and a lot of people got very rich investing in Qualcomm based on that. So his newsletter was very popular, but it was pretty much focused on-- I mean, Carver Mead was one of his pals. He hung out a lot with Carver. Anyway, so he says, "Yeah, that sounds pretty interesting. Why don't you do that?" I'm like, "Well, I don't know anything about any of those topics."

<laughter>

**Tredennick:** "I just think they're really interesting," and so he's like, "Well, but our audience knows absolutely nothing about those things." The people that are subscribers are-- the guy that invented Duct tape is one of his subscribers. The guy made \$10 million selling lawn furniture is one of his subscribers, and so what he really has is nontechnical technology enthusiasts. So he says, "All you have to do is go find a topic, learn enough about it to see what's important, and then just write that." I'm like, "Mm, okay."

<laughter>

**Tredennick:** So I took a job with George, and eventually I had my own newsletter called Dynamic Silicon, which covered all that stuff, microfluidics and MEMS, and it was a fun newsletter to write. George is really smart and he's a nice guy and he's great to work for and I really enjoyed that. Unfortunately, 2000 was about the peak of the telecom business and then there was that telecom crash, and so all that's-- and he

had this conference called Telecosm. That ran, and I had my own Dynamic Silicon conference, and I wrote the newsletter for couple years but the business started to go bad.

**Fairbairn:** Now, you distributed it through his--

**Tredennick:** It was-- yeah, it was Gilder Publishing, and they published the Gilder Technology Report, Dynamic Silicon, the Biotech newsletter and Powercosm. So there were four newsletters, and mine was one of them. As the telecom business went down, those newsletters gradually collapsed back into the Gilder Technology Report. He and I wrote Gilder Technology Report for a few years, because he was writing another book. He's written, like, 20 books, and when he was busy, -- writing a book or off giving lectures or something -- then I'd write the newsletter. So you can go back and read those newsletters. We had very different styles of writing and so you can kind of tell which ones I wrote, but I don't know if anybody else knew that there were actually two writers.

**Fairbairn:** Two authors. <laughs>

**Tredennick:** Yeah. But I was listed on there and I'm still, -- in fact, my business card still says I'm with Gilder Publishing, so as far as the world is concerned, I still have Tredennick, Inc. I still work for Gilder Publishing. I'm now retired from the military, and my wife hopes I don't run into a Marine Corps recruiter, because I've got the Army, the Navy and the Air Force all behind me now.

<laughter>

**Tredennick:** So...

**Fairbairn:** So I don't know what-- I want to go back to the general topic of reconfigurable computing. You played around with that for a while. What's happened? What do you feel the outcome of that was? What made that work or didn't work? What's the status of that?

**Tredennick:** Well, actually the whole community is still, I wouldn't say thriving, but it's growing. It's still a pretty decent topic, I'd say. Once I left Altera, I didn't have any resources to participate in any of that. I guess I could've applied at universities for a position but I just--

**Fairbairn:** Know what you want to do.

**Tredennick:** Yeah, and so I kind of left the topic behind, but there's still a research community that was pushing for features in the FPGAs, and the FPGA companies just weren't listening to the research. The university guys, because they were, they had growing markets commercially that were as good as they-- as much as they could supply. They were growing as fast as they could manage. So they didn't really need to listen to the university guys.

Eventually that happened, and so now you have features like partial reconfiguration inside the processor and it's fundamental to the processors. If one of them had done it and the other one didn't they-- the one

that didn't would be out of business. So eventually the university guys became more influential as the application base, and so let me go back to what I think the problem is with FPGAs. That's that when the company started they were all transistor guys. You know, they're layout guys. They're making FPGAs. After they got to a certain size, and I'll say it's a million components a chip, they go, "These are really logic designs and not circuit designs. We better start hiring some logic designers."

But the chips themselves still required logic designers in order to make use of their capabilities, and the community of logic designers wasn't growing very fast. So I think those FPGA companies would have done better and therefore reconfigure computing would've done a lot better if the companies, and I'm talking inside the companies. If Altera and Xilinx had started, once they passed a million transistors, they started hiring guys from LSI Logic, John Dana and those guys. The logic guys came in and started running those companies. If they had said, "Wait a minute. There're 10 times or 100 times as many programmers as there are logic designers, maybe we should have software guys running the company and maybe we ought to make these chips accessible to programmers instead of logic designers," then they could've made that transition to continue the growth rate, and I think that's really what kind of stalled both reconfigurable computing and the FPGA business. They didn't make that-- they maxed out on the number of design seats that they could sell because there just aren't enough logic designers in the communities to support the kind of growth that they could've had. So that's-- I guess that covers kind of reconfigurable computing as well, but there's definitely still a community out there that does that and the chips are now headed in that way. They're enabling partial reconfiguration, run-time reconfiguration, so...

**Fairbairn:** Okay. So let's wrap things up. You were working with George Gilder, Gilder Publishing. Sort of what comes after that? Are you...?

**Tredennick:** Well, actually, for the past--

**Fairbairn:** Are we up to speed or what...?

**Tredennick:** We're almost there. We're almost there. For the past five years I've been working with a startup company as, again, -- was three guys. Now it's two guys. But for the past five years, and we're working on transaction security, and format preserving encryption. So cryptographic stuff and chip-level identity and key management. I'll try to make the story kind of brief. We started out saying, "You know, if we did this cryptographic protocol where we have end-to-end encryption, then we don't care what the holes in the internet are and the protocols that are traveling over the internet. As long as we have end-to-end encryption, we can avoid man-in-the-middle attacks and replay attacks and things like that." Then we go, "Yeah, but the end points aren't secure." So then we started messing with write-only storage and some kind of storage that would be secure and that kind of thing, and ultimately go, "We know, really you need chip-level identity."

Each chip has to be able to create its own cryptographic keys and it needs to have three of them. It needs to have a secret key, a private key and a public key, and the public key's going to be its identity. You can't store it on chip either, so you have to be able to, when you power up, you have to be able to

retrieve the original key every time over the life of the process.” That’s an unsolved problem right now, and so we’ve been working on that for about five years, and we have the solution to it.

We can do what we call precise key recovery, and we can do self-provisioning. In other words, when you manufacture the chip, you don’t have to do it in a secure facility. It’s going to-- first time you power it up, it’s going to create its own keys that it can recover even as the process degrades over 20 years. It’ll still be able to give you that original key back, and so we’ve been doing that now for-- well, it has to be self-provisioning and it has to be-- autonomously manage those keys, and you have to have a way to communicate securely. So once you’ve solved all those problems you can do transaction security. The problem is, how do you get it into the field? Because if I go to Microsoft, they go, “Well, your protocol looks interesting but we don’t care about the chips,” and if you go to chip manufacturers, they go, “What do we want with that?” you know. “You can’t deploy this protocol,” So we’re currently working on a strategy to do that, and I’m also an advisor to Silicon Catalyst, which is a very interesting company that’s run by Pete Rodriguez, who used to be in my Navy Reserve unit, so...

<laughter>

**Tredennick:** He’s the CEO of Silicon Catalyst, and if you’re not familiar with Silicon Catalyst, that is a good place for you to mine for the people you may not have interviewed yet. Because you look at Silicon Catalyst’s website and then go to the Advisors page, and just get a list of the advisors and they’re, I mean, they’re John East and guys that are-- they’re the guys that have been in Silicon Valley for decades and they’re--

**Fairbairn:** So what does Silicon Catalyst do? What...?

**Tredennick:** It looks at candidate startup companies that are specifically trying to build hardware, because their idea-- and I think this was Rick-- I’ve forgotten his last name at the moment. Rick Lazansky, I think is his name, started this, and he said, “You know, all anybody wants to do anymore is software. So we need chip companies and this is Silicon Valley, so let’s build a support structure for chip companies,” and so--

**Fairbairn:** So is it a venture firm?

**Tredennick:** It’s a venture-- it’s kind of a venture firm, but they’ve got a whole bunch of partners like Siemens and Bosch and TSMC and Advantest and--

**Fairbairn:** Right, little ecosystem to support.

**Tredennick:** Yeah. They’ve got about 18 of these contributing partners that’ll supply you with the design tools and the test patterns and the shuttle runs. So they look at candidate companies and they call their advisors in and we sit out in the audience and kibbitz the startup companies and decide, “Hey, that’s a good idea, but that’s not going to work for this reason and this reason,” and we try to adjust them, and I think over the past few years they’ve looked at almost 300 companies and they’ve selected 18 of them, I



want to say, some number like that. So it's a pretty steep selection process, but they've got some very interesting companies and they can provide them with chip support and design tool support. Millions of dollars of support to a startup company, including shuttle runs and potentially customers. Texas Instruments, for example, is one of the sponsors, and so it's very interesting and for me, It's like I don't belong here, but if I can get in a room with all these smart people, I can listen <laughs> to them and talk to them. It's just an amazing collection of people that they've put together. But I have to say, I think I have the most interesting bio on the advisors list.

<laughter>

**Fairbairn:** I think that's a safe assumption based on these that I've spoken with.

<laughter>

**Fairbairn:** Nobody has quite the varied combination of skills and background that you bring to the table.

**Tredennick:** Yeah, I'm still searching for that-- you know, there's this movie called "The Natural," which is about a baseball guy.

**Fairbairn:** Baseball. Yeah.

**Tredennick:** Right?

**Fairbairn:** Right.

**Tredennick:** So I'm still searching for that thing that I'm a natural at, and I just haven't found it yet.

<laughter>

**Tredennick:** But I remember, I walked in. I was doing a consulting job for some Japanese company one time and I walked into the company and the guy looks at me and he goes, "Aren't you Nick Tredennick?" "Yeah." "Well, I thought you were a professional comedian."

<laughter>

**Tredennick:** "You're here to consult?"

<laughter>

**Tredennick:** Because he had been to Microprocessor Report, or the forum.

**Fairbairn:** The Forum, yeah.

<laughter>

**Tredennick:** So yeah, I aspire to be Don McMillan someday.

<laughter>

**Fairbairn:** Do you know Don personally? You must.

**Tredennick:** No, no. But I do like his presentations. I mean...

**Fairbairn:** I haven't talked to him for quite a while. We've exchanged a couple of emails, but...

**Tredennick:** Oh, yeah. I mean, his stories about <laughs> Al Stein and forgetting his badge. I mean, Don forgot his badge and he's got Mohammed somebody-or-other's badge on and...

<laughter>

**Tredennick:** Because Al's a stickler for badges and he's like... <laughs>

**Fairbairn:** Yeah. Everybody's got to have their badge. You got it.

**Tredennick:** "What are you doing today, Mohammed?" <laughs>

**Fairbairn:** So as a wrap-up, Jesse Jenkins asked me to ask you about your home in Santa Cruz Mountains.

**Tredennick:** Oh, oh. Well, so my wife is a city girl, but now she's a country hermit. So we have 37 acres out in the Santa Cruz Mountains, and I do what I call recreational landscaping. I have miles of roads to maintain and I have a number of tractors and a bunch of military vehicles and <laughs> my wife is-- she's a gem, but she says, "It's a good thing you weren't born a girl, because you can't say 'No,'" and so--

<laughter>

**Tredennick:** So we have something like 14 cars, and I've got a 5-ton military wrecker, you know, tank retriever. I've got a five-ton military dump truck, which causes problems with insurance company because you go, "No, I'm not--" you know, they want to charge commercial rates for a dump truck and I'm saying, "No. This is just a personal dump truck. I'm not running a business out of this." You know, it's not what I have it for, and they're like, "We don't believe you." So anyway, I have the military--

**Fairbairn:** Say, "Come visit me and then you'll..." <laughs>

**Tredennick:** Yeah. "Come visit me and then you'll believe me." So I have a military dump truck. It's actually my second one. I rolled my first military dump truck. I was helping a neighbor. I was going to

help him backfill his retaining wall and I was backing down his driveway when the brakes failed. One of the brake lines broke. I mean, these are old vehicles. This 1970. I rolled backwards down his driveway, took out his carport, went between the house and the retaining wall. I'm sorry, the house and the propane tank, through the retaining wall and flipped over. Anyway, so I had to buy another dump truck. So I dump--

**Fairbairn:** Well, <laughs> it sounds like you had a <laughs> good use for that insurance that you were having trouble with.

**Tredennick:** Oh. So yeah. So I'm talking to my neighbor, "I'm sorry about wiping out your carport, but I'll go get my wrecker and pull this thing out," and he says, "Well, let me call my insurance company," and he calls the insurance company and say, "Don't let him anywhere near <laughs> your place." <laughs> So anyway. So I have the wrecker, the dump truck. I have a 1954 M211, which is a Korean era deuce and a half. I have a Humvee, which is the Marine Corps Humvee. I have a thing called a Mule, M274 Mule. It's a four-wheel drive, four-wheel steering, actually, little-- tiny little military vehicle. It weighs about a half a ton, and I have a Hummer, which is different from a Humvee. It's commercial version, and then I have, oh, a bunch of ATVs. I have a loader-scraper, a backhoe, a 1948 Case tractor, and I have a number of cars. I have four Mustangs. I have one I bought in 1968. It's a one-owner car. I bought it new in '68. It's got, like, 250,000 miles on it. I've got a '65 Mustang convertible, 2012 GT 500. I've got a 2018 Mustang convertible. I got a 1993 Corvette I bought new. We have a Lincoln Town Car. We have a Dodge Dakota. Anyway, an MG Midget, so-- and then when we bought the place it was just a house, but my brother builds stuff, so he comes out, we build a garage. He comes out again, we build my office. He comes out again, we build a barn. He comes out again, we built a truck port, and so we've built or rebuilt everything there except the main house, so...

**Fairbairn:** <laughs> You keep all these things working, all these vehicles operational?

**Tredennick:** Yeah. I do engine rebuilding. I don't do body work, and I have my own forklift, because we shop at Costco. But yeah, I do all the maintenance on all that stuff mostly. I mean, we take it to Jiffy Lube for oil changes and stuff like that just because I'd never get around to it, but yeah, I do all that. I changed the clutch in my five-ton dump truck, which is interesting, because the transfer case probably weighs a thousand pounds. I rebuilt the differential in my-- so turns out tractors are different the way they do brakes. They have wet braking inside the differential. So I bought a CAT 416D, which is a loader-scraper combination that's a pretty heavy vehicle, and it turned out the brakes were going out on it, so I had to drop the whole back axle. Now, a wheel on one of those things is 24 inches. They're four feet tall or something and they're full of water. So first of all, I have to empty out the water, because otherwise you could get crushed just taking a wheel off. So I take the wheels off, take the differential out, and it weighs probably nearly a ton. Disassemble that thing, get all the brake plates out of there, go down to the CAT people and buy all the parts, put it all back together in my garage and put it back together, so that's all on Facebook, actually. I've got pictures on Facebook for doing that. So yeah, that's my place. We both love it out there. My wife's now a hermit.

**Fairbairn:** So are you doing technical stuff now? Are you consulting or what's...?

**Tredennick:** Yeah. Well, I'm still doing this startup company. I'm still working with Silicon Catalyst and so--

**Fairbairn:** Those are your two outside...?

**Tredennick:** Yeah, I'm still doing university accreditation, and George just came to visit me again and he said, "Hey, I'm thinking of starting the newsletters back up, and I want you to write one of them," and so I went through the same thing with him again. I said, "Well, you know, the topics that you're suggesting here are just like the last time we talked. They're not quite the right set. You know what happened in the computer business with the invention of the PC, how everything became standard interfaces and the whole industry blossomed off of standardization and competition. That same transformation needs to take place in mechanical engineering, and specifically in three areas. One of them is prosthetics, robotics, and vehicles." I saw this in the Army Science Board when I did a study on robotics, and this was 10 or 15 years go now. I went and studied robots the Army was using at the time. At the time the Army had, like, a hundred robots, and every single one of them was a unique robot. That's insanity personified, because that kills people. I mean, first of all, if you've got a hundred robots that are top-to-bottom integrated, there're a hundred different supply chains for all those robots. In addition to that, you give a convoy a robot and so here's a whole convoy of supplies going somewhere. They run into an IED or a suspected IED. Okay. Break out the robot and go check that out. Well, this isn't the IED robot, you know, this is the unexploded ordinance robot, and so what happens then? The whole column, the whole supply column gets stalled while they find out where the IED robot is and bring it in on a helicopter. That can be six hours. It might not even be in the same country. What you really need is a reconfigurable robot. Something that's modular, that's got components that are, you know, so the-- I go back and here's my robot kit and there's an instruction manual with it that says, "For an IED, plug these interfaces together and send the thing out,"

So there's a big transformation coming. All of mechanical engineering needs a complete overhaul, and there's a guy in Austin, Texas, at the University of Texas. He wasn't there when I was there, but I met him on the Army Science Board. I got to know him when we were doing the robotics study, because I said, "You guys are asking the wrong question. You know, what really needs to happen here is this modularization and this transformation in robotics."

So this is in a big meeting with the Army Science Board. I say, "Okay. So Del and I will write the minority report for this," and Del's sitting over there going, "What?" <laughs> But he's been doing-- he's a mechanical engineer in robotics, who's been working in the field for 40 years, and he knows exactly what needs to be done. So he and I wrote the minority report for that thing, and that was a typical, a couple of typical things happened on these Army Science Board reports. If you confirm the thing that the Army wants to hear then they'll publish your report. If you come up with conclusions that they don't agree with, they will bury it. I actually had a two-star general come to one of my presentations specifically to filibuster so that I couldn't present the results. That was a study on, you know, "What's the next communications system they were going to field for the Army?" and I said, "There are two major things wrong with this. First of all, you've got a 15-year fielding plan. From the time the first unit gets the new devices until the

time the last unit gets the new devices is going to be 15 years. That thing's going to be obsolete in two years. You'll never even get three years into your fielding plan before this is no good.

The second bad thing you've done is you got these things called key performance parameters." They say, "We've got five key performance parameters that this thing has to meet," and so what the Army does is say, "Okay. We're going to set what these parameters are and you're going to design to those parameters. I'm like, "That's not a good idea, because what you're talking about is radios, and radios are what the cellular guys are doing right now, and you've got five of these parameters, they're not defined right now, but two years from now, at least three of those are going to be defined by the cell phone guys, and you're not going to be compatible with that. So what you really need to do is start down this path using the knowledge that you have right now with the confidence that those guys are going to define these parameters before you get to the end point, because otherwise you're going the wrong way," and so the guy came to filibuster my presentation because--

**Fairbairn:** He wanted to see the other plan.

**Tredennick:** No, it's worse than that. It's like, "I don't care how bad this plan is. If I let this information out that this-- it's no good, the Navy will take our money."

**Fairbairn:** Oh.

**Tredennick:** <laughs> So we're going to spend it on this garbage. <laughs> So...

**Fairbairn:** Yeah, that happens a lot.

**Tredennick:** Yeah.

**Fairbairn:** Okay.

**Tredennick:** Well, that's probably more than I should've said about a lot.

<laughter>

**Fairbairn:** It's a fascinating story.

<laughter>

**Fairbairn:** It's more twists and turns than I had...

**Tredennick:** <laughs>

**Fairbairn:** And what little information was available, it was like, "Wow, this is much more to..."

<laughter>

**Fairbairn:** It's broader than I had anticipated.

**Tredennick:** Well, I hope it's entertaining enough that somebody will watch it. <laughs>

**Fairbairn:** Oh. It's actually very interesting, very entertaining. Yeah.

**Tredennick:** So...

**Fairbairn:** You've had quite a <laughs> unique experience.

<laughter>

**Tredennick:** And maybe I'll find something I can do.

<laughter>

**Fairbairn:** The trouble is, there are too many things that you can do. <laughs> Finding something to do is not the problem. It's...

<laughter>

**Tredennick:** Right.

**Fairbairn:** As your wife says, learning to say "No," is the problem.

**Tredennick:** Yeah, yeah, yeah.

<laughter>

**Tredennick:** Yeah, so she screens my phone calls for that very reason.

**Fairbairn:** "Nah, he doesn't want to talk to you." <laughs>

**Tredennick:** She-- that's right. She says, "You know, he's not taking any more expert witness testimonies. Not going to do it anymore." So she's trying to say, "No," for me, and...

<laughter>

**Fairbairn:** All right, Nick. Thank you very, very much.

**Tredennick:** All right.

## END OF THE INTERVIEW

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<sup>i</sup> [Interviewee's note] Early in the interview, I mentioned that I struggled with the microprocessor design because there was no documented design process. I was critical of the design automation people and design automation conference. How did those design automation people know what they were automating? I eventually did a second microprocessor design partly to document the design process. I wrote a book on microprocessor design, but, in the interview, I forgot the punchline of the story. The joke was on me. In a rapidly evolving field like semiconductors, the constraints change for each generation. There was no process appropriate to the design I was doing; it had to be invented as I did the design. Similarly, the process I documented was obsolete by the time I had written it down. Because the underlying semiconductor process evolved, the constraints changed and therefore the design process had to evolve and change with each new design.