Cisco Heritage Project Oral History Panel
Thomas C. Rindfleisch and Edward Feigenbaum

Moderated by:
Chuck House

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Chuck House: Hi. This is Chuck House. It's August 12th, 2014. We're here on behalf of "The Cisco Heritage Project" for the Computer History Museum. And I have Tom Rindfleisch and Ed Feigenbaum here to talk at some length today about the origins of Cisco on the Stanford campus and what some of the twists and turns and how all of that went. Tom, Ed, it's a pleasure to have you on camera today.

Thomas C. "Tom" Rindfleisch: Thank you. It's good to be here.

Edward "Ed" Feigenbaum: Good. I'm glad to be here. We can't see you though.

Rindfleisch: <laughs>

House: I'm off camera, so…

Feigenbaum: There you are. The shadows.

House: It's a panel of the two of you, and that's as it should be. I'm not the talent for this show. You two are. Let's begin. Maybe Tom, you could share a little bit about your history in the period from about 1975 up through now, your career and where you were working and what your job title was.

Rindfleisch: Actually, let's go back to 1971, which is when I came to Stanford. I was invited to come to Stanford by Josh Lederberg and Ed Feigenbaum, from the Caltech Jet Propulsion Laboratory. And I became involved in the DENDRAL project, which was one of the first artificial-intelligence-in-medicine projects. And as part of that project, we evolved the need for more computing facilities. And so we proposed a facility to the National Institutes of Health called the SUMEX-AIM project, the Stanford University Experimental Computer for Artificial Intelligence in Medicine. And in order--

Feigenbaum: But you forgot the M.

Rindfleisch: Huh?

Feigenbaum: Stanford University Medical Experimental--

Rindfleisch: Ah, yes. Okay. <laughs>

Feigenbaum: --Computer. For AI in Medicine. And the "AI in Medicine" was tacked on largely at the behest of the funders at NIH, who wanted to show that it was-- this is very important in the story, actually-- that it was a national service, not a Stanford resource, but a resource to the nation. Because it was being funded by the Division of Research Resources, which was used to funding nationally-related things like the National Primate Center, for example. So that gets us into networking. If you're located at Stanford but you're serving the nation with a computer, you're kind of interested in networking.

House: Well, and you had experience at JPL with the same kind of thing.

Rindfleisch: Not so much. JPL was mostly focused internally on the development of spacecraft and the software for managing image processing. And networking was not so big an activity there. But as Ed said, it was crucial to the SUMEX-AIM project. And we had users… It ran for about 20 years, and we had on the order of 15 to 20 user projects, half of them at Stanford and half at other universities. And initially in the '70s in order to get people onto our PDP-10 computer, which was located at Stanford, we connected to a variety of communication technologies in order to get the kind of coverage that we needed. So for example, we had 1-800 numbers, we were connected to TYMNET, which was a network that is often not heard about much but started in the '60s to allow people to get terminal access to TYMSHARE, T-Y-M share, computer facilities for business. And we became the first non-DOD-funded node on the ARPA network, in 1974. We were node number 56 out of an ultimate capacity of 63. In order to get a broad coverage, it turns out that TYMNET was not very fast, and as the ARPANET matured and TELENET evolved from the ARPANET under Bolt, Beranek and Newman, after attracting Larry Roberts as CEO, we used TELENET as well. And so we had ARPANET, TYMNET, TELENET, and 1-800 dial-in numbers in order to get people access to the SUMEX-AIM machine. And it was aimed at primarily research in AI but also collaboration. That is that we could share software among this community of AI-in-medicine users, which ranged all the way from research in biochemistry using physical chemistry tools for examining molecular structures, eventually to clinical medicine and research in psychology and other domains in biomedicine. During this time, there was a movement, of course, toward more individual computers. That is smaller, more compact computers. And we had this vision of computers that were going to be spread around among the community as opposed to coming simply to a central mainframe computer. Of course, the work at Xerox PARC motivated a lot of that -- the work on the Alto and Dorado computers and eventually the Ethernet work. And that led to another era of our work in the 1980s. In 1980-- actually, New Year's Eve of 1979 -- we received access to the three megabit Ethernet codes that Xerox PARC was gifting to MIT, Carnegie Mellon, and Stanford. And so we began implementing Ethernet to connect our various machines together at the early part of the '80s. And this led very quickly to the realization that we were going to end up with a network of networks in the sense that the systems group of SUMEX-AIM was in the Medical Center, whereas the computer science component of the project, Ed and Bruce Buchanan's work, was in the Computer Science Department that actually ranged over a number of facilities, Margaret Jacks Hall and some of the temporary buildings. And our medical collaborators were in the Medical School in various places, or the Department--

Feigenbaum: In the chemistry

Rindfleisch: Yeah. Carl Djerassi.

House: And I'm sorry, Ed? In what department?

Feigenbaum: Chemistry.

House: Okay.

Feigenbaum: Our DENDRAL project was joint with Carl Djerassi.

House: Mm, that's true. Yeah.

Rindfleisch: So we ended up--

House: So let me back up there just a little bit, because you kind of went from '71 to '80 pretty quickly.

Feigenbaum: Wait. I got to say though, but you didn't bring yourself up to date. Chuck asked you what did you do right up to the present. <laughs>

Rindfleisch: I was director of the project from 1973 <laughs> when it started until the end of the project, which was renamed (in 1990) to be the Center for Advanced Medical Informatics at Stanford, in 1995. At that point, I decided to move over to the Lane Medical Library and begin to convert that to a digital library. Which meshes with my computer science interests in information retrieval and the use of collaborative environments. And we evolved a project there with Ken Melmon, former chair of the Department of Medicine at Stanford, called SKOLAR, which stood for Stanford Knowledge Online for Learning and Retrieval. This was an attempt to bring a wide range of digital information from textbooks to drug literature to research literature to physicians so that they could answer questions in the course of treating patients. So I ended up being the Vice President for Technology, or Chief Technology Officer, and Vice President of Research and Engineering in that company as it spun off. We had, I think, spun off on the order of five or six startup companies in the course of the whole SUMEX-AIM project from AI companies to systems companies, like the technology for Cisco systems, and a language that was intended to be machine independent called Mainsail, and another router project that was the Kinetics FastPath router between AppleTalk systems and the Internet -- because Apple at that point had not bought into the Internet and they had their own proprietary software. Actually, that's a jumping off point, because I think it

characterizes one of the things about the ‘80s. There were a lot of companies that were trying to push their own network technologies. I mentioned that Apple had not bought into the Internet. They had their own personal, their private, idiosyncratic network called AppleTalk. Microsoft had the same situation. Novell with NetWare had their own. IBM had their own. So there were these silos of network development that the various vendors were pursuing that really didn’t facilitate people talking to each other over distances, which was the business that we were in. And so that led us to work with people developing the Internet. For example, Vint Cerf came by and I had a long conversation with Vint about the way we were integrating users between various machines by using these dial-up networks or serial communication networks along with the ARPA network. And the SUMEX-AIM computer was acting basically as a big router in the sense that a user from Rutgers could dial in to SUMEX-AIM, run a program there to get to another machine on the ARPA network and exchange data or run software or develop software, whatever they wanted to do. The problem is that you had to translate from each one of these input media into a byte stream in the SUMEX-AIM computer and then retranslate that into another technology or set of protocols to go anywhere else on whatever network you were talking about. And so Vint and Bob Kahn of course were looking as the Internet protocol to be sort of a master umbrella protocol to allow these various devices to be connected together using whatever protocols happened to be appropriate for what was going on, be it e-mail or TELNET or FTP or eventually things like the World Wide Web. And that led us into the router development technology, which started I think in 1981, about a year after we got the first Xerox three-megabit Ethernet.

House: So let me stop you there just--

Feigenbaum: I’m glad you’re stopping him, because I wanted to add a little bit to it, but go ahead.

House: So this period from ’73 to ’81. You’ve quickly moved through that, and I appreciate several points. One is that you’re trying to connect multiple universities.

Rindfleisch: Right.

House: At a distance. So you’re really, you’re doing that distance connect. If you go back to the early work connecting UCLA, Stanford, Santa Barbara and Utah, the first four connectors on what was the ARPANET at the time, that was a long-distance connection.

Rindfleisch: Right.

House: SRI I think had the ARPANET node more than Stanford itself. I could be wrong on that but…

Rindfleisch: There was actually a cluster of nodes in this area. The AI lab had an IMP, SUMEX had an IMP, SRI had an IMP, and Xerox also had an IMP, Interface--

House: But you mentioned 63 total nodes.

Rindfleisch: Right.

House: So there weren't many.

Rindfleisch: Nope.

Feigenbaum: No. But we were a bunch of them.

House: And you were several of those. You, Stanford, was, counting SRI, were several of those nodes is a way to say it.

Rindfleisch: That's right.

House: Okay.

Feigenbaum: Yeah. But I think just to comment on what Tom was saying in passing, to make a distinction. When SRI-- as UCLA and SRI and Utah were linking to each other to demonstrate some things that ARPA wanted demonstrated about networking, there was no serious work that was moving over those lines. That is, there's no computer science going on.

House: Oh, true.

Feigenbaum: The dream that (J.C.) Licklider had that somehow we'd all be sharing each other's computers to do work wasn't happening, and it never did happen. But on our machine, there really was, honest to God, AI-in-Medicine work for people who didn't have big computers and didn't have our software and didn't have our staff. They were coming in over, usually, TIPS, these things you phoned into rather than hooked your computer to. And they were really doing projects in AI and medicine. So there's a big difference between--

House: Well, but I think there were some other-- let me at least volunteer the notion that Lynn Conway and Carver Mead were doing at PARC, that led to what became the foundry chips, the silicon structures projects, was a connection of 12 universities with HP as the foundry. And Stanford led that pretty strongly with Forest Baskett and people like that. That was ’78, ’79. So I think there was at least some other work being-- you know, the book “VLSI Design” got written over the Internet.

Feigenbaum: Yes.

Rindfleisch: Good example.

House: Or over the ARPANET actually. So to me that was another classic example of trying to connect MIT, Yale, Stanford, Princeton and so forth, for a work process. And so I don’t think there were many, but I do believe there were two or three examples.

Rindfleisch: That’s a very good example. And I think, actually, my recollection is that most of that happened in the early ‘80s, which is why I sort of make the break there. The Internet itself didn’t, we didn’t change from the network control protocol of the ARPANET to the Internet protocol until 1982.

House: That’d be right. We hired Bert Raphael from SRI to HP in ’82, to bring that connection for us.

Rindfleisch: And that was a major, major transition.

House: Right.

Rindfleisch: Now, it raises another interesting point, which is the contrast that I tried to draw before, namely the silos, networking silos that the various computing vendors were building as opposed to the general interface of the Internet. It was not clear at all that the Internet was going to be the smashing success that it has become. It started out as a network of just 63 nodes, the old ARPANET, and then began to develop during the 1980s as the National Science Foundation took over promoting expansion of the network into various computer science departments around the country. But it still didn’t have a place in the general population. So it was limited to computer science departments or technical facilities and industry research labs that made use of it. The expansion into a more general kind of user-oriented marketplace didn’t take place until the end of the ‘80s when Berners-Lee invented the World Wide Web protocols. Even though before that the various protocols like Brewster Kahle’s Wide-Area Information Service and the Gopher protocol that came out of the University of Minnesota were trying to do the kinds of things that allowed people to get at information. But it was the beautiful, absolutely gorgeous design, of the World Wide Web that led to the real explosion of the Internet. And so as we were building these

network tools, sort of the plumbing to be able to hook these machines and the network of networks together, it was not clear how successful or how widespread that was going to be as a business or as a way of expanding the technology. And I should also mention that in addition to Cisco there were some other companies that were beginning to try to get off the ground then. MIT had been developing technologies in this area, I think under Dave Clark. And they tried to launch a company called Proteon, that was building and delivering gateways and terminal interface processers or TIPS, about the same time. Now, I can go on about this sort of general background, that I thought it was important to sort of set that stage, because we typically get the idea that this whole thing was designed with clear foresight of how it was going to turn out. And that everybody knew exactly what was going on and how things were going to work out, as opposed to being an experimental operation that really had a number of people who were firm believers, and a number who were not firm believers. So for example, John McCarthy, one of the pillars of computer science, was not all that sold on the Internet protocols and the Internet. And he was promoting a system called DIALNET. In fact, he had Mark Crispin working on that for about five years, where the idea was I would keep in my computer your phone number and Ed's phone number, and if I needed to get in touch with you, the machine would dial out over some sort of communication link and make a temporary link as necessary, and then shut it down. There were other people who didn't believe that the packet-switched technology that grew out of the work that Paul Baran had done (at RAND Corporation) and evolved into the Internet TCP network, each packet had a header and other information that allowed the receiving computer to understand what was in there. And if you were sending teletype or characters coming from a terminal, you may have only one character <laughs> in this packet. And people were saying, "Well, gee, that's a huge amount of overhead. This will never work." And so there were skeptics along the way. Some of them, as I mentioned, John McCarthy. Others, for example, Ralph Gorin, who was a really innovative computer systems guy at Stanford who helped John launch the Low Overhead Time-Sharing system that replaced the punch card student education system that had been in place at Stanford.

Feigenbaum: Chuck, Ralph Gorin is named in that Dienstbier interview that you did.

House: Yes. He's also named in the Merc article that--

Feigenbaum: Merc article?

House: The San Jose Mercury.

Feigenbaum: Oh, oh, yes.

House: _____ story.

Feigenbaum: Yeah.

House: And Ralph's mentioned both there and with Tom.

Feigenbaum: So you might want to talk to Ralph.

House: Didn't he later go work with Len Bosack?

Rindfleisch: He went north up to Washington State or Oregon and he was working with--

House: Yeah. I think Washington State.

Rindfleisch: --a guy named Ken Harrenstien who was also one of the early developers of network technology. And then when Len Bosack spun off from Cisco, I think Ralph connected up with him. Mark Crispin also left Stanford and went to the University of Washington. There was sort of a cluster of people that migrated to that area.

House: Sure. Okay. So I guess the question is did Ralph stay with Len then, or was that a relatively short-term thing, or do you know?

Feigenbaum: I have no idea.

Rindfleisch: I don't know either. We see Ralph--

House: It's one thing to have somebody who's a good friend of his give us an opinion. It's another to have <laughs> sort of an independent observer. But we do plan to talk to, or we'd like to talk to Ralph. I have not contacted him yet.

Rindfleisch: Yeah. We see Ralph periodically when there's a celebration at Stanford and he comes down to--

House: Oh, I imagine. I imagine.

Rindfleisch: Yeah.

House: So just to summarize what I think I've heard is the characterization through the '70s would be that primarily this was a university ARPANET-driven kind of activity. And was really restricted to just a very few sites for long-distance in a couple of cases for research, but in others mostly just to establish that communication rails could be built, sort of the Licklider perspective. And anything that came from corporate networking groups tended to be, if anything, focused on local area networks and very provincial for their own purposes.

Rindfleisch: Right.

House: Is that a fair way to think about it?

Rindfleisch: Yeah. The only thing I would add is that because we were National Institutes of Health funded, many of our users--

Rindfleisch: --could not use the ARPANET to get to our machine.

House: Well, I wanted to ask that, because that accounts for the TYMNET and other connections, right?

Rindfleisch: Right. Yeah.

House: But it was largely not, I mean, silos was the name of the game for the '70s for the world.

Rindfleisch: Right.

House: No one thought in terms of using anyone else's hardware, for the most part. I think. I mean, even to bring it forward to Internet 2 , 114 universities and 20 research labs is all that was allowed on that.

Rindfleisch: Yeah.

House: Huh?

Rindfleisch: That's right.

House: Twenty years later. So there was a mentality that this is an academic purity kind of thing. It wasn't a commercial endeavor at all. And then Xerox PARC shows up. Sort of a quasi-academic environment, but run by a commercial enterprise, right? And you had the good fortune to have one of their three sites that they bestowed the Altos on, I guess; is that right?

Rindfleisch: Altos, and a couple Dorados.

Rindfleisch: And the three-megabit Ethernet technology, including the software and sort of the hardware specs that went with that.

House: Okay. And Metcalfe was there at the time?

Rindfleisch: Metcalfe and Boggs were the guys that--

House: At PARC.

Rindfleisch: Yeah.

House: Right.

Rindfleisch: And Forest Baskett actually was working over there to help with this dissemination of the gift among the universities and coordinating that.

House: Okay. And then he came to Stanford as a consequence?

Rindfleisch: No. He sort of had a foot in both camps for a while.

House: Okay. Okay. Because he wound up being the one who described really for the world at Asilomar what was going on with the silicon structures project that--

Rindfleisch: Right.

House: Had a different name, but when we inducted Lynn Conway this last year, as a Computer History Museum Fellow, it was for her work that we were citing that. And Forest was the marketing manager, if you will. <laughs> Which he would not call it that at all.

Rindfleisch: Yeah. There was this famous summer course that Carver and Lynn did that had Jim Clark and, that's right, Baskett, and Andy Bechtolsheim and John Hennessy in it that led to these various--

House: Oh, yeah. No. It was--

Rindfleisch: --Sun Microsystems, Silicon Graphics, MIPS and…

House: That might be a good segue for you to talk about that, because those companies came off the campus.

Rindfleisch: They did.

House: As did Cisco, but they were structured differently in terms of the research that led to them and the way in which they got, that they had the intellectual property transfer.

Rindfleisch: I have to say that during this period, Stanford was trying to learn how to deal with this business of technology transfer. There had been lots of criticisms of government-funded work that it got to a certain point in the research demonstration, but then the transition into industry, into something practical, didn't go so smoothly or so easily. And then what was called the Office of Technology Licensing (OTL) at Stanford was trying to figure out how to deal with this. And each of these transitions was sort of a one-off kind of thing as they began to experiment with what the licensing should be like. I should say that the router project, which included also TIP technology, terminal interface processing, used the blue box, the Motorola 68000-based system, that Andy Bechtolsheim had designed that ultimately became the first step for Sun Microsystems.

House: Right.

Rindfleisch: And so we used that hardware as part of the router development work, but we, what we contributed was software. And I want to give credit to Xerox PARC, because they at the time, in the late '70s when Metcalfe and Boggs were doing the three-megabit Ethernet, realized that there was going to be a network of networks and they built a simple kind of gateway or router technology based on PDP-11s. And the very first thing that we put together by the end of 1980 was a PDP-11-based router that allowed us to get the Medical Center computer hooked up through Pine Hall, which is, I don't know, a quarter of a

mile away, and then up the chain to Margaret Jacks Hall and some of the other computer science locations so that we could get the various terminals and computers that were there, the Altos and Dorados and other machines that were being experimented with, hooked up to the resources in the Medical Center.

House: So was the technology that you had, machines at the Medical Center and other machines at the computer science labs?

Rindfleisch: Yeah. The--

Feigenbaum: Well, that's the nature of-- all of this was joint work between my group and Joshua Lederberg's.

House: But both are sitting in front of Altos is what I'm trying to ask? They're not sitting in front of a terminal.

Feigenbaum: Tom was over in the Medical School, and I don't know if there were Altos sitting there.

Rindfleisch: There were no Altos there, but we had an experimental graphics machine from DEC called a GT-40.

House: Okay. Sure.

Rindfleisch: Which is a PDP-11 based graphics tool.

House: Right, right, right.

Rindfleisch: So we were experimenting with different kinds of machines.

Feigenbaum: Right. But we computer scientists in Margaret Jacks Hall certainly had stuff.

House: Well, I know, I mean, I was in that lab enough I knew what that looked like. But I didn't know what was in the medical side. But the point was you had them connected and you could do essentially joint work.

Rindfleisch: That's correct. That was the whole point of it. And--

House: Yeah. As late as, or as early as 1980, end of '80.

Rindfleisch: Yeah. That was when it started really in earnest, I would say. DEC came out with the DEC-20 series in the late '70s. And we bought a DEC-2020, which was the small version of the DEC-20 in our machine room. The idea being to have a way that we could export AI programs, since we couldn't do it just with the software, because it was written in LISP and required a fairly complicated systems environment. We were looking at that time for a machine that was a small enough package that it could be purchased economically at some other place. And so we were experimenting with different kinds of hardware and the way of packaging software to be able to collaborate as graphics became more and more important in the interfaces to these machines.

House: So that triggers a bit of a thought. So Len Bosack is said to be a DEC-20 bigot. That probably stemmed from that machine.

Rindfleisch: Well, yeah. He, the AI Lab, and the Computer Science Department, got one of the very early DEC-20s, because of the close cooperation between John McCarthy and other people in the AI Lab with Digital Equipment. And so they got a very good deal on that. I think it was not a DEC-20 at that point, it was a KL-10, in DEC's designation. But that began that upgrading from the PDP KA-10 that John McCarthy had had in the AI Lab, to the more modern machines.

Feigenbaum: There's a interesting twist for the exhibits that are behind us here and that will be coming next year. The, what Tom was just saying, what might have started out as a slight orientation toward the DEC line of machines based on some hardware architecture -- Gordon Bell's intellectual genius -- really became glue when the software got involved. And the TENEX operating system began to be developed. And in particular, inside of that, a beautiful programming language system called InterLISP, with LISP as its basis, but a whole surrounding, programming environment, the beauty of which has never been duplicated since.

House: That was Warren Teitelman and people like that.

Feigenbaum: Yeah.

Rindfleisch: Yeah.

Feigenbaum: And so that was really the glue.

House: And he was at BBN, when he did the original work, and then he came to PARC and finished it.

Rindfleisch: Exactly.

House: He just passed away--

Rindfleisch: Really?

Feigenbaum: Warren died?

House: Yeah. Yeah. (August 12, 2013)

Rindfleisch: Oh, my.

House: Yeah, tragically. Had a heart attack and died.

Feigenbaum: Oh, no.

House: Some months ago. I can't tell you when.

Feigenbaum: An accident or medical?

House: No. Apparently a stroke or a heart attack. I never knew which.

Feigenbaum: Oh, my God.

Rindfleisch: That's sad.

House: Yeah.

Rindfleisch: Sorry to hear.

House: So he was my classmate at Caltech and--

Rindfleisch: Yeah. <laughs>

House: --my son's soccer coach and, you know, <laughs> I mean, so I knew Warren for a long time.

Rindfleisch: Yeah.

House: But yeah, very-- and a young man. I mean, about my age <laughs> I say, confidently.

<laughter>

House: You know.

Feigenbaum: So let me back up to a branch in this conversation.

House: Yeah. Is this a comfortable conversation for you two?

Feigenbaum: Sure.

Rindfleisch: Yeah.

House: Is this working fine? I'm enjoying it very much, and I think you're really hitting the elements that I think will build the story very nicely for us.

Feigenbaum: Actually, I have a thick branch that I want to talk about, but I also have a thin one that goes back to Tom's monologue. So I want to do that one first. Stanford was extremely in my-- except for computer science, was extremely fortunate in-- two people that in its early days it was able to hire. One was Tom which was an amazingly fortuitous, excellent-- maybe the best thing that Lederberg and I ever did together.

RIndsfleisch: That is very kind.

Feigenbaum: Actually, Elliott Levinthal-- Elliott Levinthal of the Instrumentation Research Lab was cooperating with JPL on a Mars project and met Tom down there. But the other one was Les Earnest which Ivan Sutherland-- I think it was Ivan who-- Licklider —Licklider gave McCarthy the first batch of

money to start the Stanford AI lab when Licklider's first term in office as Director of Information Processing Techniques. But then when Ivan took over-- and Ivan knew John (McCarthy) real well from the Boston area. And Ivan said, "Oh my God. We're putting millions of dollars in and John doesn't know how to manage five dollars."

House: You've got that right.

Feigenbaum: Let's get someone in there who really knows how to manage. And John is an abstract theorist. So he happened to-- Ivan happened to know Les from, I think, my-- or Lincoln Lab days-- from Lincoln Lab days. And Les came out one day and showed up, and we interviewed him-- John and I-- and hired him and that was another sensational find. Now, why? Because these people you could look at their facilities-- the Stanford AI Lab facility or the SUMEX-AIM facility and you could-- one way of looking at them is to stand-off a thousand feet and say, hmm, that's a service facility that's aimed at helping Feigenbaum and his research people, or McCarthy and their research people do their AI work. Another way to look at it was, "oh, they're there to be the human machine interface with a national collection of people interested in AI in Medicine or something like that." But in order-- but Tom and Les were both very, very cutting-edge people. And I always like to say that the best-- in my view and I've published this numerous places—the best way to do computer science is as experimental computer science. Another way to put it is it's easier to discover than to invent. And you discover great things by being out there getting your hands dirty and working on cutting-edge problems. And so a significant part-- so Tom had wonderful people helping the rest of us be cutting-edge, but then they had this chunk of budget. And Tom gave them a focus of attention on new things-- develop new things for the community-- not just to serve them but to point in new directions. And the reason I wanted to mention that is-- first of all, you wouldn't expect it. You wouldn't expect there would be a substantial research component to the SUMEX-AIM facility. And I'm not even sure NIH knew that.

Rindfleisch: Some of the people at NIH did, yeah.

Feigenbaum: All right. And the Stanford AI Lab it never gets as much credit as it deserves for-- it gets a lot of credit for what AI it did, and for the work that John Chowning did in music synthesis and a few other things like that. But it really did some cutting edge hardware work, and it did some cutting edge software work as well.

House: I'm pleased to hear you say that, and I could only second the motion because my view is that the tools makers and the infrastructure builders, are researchers and discoverers quite as much as the people who use those tools. And without that underlying toolset of efforts the scientific world couldn't make the advances that it makes. But it is rare to (A), see it happen and (B), and rarer still to give credit for it.

Feigenbaum: So when you go out in the hall there and walk around the other side and see the display about Bill Yeager and the router. You realize Bill Yeager was working for Tom.

House: Right.

Feigenbaum: And the Computer History Museum after researching the situation gave him the credit for the invention of the router, and that really is giving SUMEX-AIM the-- we talked about Mark Crispin before.

House: Right.

Feigenbaum: Mark is the inventor of IMAP. How many people know that?

House: Well, I think--

Feigenbaum: Everything has to have an inventor, right?

House: What-- what you're touching on, I believe, is one of the purposes of a museum like this. Is in fact to honor-- first of all, to identify and then capture the stories of the things behind the scenes. The things that, in fact, led to others being able to build the companies that carry the names that have the billion dollar revenues are built on the shoulders of so many people that are unsung heroes. And I think our-- our opportunity on the one hand, our responsibility, absolutely is to identify and discover and honor those people. So I mean this is not just an interview about Cisco -- whether Yeager did this or Bosack did that. This is fundamental to the question of how invention and innovation takes place, I believe.

Rindfleisch: I agree completely with that.

Feigenbaum: Let me get back to my main--

House: Sure.

Feigenbaum: I just wanted to make sure that got said.

Rindfleisch: Thank you.

Feigenbaum: But the-- here's a-- here's a story. Tom already brought up the issue that the-- there had been circulating-- and by that I mean in Washington, not just locally-- the idea that we're not getting enough out of university research. Congress actually did things in those days and--

House: Hard to imagine all by itself.

Feigenbaum: Hard to imagine but there was a bill that went through-- I think it was Senator Dodd who promoted it, but I could be wrong on that (followed by the Bayh-Dole Act 1979)-- that shifted the locus of intellectual property rights from the government to the university- or to the non-profit. In the case of institutions of below a certain size-- I think maybe the size was 200 million dollars a year or some number like that. And that year was 1972 if I'm-- if I have it right. So you could say that in one sense the universities were unprepared for that. And Tom mentioned that in terms of the Office of Technology Licensing. It was like throwing them into the middle of the swimming pool

House: When was OTL created? (1970)

Feigenbaum: Maybe then.

House: Yeah, I think it was that event that sprang--

Rindfleisch: That event in the '70s. Yeah, Niels Reimers was the guy. Niels would be a wonderful resource--

Feigenbaum: Well, I know how-- no, no, no--

House: I talked with him some years ago-- maybe eight years ago. I had an interview with Niels, and I believe it was this trigger event is what he told me.

Feigenbaum: Well I-- no one had the guts to say all these years that they over promoted their role way too far, and they really screwed up continuously. And didn't know what the hell they were doing. And could not really say that well--

House: He said as much. I've never published an interview but--

Feigenbaum: -- while he was alive (he is still alive circa January 2017 $_{CHH}$).

House: -- he would agree with that.

Feigenbaum: So anyway, here we were-- but there was a commonly-- I want to give you an example of a commonly accepted view among the faculty as to what the rules of the game were. Partly it was formed by the discussions and agreements surrounding the Stan Cohen and Herb Boyer-- basically the invention of gene splicing and genetic engineering-- the famous patent that's jointly held. But what-- I guess it's expired now, but it was jointly held between Stanford and UCSF. So that made public a lot of the-- what one should think about-- how one should think about intellectual property. But here's a specific example, I was Department Chairman of Computer Science from '76 through '81. Inside the department there is almost no structure. So-- literally-- at any time, any chairman. The chairperson is the structure. So everything comes to him or her. There is no one else except if it's a budget matter that has to go to the administrative people. But otherwise if it's an issue of substance it comes through the chairman. One day Jim Clark comes by, and Jim says, "Ed, I got to talk to you." "Okay, great, what's it about?" "Well, as a result of this course--" that we're talking about here--

House: I built this chip.

Feigenbaum: -- I've invented this geometry chip. And I don't know what to do. What's my next step? Do I-- I want to make something of this, but I know that Stanford owns rights in it. And who do I go see and so on. And I told him to write this story. Go to see the Office of Technology Licensing and do what they say. Write it up for them, and they'll look at it. And it turns out-- again, one of their really stupid decisions. They looked at it and said, "Mm, oh how interesting but we don't really have any interest in that."

House: I remember that, yeah.

Feigenbaum: So they gave Jim permission to do what he wants with it. And we're in the Clark building. We're already sitting in the building.

House: There are schools that today their OTL function is to get the graduates to donate buildings rather than hold rights to the IT.

Feigenbaum: So and I don't know-- John Hennessy was a EE. He was joint with CS, but his primary link was through EE, and so he might have done the same thing with the EE chair, and he did the correct thing in asking for a leave of absence so he-- there was no conflict of interest with regard to his role on campus, and then he extended his leave of absence. But only to the maximum allowed, which was two years. Didn't try to get five years like some of my colleagues have tried to do and so on. So it was-- on the one-- that was-- that was one view. The other view that one could have was that things were much looser than that-- in the following sense that if you looked out over what we were calling the DARPA Research

Community which included UCLA and MIT and Carnegie Mellon and us and SRI and Utah, UC Santa Barbara. I've named almost all of them.

House: Yeah, that's pretty much the set.

Feigenbaum: And Xerox PARC.

House: Yeah.

Feigenbaum: If you looked out over that community that community in essence had nothing in mind about intellectual property rights. It gave everything away.

House: Right.

Feigenbaum: We--

House: More like--

Feigenbaum: We developed a software system for allowing other people to build expert systems rather rapidly. It's called EMYCIN, and the greatest thing that happened to us was hundreds of people wanted it. So we would send out hundreds of tapes, and we would-- we kind of-- it used up a lot of time, but we loved the idea that we could give it away. And then came along another one called AGE and we gave away maybe a hundred copies of AGE, and no one asked for any payments or signed away rights or nothing like that. It was just everything was given away. And I think today that would be called *open source*.

House: Yes.

Feigenbaum: I'm not sure, but so it-- there was definitely a confusion factor in the air about what happens when something is invented at a university-- especially with government dollars.

House: Right.

Feigenbaum: Does it belong to the university? And that was the-- the sort of the-- the given story and the one that Jim Clark was following when I sent him over to OTL. I did the same thing when we started a

couple of AI companies. We wanted to use this software that I was telling you hundreds of people had asked for. We wanted to not be involved in maintaining it and sending it out and servicing it. We wanted to set up a company to do that, but you had to go through the Office of Technology Licensing. The CEO of that AI company basically couldn't come to an agreement with OTL. OTL was really screwed up in terms of their view of what Stanford should receive as a benefit-- as the owner of the intellectual property. They were asking for far too much. So the CEO of that company-- the company was called Teknowledge-- said, okay, if you want to-- if you want to do that then we'll just build it from scratch. It was the clean room idea. We'll just--

House: Start over.

Feigenbaum: We'll hire Stanford people who have it in their minds, and we'll start over and which is what they did. And that was a disaster for them actually because they were quite late in getting their product to market by doing that. But so the...

House: So I think what you're--

Feigenbaum: When you -- when you hear these stories coming out from-- about who took what when. You have to keep in mind that--

House: Yeah, there's a couple of points of view--

Feigenbaum: -- there was a-- there was--

House: A fuzziness factor.

Feigenbaum: -- some confusion. It wasn't-- it wasn't that the people who allegedly did bad things didn't know the other rules. It's that you never knew when they applied or when they didn't. Or OTL didn't have a clear-- there wasn't a clear path. It wasn't like a red carpet that says go down this carpet. And I-- it was that way for me when Jim Clark came and asked. I knew the carpet was there and he did.

House: So Stanford's had a long history with this. I mean Varian-- a lot of money went to Stanford from Varian . No money went to Stanford from Hewlett Packard. And then they were essentially all in the same lab when you get right down to it-- the Yahoo and Google story. It looks odd to the outside world that there are distinctions who-- for what was done in a dorm room and what wasn't. But it-- it looks fuzzy to many observers.

Rindfleisch: I have a-- I'd like to add on one thing to what Ed was saying which I used in managing SUMEX-AIM. I think there's a spectrum of situations that we have to deal with. The Internet is a perfect example where through the Internet engineering taskforce-- taskforces. Various people get together without remuneration to jointly develop pieces of software. Protocols anywhere from email protocols to FTP to web and so on, and those involved the inputs of lots of people. And we benefited tremendously in developing the SUMEX-AIM facility by taking those tools from the Internet and contributing back. And so we felt that should be open source. Things that are the other end of the spectrum which we developed in house with in-house intellectual capability and tools and so on-- they were not shared across such a base are a totally different animal, I think, in terms how you deal with the intellectual property. And then there are things in between that make it really muddy.

Feigenbaum: Let me add two points to this cloud of-- if I can remember my two points. The-- oh, yeah. One of them is that-- I'll at least get this one out. Yeah-- remind me in-- the second one is going to be the so-called Brian Reid case. But there is more to substantial remuneration than simply the dollars that the Office Technology Licensing is able to negotiate with a company. And that is the honor and fame of having invented something. And if-- I don't know this for sure, but I'm guessing that it was the pain of the latter that was more strongly felt by Bill Yeager than the pain of the former.

House: Oh, I think without question that would be--

Feigenbaum: And-- I mean, that was a tragedy-- an intellectual tragedy. When we-- here in this museum we go to great lengths. It takes hundreds of hours of people's time to find the great Fellows of the year. We honor that kind of thing. And here it was all covered up, and who knew Bill Yeager except Tom got after the people at the San Jose Mercury News-- Pete Carey. The story gradually came out and eventually the museum woke up and did the research that it needed to do, and got the story right. So that was-- I wanted to say that that's really important for university people. So when the various people who are alleged to be perpetrators in this, that and the other thing. They probably don't think of it that way. They don't think of what hurt they're doing to other people by changing the story. Then the other thing I wanted to mention was the Brian Reid case because it came up between the two of you in some discussion which flittered by here rapidly five minutes ago--

House: If I didn't know the name.

Feigenbaum: -- about dorm rooms.

House: Oh, yeah.

Feigenbaum: There is a famous case that went to trial-- Carnegie Mellon. The individual is Brian Reid. He later was working for DEC (Digital Equipment Corp) in their downtown Palo Alto facility at the time that they were doing the--

Rindfleisch: Alta Vista.

Feigenbaum: Alta vista-- and he got actually involved with a lawsuit with regard to DEC also. But in this case there was a piece of software that he did at Carnegie Mellon that we were all using, and it may have been Pub or it may have been--

Rindfleisch: It was Scribe.

Feigenbaum: Scribe-- that's it. It was a text editor-- Scribe.

Rindfleisch: Pub actually came out of the AI Lab at Stanford.

Feigenbaum: Okay, anyways-- I got it wrong. But anyway, it was Scribe. And Carnegie Mellon said, "Oh, everyone loves it, and we own it. So we'll put a price on it." And Brian Reid said, "You don't own it because I'm a student, and I'm not your employee." And that case won in court. Brian as a student owned whatever he did, and Carnegie Mellon did not own it. So that adds another dimension to the confusion. Andy (Bechtolsheim), what he did-- was it Andy's property because he did it as a student? Probably. I don't know. No one ever worked that one through, but Andy comes up in a lot of versions of this story.

House: Right, right.

Feigenbaum: Because his boards show up at various places. Well maybe it's okay. Maybe Andy owned those boards. I'm trying to paint the ambiguity in this situation.

House: And I really appreciate that. I think for-- I think for to get this on record with the dichotomies that show up and the ambiguity of this all is important.

Feigenbaum: And there's some people just didn't want to play that game. When the second of the two companies that I was involved in starting was called IntelliGENETICS (later became Intellicorp). It was a-- it flowed out of research that had been-- that Lederberg and I got a research grant from the National Science Foundation that led to the-- basically, the first software in computational molecular biology and it

was much used by the-- by Tom's users all over the country coming in over TYMNETs and TIPs and all that.

Rindfleisch: Its product was called MOLGEN at that point?

Feigenbaum: MOLGEN, and we went to great lengths to go back to NSF and reiterate that Stanford owned that software and then went through Stanford to make sure that that software got licensed and it was a very careful process. It took about a year to do because some people don't want to play that other game in the-- in the area of ambiguity-- rather get it right-- rather--

House: Yeah, and then you get into corporate law which-- I mean OTL is one thing but in companies sort of the presumption is the company owns everything you do because you're owned by the company. So it's the rare individual at a corporation that's able to claim they did it at the dorm room.

Feigenbaum: Well, at Stanford they-- I wanted to say this because it relates to something Tom brought up. At Stanford they try to be pretty clear about the ownership shares in-- and it's one third the inventor, one third the school and--

Rindfleisch: One third Dean's office.

Feigenbaum: -- and one third the Dean's office--

House: Dean's office.

Feigenbaum: Dean's office, yeah. So--

House: Well, it's the department isn't it?

Rindfleisch: There's a sharing or discussion between the Dean's office and the department. So--

House: And then there's that 10 percent slice of all of that that comes off to run OTL so it's--

Feigenbaum: But the important point there I wanted to make was that in the case of Tom running SUMEX, he and his people came to an agreement that we're all in this together, and the share that goes to the so-called inventor goes back to the project to fund new research.

House: Okay.

Feigenbaum: Rather than put in the pocket of a set of individuals. That's correct, isn't it?

Rindfleisch: Yep. That was the policy we developed. It was later over-ridden by the office of the Associate Provost for Research much later. The Kinetics FastPath gateway that is the Appletalk to Internet gateway produced a case. Bill Croft was the guy that wrote the code in my group, and he resisted this and complained, and we ultimately appealed up to the Office of Research Administration. And they said we couldn't enforce that policy.

House: But Yeager did give his share back?

Rindfleisch: He did indeed and most of the rest of us who got income from various sources for doing things gave it back. And so it was an era in which we had a sort of a philosophical feeling. As Ed said, it wasn't just for that money. It was for the excitement of doing the research and developing neat things. And it was the era of trying to do basically open source software. We had started a resource in the mid-'80s when we had moved to Macintosh's with the Texas Instruments Explorer Lisp boards in them that was called Info-Mac which was a repository that we ran open to anybody in the country who had Macintosh's and wanted to contribute or share software. And it was a wonderful tool. It just went on for a decade or more before we ran out of resources. But this tension between making money from software that was shared as opposed to sharing the money that was made is, I think, the crux of what has been the difficulty with the Cisco router. We shared--

House: So--so--

Rindfleisch: Go ahead.

House: So the other context here is that nobody made money off software until 1990. Even Microsoft was a very small corporation. Oracle was just beginning to be a corporation-- the '80s were fledgling years for all of the software companies whereas the hardware companies were already robust and really going.

Rindfleisch: Certainly *Fumbling the Future* documents Xerox's problem with that.

House: Yeah, classic document.

Rindfleisch: Yeah.

House: So let's move now--

Feigenbaum: I just want--

House: Sure.

Feigenbaum: -- to add one more thing about-- in this whole story. If you went and probed the sensitivities of the people who remain-- they're still alive, and they know about this story. I think you would find a certain contour there, which is, yes we know there is some ambiguity but what we-- what we had expected is openness, nothing hidden and no conflict of interest. If you want to do what you want to do take a leave and go off campus and do it, but don't kind of interleave your Stanford work and earning a salary with your corporate development, so to speak. People expect that kind of transparency-- that's the word I'm looking for. And I think the disappointing thing in the Cisco case was, it wasn't there.

House: And let me-- I appreciate that point, and I think that's an acute point to make. But I would also say I think there was a difference in attitude between employees of Stanford and faculty and students of Stanford-- and maybe that's not fair to say.

Feigenbaum: No. No, it may be totally right. I'm the wrong person to ask about that because I don't know the answer.

Rindfleisch: Stanford is a class system. There are definitely different rights and opportunities that go with being a faculty member, being a staff member, being a student.

House: So I've been all three. I can relate to you. Being staff is not as comfortable as being faculty.

Rindfleisch: And in a way we were sort of exploring what the role of staff people who did innovative things were. And everybody at Stanford signs a document--

House: Right. Right.

Rindfleisch: -- that gives rights as an employee to the university for things that are done as a result of that employment.

House: Right.

House: So I just wanted to make that point. And I'm not arguing against transparency. I think that's a policy in general we should have. One I got caught on last week actually with a CEO in the valley where I didn't see any reason not to be transparent in a discussion with CalTech, right? But my wife came home saying my CEO is madder than hell at me because you shared da, da, da, da, dah. Come on. But the point I want to make, Ed, is I believe the kind of the value set and the ethical-- what looks like proper ethics to one community might be somewhat different than another.

Rindfleisch: Yes.

House: And I think this case has some of that-- there's the possibility of some of that different interpretation affecting this case.

Rindfleisch: Moral compasses point in different directions.

House: Right. Right. And it doesn't mean that they're unethical, but it does mean that they're traveling by different standards.

Rindfleisch: I think there is an element of lack of ethics in this that I-- let me try to explain that.

House: I actually agree with you and I-- I think it is time to turn to the Cisco case directly.

Rindfleisch: Yeah. So this router development took place during 1982 on the blue box-- the Bechtolsheim box. And we found that trying to do something on a PDP11 with DEC RT 11 operating system just didn't hack it because we were trying to put together a router that was able to handle a really diverse set of protocols. First of all, with the three-megabit Ethernet was the PARC Universal Packet. We were working with MIT LISP machines which were using MIT's Chaosnet. When Xerox and DEC got together and promoted the 10-megabit Ethernet, which happened quite quickly, they were promoting-- and we got DEC-- I mean Xerox LISP machines, so the Dolphin and the Dorado, they were at that point using XNS protocols-- Xerox Network Services. And so then TCP-IP had to be routed in there. So this was really a general router and Bill (Yeager) started-- Bill and I had long discussions about this, and he started and said, "Look, the only way we're going to do this is to write an operating system that is sort of like a time-sharing operating system. "

Rindfleisch: And it's got at its core the business that it is routing packets as efficiently and as quickly as possible so the throughput is there." And so he coded this in the-- he spent hours and hours-- Bill, as you interviewed him, I think, will find that he is one of these coders who is a fanatic for perfection. And he prides himself that the router that he developed didn't crash. That operating system was really a well, well

done piece of software. We shared that. We felt that because we were doing work with all of these people who had contributed the ideas and the technology for the network protocols and so on that we should make that available to other universities and to Stanford. Stanford at that time was getting the idea that by God it really ought to network the campus together. And so they were buying and building routers hand over fist. Bill Yundt was the guy in the campus computer group that was in charge of this. There were people in computer science that were doing the technical part of building these routers and helping to get them installed and operating. And so this software went over to Computer Science and became a part of what they were doing. They added Kirk Lougheed, who was one of the key programmers there, added with Bill (Yeager) TCP-IP protocol routing in the router. And so that became the package that was available. And I think what happened is that in the course of pushing this stuff out into the university Len Bosack and other people in the department-- Kirk -- got the idea that it was really their stuff. They were-- they were doing this work. It was also an era where Sandy Lerner was working in the Graduate School of Business running the DEC 20 computer there. And an interesting point is that in the years before Cisco got formed which was in 1984, as I remember reading the documentation.

House: Yeah, December '84.

Rindfleisch: And then they were forced to make a choice between Stanford or Cisco in some time during 1986. But before that Lerner and Bosack were trying to develop a business within Stanford which had nothing to do with networking. It was to build a group that was going to do maintenance on DEC computers, and do that more expertly and at lower cost than Digital Equipment Corporation was going to do it. And the university decided that they really didn't want to be in this business of competing with an outside vendor for the maintenance of their equipment that this was just a kind of business that didn't lead anywhere but used up university resources.

House: You just said something that I've not heard-- I've heard an implication of that, but I've never heard it as explicitly. If I-- let me just make sure I heard you correctly.

Rindfleisch: Yeah.

House: When Len went to OTL to ask permission for something to set up a company it wasn't to build a routing product. It was to build a DEC 20 maintenance program-- company. Is that what you said?

Feigenbaum: I think you heard it wrong.

Rindfleisch: No, I think there are two steps along the way. One, they were going to build it inside of Stanford-- build-- have a group there that the university would support and house. The university said, no,

so I think at that point they were looking on building such a group outside of Stanford as a business that they would market within Stanford or other people using DEC equipment like SRI and--

House: And then step three was the router?

Rindfleisch: Step three was-- I think that (step 2) didn't fly. I don't understand, or I don't know anything about the venture capital efforts that went into trying to do that. But that led then to trying to do something with the router, and it was at the same time that this company Proteon was trying to spin off from MIT and compete in what was still not a very full marketplace. I mean, we're still talking about--

House: So if you took those as a two-step, one is I want to build a department inside Stanford to do X.

Rindfleisch: Yep.

House: And if rebuffed then I'd like to take it outside and do X.

Rindfleisch: Yep.

House: They might have done a two-step twice?

Rindfleisch: They could well have done.

House: That would fit most of the data I've-- I mean, every element I've got would fit in one of those pigeon holes. What I have not heard was that they wanted to build an outside DEC company early. But I've had several people say there was this love affair Len had with the DEC 20, and wanted to perpetuate that.

Rindfleisch: Both he and Sandy were in love with that machine.

House: Okay.

Rindfleisch: That's where he built his--

House: So that's a very helpful factoid that you supplied. Thank you.

Rindfleisch: Now, at this point-- this was mid-- early, mid '80s we were off doing other things. We were making a transition. We-- in the course of the SUMEX-AIM project I think we went through seven different phases of computing equipment in the course of those 20 years.

House: Wow, sure-- I'm not surprised.

Rindfleisch: An early KI-10, other DEC equipment, the VAX machines to Lisp machines -- Apple Macintosh's with Texas Instruments Explorer boards in them and then to hand-held machines. We were working with Apple's Newton in the 1990s trying to introduce those into clinical care environments so doctors could keep track of things better. So there was this whole series of evolution, and we were just in the process of moving to Macintosh's which is how we got into this business. Ed mentioned IMAP which is interact-- we-- our name for it was Interactive Mail Access Protocol. It later got changed to Internet Mail Access Protocol. But the basic idea is that the Macintosh's came without any capability whatsoever of getting access to real net-wide email systems.

House: Just like the Alto's, Apple gave you a big donation of Mac's.

Rindfleisch: Yeah.

House: Well, they are.

Rindfleisch: Actually, we had to buy them, but we got a pretty good deal.

House: Okay. Okay.

Rindfleisch: But they were these silos, and we wanted them to fit into the overall environment. So we built some of this software. We built the gateway that connected Appletalk to the Internet. We built IMAP that allowed an email program-- real email program that could run on the Macintosh's and connect out over the network. And incidentally, IMAP is still one of the primary email access protocols that is offered by Google and Yahoo and Stanford and any other reasonable email provider in addition to POP which is the Post Office Protocol that was done down south. So the idea here is that we had spread this technology. We had moved on and where I come down and have problems, is that Bosack and Lerner went off with this software as if it were theirs. They never consulted with Bill Yeager, who in the negotiation with OTL got 85 percent of the credit for inventing-- for the invention. And Stanford, of course, didn't quite know what to do with the negotiation with Cisco. So they did not take any equity position. They got something like $150,000 in hardware credits so that they could get equipment and help build this-- continue building this network inside of Stanford. But Bill got no credit. He got-- in terms of being a

precursor or a participant in this he got no tangible benefit from it and I-- that's where I think the rankling difference in ethical behavior comes out in-- and is my complaint about what Len Bosack and Sandy Lerner did.

House: So going back to what Ed shared a few minutes ago, that point you've just made sounds like it's the credit and not the monetary reward that is your chief concern.

Rindfleisch: I think different people-- I have-- the reason I spent 30 years at Stanford was not to make money. It was to participate in this candy store of opportunities to build new ideas and to work with people like Ed and the Computer Science Department and all the systems laboratory and so on. And so that-- that isn't my primary motivation. I feel very strongly that there's an ethical-- an integrity issue in giving credit where credit is due. And that much of what we build, whether we can identify where all the roots go or not, link back into all the bodies that are along the computer science development highway that are just lying there as experiments that sort of pointed out what didn't work or were too early for their-- for the time but later on led to continuation of neat ideas.

House: So we've got a rule here at the museum that we say we never use the "F" word. And the "F" word is “First.” You almost never say this person was first with this because you'll find someone earlier claiming almost always.

Rindfleisch: Yeah.

House: Or you'll find teams did this. It’s just hard to tease this apart, but holding that thought on one side and then taking what you've just said-- let me observe and maybe this is unfair because I've done some interviewing and, again, it's not part of the public record. But Kirk Lougheed had a lot to do with how that software evolved.

Rindfleisch: That's true.

House: He wasn't credited either. And he was a cofounder of Cisco in the sense that he was the-- the first day that they had official employees he was one of the official employees. But you would-- you would be hard pressed on a Cisco website then to now to find him mentioned.

Rindfleisch: Kirk was deeply involved in putting TCP-IP in that router.

House: So not only did they disavow an earlier contributor they disavowed their own person.

Rindfleisch: Yeah.

House: I mean it's a strange-- at least for-- I came out of an HP where Hewlett never put his name on a patent that he didn't actually do. He made sure the kids who did it got the credit. Not everybody at HP held that same standard but it-- it's kind of this ethical perspective Ed, that you're talking about that-- that-- what-- who do you credit? And I think you could fairly say that they were quick to assume the credit. Where they really were emulating or borrowing pretty freely. So I'll accept that without-- I don't think we need to qualify it. I think we can say that's been established certainly with the reporting that got done and some of the different observers because we've got what 20 people have weighed in on this question now in a public-- in quasi-public situations. So I think we've kind of got that understood. There's also some other questions though that had to do with ethics, right?

Rindfleisch: Well, there was this two year period where the Bosack, Lerner team were both employees of Stanford, and starting the business if that's what you mean.

House: Yeah.

Rindfleisch: So they were using--

House: Help me understand that from your perspective.

Rindfleisch: I was an outside observer of this. I--

House: Okay.

Rindfleisch: We were busy doing other things at that time.

House: So, as you said, your lab had moved on in terms of perspective--

Rindfleisch: Yeah. We had a different set of goals that we were trying to achieve. We were not responsible for implementing that the network throughout Stanford, and I should not comment because it's hearsay. And I think you'd be better off talking to Les Earnest.

House: Okay. So this would be Les Earnest and--

Feigenbaum: That what may be what his emails are about-- those emails I was telling you.

House: Okay, and so and Tom Dienstbier talked to this point a bit and--

Rindfleisch: Tom was certainly there in the department and I-- who else would give you--

Feigenbaum: You mean Les?

Rindfleisch: Well, Tom Dienstbier was working part time for computer science and part time for Pat Suppes' operation for a while before he ended up over there. I-- there are other system programmers around-- Marty Frost who may have some input on this, but the real managerial coverage, I think, came from Les Earnest who was tasked by the department chair to put things in order.

House: We did an interview with Jim Gibbons and we got some of his perspective.

Rindfleisch: Ah, ha.

House: And of course, Jim-- it's not conflict of interest but he was on the Cisco board for a number of years. And of course he was prominent at Stanford and had at least got to adjudicate the final solution-- or maybe at least bless it. I don't know. And we've had-- I'm trying to think. We've had a couple of other people that were-- that were close in that lab, comment to different things. But the story that I've-- that at least we're working with is the notion that they used Stanford time and money to buy the parts, and then delivered an invoice for Cisco. And took money in from other universities into Cisco, where in fact, the parts and labor came from Stanford. And that that was a very clear conflict of interest.

Rindfleisch: Les has a very strong point of view about that.

House: I would imagine, and I'd like to get it. But I-- at least from what we've uncovered so far it appears that's a pretty clear trail.

Rindfleisch: Yeah.

House: Now, I also understand-- and you may have perspective on this that Cisco, once some of this came to light, attempted to do some redress.

Rindfleisch: In what way?

House: Monetary, primarily and to some degree willingness to put a more accurate story out there.

Rindfleisch: Certainly, Len and Sandy made philanthropic contributions to the department of -- Engineering School and other places. I don't believe any of the players; Yeager or any of the other people that stayed at Stanford got any benefit of that. Unless I-- if you've got other--

House: I-- I'll-- I don't-- I have not heard that they did.

Rindfleisch: Yeah. I think Sandy and Len each had-- they-- after they split up had their own sort of model of what kind of charitable contribution-- what they wanted back for the money, and that's a separate issue that I'm, again, not involved in and Gibbons probably has a much better idea.

House: But they did in fact contribute back to Stanford, each of them?

Rindfleisch: That's my understanding, yeah.

House: And I believe that's-- at least through Morgridge I believe there was some additional restitution that he attempted on behalf of the company.

Rindfleisch: Yeah, I think Morgridge did make some contribution back to Stanford. Again, none of that went to any of the groups that developed the-- did the work to develop the technology.

House: So it's sort of the confession of the Catholic Church after the fact.

Rindfleisch: Yeah, okay. But I mean it was to Stanford University as an entity.

House: Right. Right.

Rindfleisch: As opposed to any way of trying to remunerate this ethical breach or oversight in taking the software and--

House: Sure.

Rindfleisch: -- building the company on it.

House: So you ran this lab until '93, you said? Did I get that right? '95?

Rindfleisch: I ran the-- SUMEX-AIM lasted until '93. CAMIS, the Center for Advanced Medical Informatics, at Stanford lasted until 1996. And at that point I was involved in information retrieval. It became very clear that search engines and digital information was the crux of what scientific research was going to be about. And so we converted the Lane Medical Library from a paper library basically into a digital library. This is in parallel with the work Mike Keller was doing with HighWire Press to bring out journals-- first class journals in a digital form. And I have a private paper that documents that the use of these materials at Lane Library jumped by a factor of 20 when they were available in digital form as opposed to people have to trek over to the library and look up a paper copy of the journal. It was astounding.

House: I did the-- I sponsored the IEEE digital library in the late '80s, and we had the very similar kinds of numbers. And I did the ACM digital library in the late '90s. And it remade the organization. It's the revenue stream today.

Rindfleisch: Ours was not for revenue but it changed-- it literally changed the way students and faculty went after the literature in profound ways.

House: It-- I can be more productive in a year now than I could in five years then.

Rindfleisch: Yeah.

House: It's a stunning-- well, we all know. I don't need to go down that path with you. Let me come back though to this story and help me with Sun Microsystems and Imagen and some of the other companies-- and Silicon Graphics that are contemporary and to a certain degree I think you could argue came almost out of the same Xerox PARC impact on Stanford.

Rindfleisch: So Imagen is different--

House: How did they get treated and what were the nuances there?

Rindfleisch: Again, Les Earnest is a good resource for Imagen. We were using Imagen printers in the 1980s. These were not laser printers. These were a chemical process to develop the image, but that grew

out of a gift that Xerox made to the Stanford AI Lab of a laser-driven printer that would support Alto's and really fine fonts. And Les Earnest and the programmers at that AI lab were responsible for developing that. There's another player involved in that story which is Luis Trabb-Pardo who worked with Don Knuth in the development of the font system and the TeX printing technology. And so Luis and Les Earnest spun off. They actually severed their ties with Stanford for a period of time to build the Imagen company. (CHH note: see https://tug.org/interviews/trabb-pardo.html for a 2010 interview with Luis Trbb-Pardo re founding Imagen).

House: That's where I know Les Earnest from. I've been sitting here trying to figure out why I knew that name.

Rindfleisch: And they did it privately funded. They tried to make that go without getting venture capital. And Les I'm sure has a--

House: That's a whole other story.

Rindfleisch: -- lot to say about that experience and Luis Trabb-Pardo is also interesting. As far as the other ones that you mentioned, we were using Sun Microsystems work stations at Stanford for lots of different things. Even though for the AI work the emphasis was on Lisp. And so we were primarily using Lisp machines or ways of running Lisp in a work station environment. People who were doing computer graphics like molecular biologists--

House: Right, for the SGI machine.

Rindfleisch: Right. And I think if you were to talk to a researcher called Doug Brutlag, who was developing some of the tools that Ed was referring to in MOLGEN for analyzing molecular structures and sequences and looking for ways that the motifs of sequences of the protein building blocks determined what the structure was going to be, were using Silicon Graphics terminals as a way of-- and Sun Microsystems as a way of displaying that.

House: Well, what I was getting at--

Feigenbaum: I didn't get the gist of your question. I was understanding Tom's answer, but I didn't understand really what you were asking.

House: Well, what I was thinking back to is when you said that Jim Clark came to see you and ask what should I do. What happened with Sun or what happened with Imagen in an equivalent way? Did Andy go to OTL or do you know? How were the rights and those things--

Feigenbaum: Oh, Andy? If now--

House: I assume we mean Andy Bechtolsheim.

Feigenbaum: Yeah. Andy - well, I-- It's not that Andy told me this directly. But my understanding-- and this could be wrong. But my understanding was that OTL looked at it with prodding from Andy, I guess-- or steering or something. There's nothing here. This is--

House: Standard--

Feigenbaum: This is a Sony tube. This is a Hewlett Packard bus. This is a--

House: Motorola--

Feigenbaum: I don't remember who invented the keyboard. There's nothing in this box.

House: Yeah, what's with the license?

Rindfleisch: Looks like a Commodore. It's just another one of these things.

Feigenbaum: And OTL bought that story.

House: Okay.

Feigenbaum: I believe.

House: So they--

Feigenbaum: Yeah, okay. So we don't-- not something of interest to us. But I-- I'm not-- I'm not a hundred percent sure that that was it, but I think OTL was involved at the right time in that one. Then you could ask John Hennessy about MIPS

House: MIPS is another one, sure. And -- you gave me enough color on that. I think that certainly fits what I'd heard about that.

Rindfleisch: And I think Jim Clark's leaving was clean. He gave up his faculty position to go--

House: That's quite clear.

Rindfleisch: -- work on Silicon Graphics and then after that, NetScape with Andreessen

Feigenbaum: and-- there was one other thing. Oh, I was going--

House: This is fascinating-- so many things I should ask and haven't asked, what part of the story do we need to cover?

Feigenbaum: Let me just back-fill slightly.

House: Okay.

Feigenbaum: Because there will come a day when you're going to paint this whole story like an artist.

House: If I live long enough, you're right.

Feigenbaum: Yes, we will make sure you live long enough.

House: Well, let me just-- it's not a correction, but it's a clarification perhaps. You know the classic thing we say at the museum that our job is to identify then capture, then preserve, then provide access and then finally interpret what history is about, right? We're in the capture phase. We've identified this is a topic of interest for capturing it. It may not be us that do the interpretation but if we capture this well enough it can later be interpreted by-- by historians or whoever. I hope to be the one to do it, true, but it needn't be us, is my point. That's why we record these-- to have enough of the story in the files accessible by all. Give you a different example, there are 15 books on Cisco today. None of—one of them treats this

story lightly, and that's it. But what's more important is every one of those books had research done by the author which never became available to any other erstwhile author. So it's a-- everybody has to re-dig their own little mine, and you never get a very fully faceted story. So I think what the museum tries to do-- what the Babbage Institute tries to do, what the Chemical Heritage Foundation tries to do is terrific in the sense that they try to catch the players who were there while they're still alive in a way that you can get more of the story. Give you one quick one, Bill Hewlett did an interview with Alfred Chandler at the Babbage in maybe '75, mentioned in passing his friendship with the Sony-- or with the Canon founder that came out of a trip right after World War II. And the fact that he was dyslexic when he got into Stanford. The son of that fellow couldn't get into Stanford 20 years later. Bill got him in. About 10 years later, that gave us (HP) an exclusive license to the laser jet engine technology, and a two page contract that has transferred 200 billion dollars between those two companies. I mean this-- you would never know that story, and the point of it is no one knew that story until I'm reading this transcript thirty years later, and Bill was long gone.

Rindfleisch: That's amazing.

House: And you go to the family and say, "Why was Bill in Japan?" Well, it turned out that Vannevar Bush sent him over as a 29 year old. He was the youngest scientist on the trip-- stayed three months looking for atomic bomb secrets and befriended Morita. So you know-- so the point I'm trying to make is interpretation can be significantly later, but the story can come out. Now, that wouldn't do Yeager much good, but it does do history a lot of good. And--

Feigenbaum: I don't think you meant Morita that was--

House: I didn't mean Morita, no. (Takeshi Mitarai, Canon)

Feigenbaum: I just wanted to correct it--

House: Yeah. His name escapes me at the moment. But I don't mean to-- sorry, that was the digression on your point. Yeah, I do hope to write the story, and know that we're putting this mosaic in place. You're point was going to follow from that.

Feigenbaum: So I suggest maybe capturing-- maybe getting yourself a table of values adjusted by inflation for-- so that dollars come out looking like dollars not inflation-- inflation adjusted and do-- look at some of the donations. You talked about Bosack and Lerner engaging in philanthropy, and that indeed was the hope of some of us computer scientists that oh, all of this will pass, and there'll be a lot of money coming in. And if for example, that were Jerry Yang, the money that came in was 50 million dollars for the Yang and Yamasaki Energy and Environment Building. And you look across the street and there's Jim

Clark's building at 90 million dollars, and the day that Google went public Stanford stock was worth 200 million dollars. Stack these up versus the Lerner plus Bosack plus anything that Morgridge added into the pot. It will be interesting to see. So I--

House: So I've done a junior version of that. I mean a trial balance sheet, if you will, and it comes out much as you might anticipate. But I will tell you that having done that two years ago, I was stunned by the Silicon Valley Business Journal. In February this year they published a list of the top 10 contributors in the valley in history. And they did it as a percentage of their total net worth providing the total gift was over 50 million dollars and Zuckerberg was 10th, Packard was like 7th, and Len and Sandy were number one. They gave more of their net worth to this valley than any other people on record.

Feigenbaum: That's astounding.

House: Just astounded-- not only astounded me, it astounded Cisco PR.

Feigenbaum: That's astounding.

House: And-- but it was not to Stanford. It was not-- not very much of that was to Stanford, but it was exceedingly generous for what they were worth at the time, which actually surprised everybody that saw the article.

Rindfleisch: That's--

House: I don't know how accurate the article in fact is. So I have that digging yet to do, but it-- it certainly put me a little bit back on my heels for that kind of thing.

Rindfleisch: Yeah.

House: So there're always surprises in this game. If you do time-adjusted-- and this may have been a time-adjusted thing as well because I don't think anybody knows how to calculate 40 billion today against any other-- I mean these absurdities today are just beyond my count. But case in point, Packard-- I believe Hewlett and Packard maybe together gave more money than the Stanford students to Stanford on a time-adjusted kind of number.

Rindfleisch: Yeah, so maybe account the Children's Hospital and all the stuff there they've done. It's a--

House: And for a long time they did it anonymously. That was their kind-- so again here's a set of ethics. Do you want to have your name in lights or do you want to-- I mean there's just-- there's a lot of ways of looking at these questions. I think what we've done today has been illuminating for me. I read the articles and Tom, I appreciate you sending over-- well first of all, I appreciate what you did to dig this story out, and to get Carey to write that article was a phenomenal piece of sleuthing.

Rindfleisch: That was 15 years ago, and I look back and I'm glad I spent the time to do that too. It's a--

House: Well, if you hadn't done it then it would have never happened.

Rindfleisch: I know.

House: Out of the-- it probably took you weeks to do that, but that was an important juncture.

Rindfleisch: Yeah.

House: I don't know if you've both seen this book that Mike Malone just did about the Intel trinity.

Rindfleisch: No.

House: Mike is a prolific journalist author for the valley and as you probably know. He just gave a talk here at the museum two weeks ago about it, and he looked-- he compares Noyce and Moore and Grove--

Rindfleisch: Grove, yeah.

House: -- and the interplay between the three. It's a wonderful-- he's almost as good a writer as Walt Isaacson. And the way-- and I have talked to almost no one that doesn't like both books. They're just, oh, this is fantastic reading. And their reaction to both is each omit such significant chapters of what happened that it's almost scary. They tell a grand story, but they don't tell what happened in fact.

Rindfleisch: It's hard to be totally even handed--

House: Well, it is.

Rindfleisch: -- if you're invested in something your filter works very differently.

House: I know, and that's the conundrum we all have. I've had to back off and say the beauty is that people take the time to do what they do, and we ought to treat that as a partial contribution. And then if someone else has something to add as a-- as a good friend of ours told my wife. I wrote a book for my wife one time and a paeon to our first few years of marriage. She just couldn't stand it. And I finally asked why, and then she asked her friend-- her cousin actually, Joan Didion-- you may know the name. And Joan says, "Well, you have three choices. You can say you're grateful for what he wrote because you at least see how his mind works. You can get out an editing pencil and make it more correct or you can write your own damn book." And I think where we are-- and this, Ed, is what I really appreciate you bringing it up to the board first of all, is we want to get more of this story understood in context. And I think what you gave me today-- what you've given the world today because this will be part of our record is the context of the times as well as the specifics of what happened. And I think it's that context that will allow people to understand it in a more appropriate light. So I really think that's been the contribution of today.

Rindfleisch: Thank you for the opportunity.

House: Yeah, no, thank you. It's a pleasure.

END OF INTERVIEW

