John Selker Oral History Interview, August 25, 2015

Title
“An Engineer Without Borders”

Date
August 25, 2015

Location
Valley Library, Oregon State University.

Summary
In the interview, Selker discusses his family background and upbringing, including his mother's story as a Holocaust survivor and his own early interest in bicycle touring. He likewise recounts his boyhood interests in engineering, his early departure from high school in favor of Reed College, his academic progression as an undergraduate, and his summer work at the Stanford Linear Accelerator. Selker next describes his first contacts with Oregon State University, where he worked for one year as a campus-based employee of the U.S. Department of Agriculture. He then outlines his travels and work experiences in Africa that inspired him to return to school at Cornell University and study agricultural engineering, with a focus on water resources.

From there, the session turns its attention to Selker's years as a faculty member at Oregon State. He recalls the circumstances by which he returned to OSU, the state of the Bioresource Engineering department at the time of his arrival, colleagues within the unit who proved influential, and trends in the university's culture that he has observed over time. He also reflects on the evolution of his approach to teaching, shares his memories of setting up his research laboratory, and describes an early project that he led at the Hanford Nuclear Site. In further discussing his research, Selker shares details of studies that he has conducted in Chile and the Dead Sea, as well as his work capturing hydrology data using fiber optics.

As the interview nears its conclusion, Selker details the formation, implementation and potential impact of the Trans-African Hydro and Meteorological Observatory initiative. He also shares his thoughts on the future of water in a warming planetary environment. The session ends with Selker providing his sense of the university's current direction as it approaches its sesquicentennial.

Interviewee
John Selker

Interviewer
Chris Petersen

Website
http://scarc.library.oregonstate.edu/oh150/selker/

PDF Created February 11, 2020

Transcript

Chris Petersen: Okay, today is August 25th, 2015 and we are in the Valley Library with John Selker, professor of Engineering, specifically Biological and Ecological Engineering and we'll be talking to him a lot about his OSU experiences and his research, but we'll start at the beginning. I'm interested in knowing where were you born?

John Selker: Yeah, I was born in Seattle, Washington and then moved steadily south. And so, the first four or five years in Seattle; Tacoma for four or five years, then in Longview Washington I think has been the most formative, kind of grade three through eleven, and then I ditched out of high school a year early to go to college in Portland at Reed College. And then, in fact immediately following going to Reed College, I ended up at OSU doing tactical work.

CP: What were your parents' backgrounds?

JS: My mother was a Holocaust survivor from Germany, and so she came to—she was a nurse in training in Germany, and then in the late thirties, or '37, she escaped to England, spent the war in England delivering babies in London and then came to the United States following her brother and met my father in Washington, D.C. in the early fifties. My father was from an engineering family. He's also Jewish in decent. His father came to the United States when he was, I think he was twelve, and never finished high school because he had responsibilities to make money for the family, and he did so by carving patterns for making cast iron. And then he ended up owning a foundry, a large foundry, and then was a prolific inventor. So, he has a patent on a fluid shock absorber for cars, for example, and a vacuum cleaner, first patent on a vacuum cleaner device.

So, that's my grandfather, and my father picked up on my grandfather's tradition but with a strong emphasis on education, and so my dad worked through his undergraduate in chemistry in chemical engineering and went to enter in World War II, was a researcher at Harvard and at the National Institute of Standards, and then he—but he still hadn't earned his higher degree, so he finally moved out west and attempted to get his PhD at University of Washington. A side note was that he's a Quaker, my mom and her—anyway, long story there, but we were from a Quaker family, and so his PhD advisor didn't get along with him well. He was a hawk during the Vietnam War, and so on his qualifying exam asked him to solve the equation of a trajectory of a missile, and Dad refused to do that, and so he never got his PhD.

And I think that influenced my brothers and I a lot in that both in the kind of principle stand but also I think that my father's frustration with not having been able to get his PhD after he put so much into it. He had been teaching as a professor in multiple institutions and highly regarded in that but was, he had five kids by then and so it was—well actually seven children by then, and so it was a tough situation, and unfortunately it didn't work out for him. So, my father then went into research for Weyerhaeuser and, well Richold Chemical, Alcoa and Weyerhaeuser in new products, and so he had several patents himself and kind of inspired all of us children to kind of have a similar kind of way of looking at the world.

CP: Wow, that's a really interesting story. Did your mother talk much about her experience?

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JS: No. It was not talked about, and very sadly she committed suicide when I was twelve, and that—her brother in D.C. was also reticent to talk about it. Her sister, who moved to Cleveland, didn't talk about it, but their cousin, who was a concentration camp survivor, I finally had a video; I was able to videotape an interview with him in his nineties, and so I did learn some of the details there. And then a German fellow has written a history of our family in Germany and the Jews of that area, and then another German fellow, it turned out my great aunt was one of the first PhD mathematicians in Germany, women, and he wrote a book about her. So, we later learned, pieced things together a bit, but yeah. And she didn't talk about that. She was definitely a move-forward sort of person, and so it wasn't a—well, we all wonder a lot about exactly what was going through her mind.

CP: Yeah. It sounds like your household was rich in ideas.

JS: Yeah, it was. I was considered the stick in the mud, although very few would call me that here around OSU. I don't know why, but to give you a sense, I think it's valuable to give you a sense in the way the family worked in these regards;

my brother Ted, who was a professor at MIT and is now in the Stanford area, or the Bay Area, he had the idea of making non-woven fabric by spraying liquid, molten plastic onto forms. And so, he and my dad went in the basement and took an aluminum tube and a water heater element, heater element, 220 volts, and made two ends and screwed them together with long screws and then put a nozzle on one end, and they packed that full of plastic and plugged it in and got it to the molten temperature and then proceeded to put a glove on Ted's hand and sprayed Ted's hand with this plastic, to make a nonwoven, pliable, reinforced glove. You know, any one of these—we had lots of disasters. I mean, there were lots of disasters. Ted electrified his door knob, we would get shocked every time we went to visit him; people would fall off of mountains all the time. It was a very, very busy household.

CP: Well, what were you interested in, specifically, as a kid growing up? Was there anything in particular?

JS: That's a very interesting question. I was fascinated by energy and motion, so I ended up turning a lawn mower into a go-kart and building my own powered scooters, having several big disasters with those. Building my own steam engine, or attempting to, was a very challenging thing with no real official machine shop. So, took a little propane bottle and built a steam engine out of that. So, I was fascinated by making things and by motion and energy. We would do bicycle trips. For example, my brother Frank and I would, from age twelve, essentially on, we sewed our own panniers and then just went off on bicycle trips. And so, we'd ride around Washington state with just a friend or two. And so, we were interested in kind of making things and going places. The household had a very strong doer, kind of maker, kind of environment. People were not sitting around much.

CP: So, that interest in travel was there from an early age.

JS: Yes and no, I mean the tra—the bicycle thing was this incredible sense of freedom; it's that sense that you could go somewhere, but keep in mind that by the time I went to college, I had only been to California and Washington and Oregon, and so the travel bug I think I'd say hit a little bit later after college. But I guess I'd say I was interested, but my world expanded, and so the interest was very local and then grew to be kind of the state and then kind of grew from there.

CP: You mentioned you skipped your senior year of high school, I gather that school was pretty easy for you growing up?

JS: You know, I wouldn't put it quite that way. In fact, I was not a straight A student. I would claim that I didn't know how to write until I went to college, and that's why I went to college. The decision to skip a year of high school was just that my dad left for another job and I was left with the house and I took care of the house and everything, bills and this and that, for my junior year of high school, and then he sold the house. And so, he wanted me to move to a different high school, different city, and I was unwilling to do that and so I just, on the spur of the moment, applied to two colleges: Reed and University of Washington. And University of Washington rejected me because I didn't have a diploma, and Reed accepted me, which I was really thankful for.

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And so, I went to college immediately. And honestly, that was one of the best decisions I've ever made. It was a really key point where I needed that next level of intellectual stimulation that I—Longview, Washington is a great place for a kid to grow up, but it's not particularly a hotbed of intellectual kind of stimulation.

CP: Yeah, Reed certainly has a reputation for being a lot of things.

JS: Uh-huh, yeah.

CP: Why don't you tell me about sort of the environment that you encountered there.

JS: Well, it was a—my world threw open quite a bit. That was my—I had gone to public schools in a logging town, and so these were students who had been to fancy private high schools and who were kind of thinking themselves high achievers. I had never really thought of myself in that sense. I was just kind of someone who liked to do things. And so Reed, though, it was just fabulous. It is a great institution. I should say I'm quite biased; my daughter just graduated last May from Reed in physics, and so that was my degree in physics as well, and so I have a very big soft spot for Reed. And then also three of my older brothers went there, so Eric, Harry and Frank. So, I was number four. So, it was a well-trodden path. But Reed was very intense, it's a very intense school, it's very independent, they—you don't know your grades, so it's all about ideas and learning, it's not about grades. I went in and I think I was, as I reflected on this recently, very naïve and also just intuitively, insofar as I was not saying what am I trying to get out of this experience, I simply went into Reed and said well, what's here for me?

So, I became the shop supervisor for the Art Department. It was a tough decision made in the coffee shop at the very last moment when I had to decide what major, whether I was going to be an art major or be a physics major, and I finally decided on being a physics major. But I worked in the art department a lot and I was—they had built a new building and I set up the entire shop there, and then I was the shop supervisor, so I could help people with their projects and, moreover, just make things. And so, I spent a lot of hours making things there and then just—Reed really, really taught you to work independently and to work with your brain.

And so, to jump forward a little bit, for example, when I went to Cornell some years later, I took some years off, but I sat down with my advisor the first day and they said "well, what's the thesis topic?" and we talked about it and came up with an idea. And I just got right to it, because I knew from Reed this is how you do it, you know, it's this—and it was frankly, you know, eventually it was like nine months later I was done with the master's thesis and it was fine, and we defended it and went on to the PhD. But it was strictly the Reed education, I think, and that experience of this is how you do it, just get the thing done and get in; this is how you do research and this is how you get things written down. And so, Reed really was an extremely important part of my intellectual development, yeah.

CP: It's interesting to hear about this decision between physics and art. You had artistic inclinations? Or was it more the maker piece that you described earlier?

JS: Oh no, I love making beautiful things. So, that's a big thing for me. In fact, when I make experimental work now and I make anything, I want it to be beautiful, I want it to touch well, I want it to reflect the essence of what we're trying to do, and I want people who handle those experimental tools to appreciate and to understand them, just through their interactions with them. So, for me the sculptural piece has very much maintained and I still do sculptural work at home, and not as much as I'd like to, but to me there's never been a true—you had to choose a major, but I never separated those things in my mind.

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CP: Was there anything about physics in particular that you were interested in pursuing? Or was it just to try to get a broader understanding of the world and how it works?

JS: Again, it was rather intuitive. It jived with how I thought of the physical world, and the mechanical world. I'd had a fabulous physics teacher in community college, but when I was in high school in my junior year, I took a lot of courses at the community college and I had a fabulous physics teacher, and he got me launched in that area. And then we had some fabulous physics teachers at Reed, and so it was a very natural thing. You can tell when the ideas come to mind easily, and I'm a strong believer in following your native gifts. And one of the things I really have to help students with here when I advise is to separate their objectives for their life achievements from their native gifts, because many times people have—they let those things drift apart, and we have to always, I think, be true to what our capabilities are and who we are and what we're good at. And so physics, it came a little bit easily in certain aspects. I'm not a great mathematician. I'm adequate. There were people who were way better at math, but the intuitive aspects of physics has always been quite easy.

CP: You had a summer job at Stanford, right? Stanford Linear Accelerator?

JS: Yeah, yeah that was great. I worked with a fabulous physicist, David Hutchinson and he took me under his wing and taught me electronics, so I rode my bicycle from Reed, the front door of Reed to SLAC, and I brought a few heavy electronics books on the way and I read those, and then—so I knew nothing, really, about electronics other than what I read there. But David just started from scratch and we had to build the preamplifiers for a big muon detector they were making, and the trick was it had to be extremely high-speed and extremely cheap. And there was this German guy who was a visiting sabbatical scientist for a year who was over in a different lab. I never met the German guy, but he was there, and he was trying to make—there was competition between the two amplifier makers and David was a master analog electrical, electronic design guy, and a PhD physicist, but—so he would just say "this is what you're making, here's how you do it," and I learned how to make it.

And then I would try to add ideas, and then in the very last week of my internship there he said "John, you finally had an interesting idea." But he was a sweet guy that it was completely innocent, he was just saying "well, you know, that actually is an interesting idea." But he really got me on a track of taking the invisible, you know, the sculpture is very physical and everything I'd done at that point was gasoline and power and bicycles and movement, and this really took me to a different place, which was these static-looking components sitting on a table, and how do you make something exciting happen, and what can they do, and the amazing things it can do.

And so, this was in the mid-seventies. So, integrated circuits were still kind of newish, but SLAC had the best guys in the field, probably; you know, NASA and SLAC, that type of thing. So, I was working with this team who really knew what the heck they were up to, and again, it was kind of this semi-academic environment, because they were all professional physicists and I had my couple electronics books and then just everything was oral, and then a few drawings. And so, it was an interesting way of learning, really fun. And my brother Eric was doing his PhD at Stanford then, so I was able to spend the summer with him and it was just fabulous, it was a great summer.

CP: It's interesting to hear you talk about bicycle touring. It's a little bit more mainstream now, but I gather it was probably not quite so developed back then? Were there other people as like a community of bicycle tourists back then, or were you kind of on your own?

JS: Oh, in Longview, Washington we were on our own. There were no helmets, keep in mind, and no—I don't know, it was, I suppose my brother Ted, again, he is kitesurfing and hang gliding and you name it, Ted does it, and he was kind of the most—he rode his bicycle to Alaska, and so that—and it made me, we just all kind of, we were into this stuff. And so no, it was not a mainstream thing at all, and yet we really, really enjoyed it. It was really a key part of our childhood.

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CP: Well, speaking of bicycles, you did a piece of research at Reed as well, is that right? On a bicycle speedometer and building a sensor for it?

JS: Oh my goodness, yeah. That was a very modest effort. It was I was teaching the junior—after I came back from SLAC I taught the junior physics lab with Richard Crandall, who is a brilliant electronics mathematician, physicist. And so, I had nothing to do really while the students were doing their stuff, and I wanted to make something and so I talked to Richard, and I wanted a speedometer for my bicycle that had no moving parts and no contact. And so, it turns out if you just take an ultrasonic speaker, essentially, it also works as a microphone, and if you bounce it on somebody that's moving, then there's a Doppler shift of the sound and then the two waves constructively and destructively interfere with each other. And it turns out if you get rid of the high frequency stuff and just leave the low frequency interference, then you have a signal which is proportional to your speed. And it worked out quite nicely. It was just a little circuit and I don't know, it was just kind of a fun little game.

CP: Well, you mentioned that you graduated from Reed and you didn't follow the orderly progression of the academic; you went into the workforce for a while, and your first job was at a very different place from Reed - Oregon State University in 1982.

JS: Yeah, yeah. Well that, my very first work was finishing up a house that my family was building. So, we built a three-story house and I put in the kitchen and did a bunch of the finish work on it. Then I ran off to Europe for nine months and hitchhiked around Europe and bicycled around Europe with my brothers on and off for nine months. Then I came back and I was broke, and so I needed to do something and my contact here at Oregon State University, Ed Trione, he was in Botany and Plant Pathology and he knew I did electronics, and so he had these huge environmental control chambers that were broken and he had like a row of them and they were tens of thousands of dollars each, and very complicated. They had lights and fans and refrigerators and heaters and all that stuff, and timers. And each of them was broken in a different way. And anyone who knows me knows that that's a perfect John thing to do, because I love fixing things, I just love fixing things. So, I dug in and I oh, you know, I'd figure out each one, and went ba ba ba bum bum down the row of those little, of those big chambers, and got them refitted and fully functional. And so, he was happy with that, because I had saved him probably like a hundred thousand dollars for new chambers.

And so, then he and Ed, was it Ed and Chuck, Charles Leach were looking at fungus, wheat fungus, and the thing is that it responds to both day and night temperatures, and so they had this idea of making what's called a thermogradient plate in which we have a gradient of high temperature to low temperature and then the fungus does something in the middle. And so, he wanted me to make a two-directional thermogradient plate that could be auto-claved and was solid state. They'd been using chillers and stuff like that. So, I undertook that and did make that for them. As far as I know, nothing was ever published off of it, but it was a fabulously challenging little project that I had about I guess like four or five months to make from scratch. And so, it was a fully digitally controlled, and everything had feedback on the heaters and coolers, and it was a fun project.

And out my window from my lab, that was in Cordley Hall, there was this little building, Gilmore Hall, and very modest building, little brick building, and out in front it said "Agricultural Engineering," and I honestly had never even dreamt that there was such a thing as agricultural engineering, but I looked at it, I said well gosh, you know, I like food, that's agriculture, and I like engineering. Maybe that's an interesting thought, I don't know. So, I really just put that out of my mind, and then what I really wanted to do, as you mentioned earlier, traveling was getting important for me. I felt that the one huge gap in my understanding was a global humanity. I felt that I'd been exposed to a lot of European history; I'd gone to Europe and seen all that, but what is the essence of humanity on earth and why are people so different and what are they doing and why, and can I somehow gauge in making the world a better place for people to live?

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And so, I was really, I needed to go to developing countries and to understand at that time, which was just this kind of very vague notion of countries that weren't functional, that things weren't working right. And so, I saved up some money and then eventually was able to get training, and we can talk about that more if you'd like, but I was supposed to go to the Peace Corps, and the Peace Corps mission that I was going to go to was going to was Ghana, and they had a civil strife at the time, and so they reassigned me to go to Mali, and as it turned out, I had picked up a hitchhiker who was an OSU-affiliated person, actually, Ianto Evans; he was part of the Aprovecho Institute. And I had picked him up months before while I was doing that construction on the house, and yeah, about a year before, and I just remembered that I, well, I picked up this guy who worked on cooking stoves. That's kind of interesting, and now they want me to work on cooking stoves on Mali, and I should just call this guy up.

And so, on a lark I called the Aprovecho and talked to him, and he made it clear, he'd just come back from Mali actually and no, the cook stove program there was terrible, you shouldn't do it. You should come down here and get really educated on what cook stoves were all about and then go do something really at a serious level. I thought that sounded kind of interesting. And so, I did that, went to Aprovecho at some point. So, kind of ticking through the years, we have the construction, then we have the European travel, then we have the repairing of the chambers, and then down to Aprovecho to take a six month training, intensive training on how to make cooking stoves for developing countries. I wanted to have something I could do which would be useful and which made—and which was suitable to my skills, and it seemed to fit.

So, as it turns out, I met my wife there, and happy birthday Laurie, today's her birthday. So we then—I was again broke, so I went down to the Bay Area, I suppose you can see that, and I got a job with a company called Mouse Systems, developing optical mice for computers. And this is, again, before optical mice really were mainstream. So, they had already developed a basic system, and then I was hired on to kind of make slightly a higher resolution and make it a little less expensive for doing some other things. So, I was broke and slightly in debt, but by working at Mouse Systems and developing these mice, I was able to save up a little bit of money. And it was a great job experience.

I mean, I have been so lucky, but I basically, I had my moped and I would, well I mostly bicycled to work, but then my moped was for long distance, if I had to go visit a vendor or something in other parts of the Bay Area. And you'd just walk into these meetings, it's like "yeah, I need this very large-scale integrated circuit, it has to have this optical stuff, it has to have these linear amplifiers, then has to this digital stuff, and so let's talk." And sitting now with ten engineers huddling to make some of the very first optical electric integrated systems, and so having those sorts of opportunities and working with, all the way through from heading to Los Angeles where we were doing the physical production of the boards and working in teams of engineers, it was great education in engineering. And that's always fascinated me. Again, so it was a bit intuitive.

One of the typical situations, though, was that we had to plan, we had to get the thing delivered and we had three months to deliver this thing to Texas Instruments. And so, I took out a roll of butcher paper and I said "okay, here we go, that's today, this is where we're going, now let's draw all the pieces in it and make it a chart," and we charted it all out. And this woman looked at me and said "where'd you learn to do that?" and it's like "I didn't learn to do this anywhere, it's an obvious thing we have to do, we have to get this thing worked out and we have these dates and we have people, I mean let's just do this." So, then I learned that there's some kind of a standard procedure for that, but I've always been a bit of following my father's lead, a little bit of a do-first, look for standard references later kind of approach to doing things like this. So, we just kind of did it and it was very successful and the company was really nice to me and put on a big farewell party and gave me all sorts of safari gear, which I took to Africa with a big smile on my face.

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So, then we launched, so my wife and I went to Kenya and I was supposed to teach at a polytechnic school there. The polytechnic really, as it turned out, didn't believe I was ever going to show up, you know; why would someone come all the way from California to Kakamega? So, I show up in Kakamega and they're like "what are you doing here?" This is before, obviously, any internet or anything like that, and this is '84. So, I just started volunteering, and so I started developing some bread ovens with a Peace Corps volunteer, and that turned into a set of design manuals for bread ovens, and then that got picked up by the German government to make a book on bread ovens.

And then we got hired by UNICEF to go to Somalia, and Laurie and I worked with a fabulous team in Somalia. And I had to learn how to carve sepiolite, which is what they make meerschaum pipes out of and stuff. So, my first thing in Somalia is we'd throw some rocks in the bathtub there and get them all wet and then this Somali master craftsman comes in and we stood on the floor carving soapstone and we carved the objects out of soapstone, so I could learn how to carve stoves out of soapstone, so I could learn how to train people and understand the technical issues. And so, then we drove right to the middle of one of the hottest inhabited places on the border between Ethiopia and Somalia and worked with the soapstone carvers. I unfortunately did come down with dengue fever as well and had a bit of a medical situation, but got back to Mogadishu and went on to work.

And then we flew up to Hargeisa, and it was funny, one of the staff members, Mohammad, had been on the airline, and so we had to, of course, pay all sorts of bribes to get—even though we had legal tickets, everything was legit, but you have to just kind of, they don't—things don't go, so you get there, you're sitting on the tarmac at four in the morning and it's freezing and Mohammad's there, I said "Mohammad, tell me a little bit about Somali Airlines." "Oh yeah, Somali Airlines, it's fine. We've only lost a couple of airplanes," when you did see that there was two 707's at the end of the runway that were nose-down. And they'd only lost two of them, they lost two airplanes, they were losing—so I said "what happened?" He said "well you know, of course my friends were on those airplanes." I said "well wow, that's bad." One of them the wing fell off and the other one had a catastrophic engine failure.

So, we get on this airplane, and with that you're kind of just freezing, you've had a poor night's sleep, you're on this airplane and they say "we're going to get to Hargeisa at this time, *in sha Allah*," which is God willing, and you're thinking "oh, this is great." But anyway, so we do get to Hargeisa, but the reason for this long story is that the U.S. Embassy and the German emb—everyone got together while we're on the flight; a 707 from Somali Airlines couldn't land in Frankfurt. They literally hand-cranked down the wheels for a jet to get into Frankfurt. The Germans condemned the airplane on the spot, it was a complete disaster, it was all corroded, everything like that. They would let it take off; it was scrapped on the spot. And they'd shut down the whole business, so we could not get home, I mean we were stuck a thousand miles from even Mogadishu.

And so luckily—and I have to say, through this story luck plays a huge role here. I mean, I'm an incredibly lucky person—so as it turns out, the project we were on was buying a four-wheel drive Toyota from Djibouti, and we just go up there, get this four-wheel drive and we now have a brand-new Toyota Land Cruiser that we were able to drive all the way from, essentially from Djibouti, just outside Djibouti, all the way back down to Mogadishu, to the middle of Somalia. It was a phenomenal trip. So, all the diesel on the roof and just went, and I'll never forget that trip, being with the Somali colleagues and listening to Stevie Wonder on the tape player and just kind of watching the Somali landscape go by and having to get out of the truck to herd camels with the camel herders because they were in the road and all that other stuff.

So, we had some amazing experiences in our stove work and then went back to Kenya, did some more work with the German mission, and then we were hired to go to Sri Lanka with the British Schumacher Foundation and ITDG; Intermediate Technology Development Group. And so, we went to Sri Lanka on a number of occasions developing cooking stoves there. In that case it was ceramic. We often had a—my wife's a ceramist, I'm more of an engineer-type, so she would work with the local artisans, so I would work a lot with the crafts, the metalcrafts people and stuff like that, and we developed designs. And so, we were working, developing designs in Somalia for the refugees and for just the public there. And then in Kenya, of course, my wife was very—material and development of the Kenya Ceramic Jiko, which has now taken off across Africa and has essentially saved as much wood as the entire weight of humanity on Earth today. So, it's an amazing success story and development.

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And I guess one of those things that comes through this is that while development projects are highly maligned, in many literature and in probably the academic world as well, that wasn't my experience. We actually saw some amazing things happen through intensive efforts of people who cared a lot. And it was in Kenya where Laurie was hired to—she's an artist as well, and so she's great at drawing things—so she was hired to draw construction manuals for water tanks. And this was during '85, during the severe drought there. So, then we went and visited the water tanks and this and that. And what you see is these brown hill—it's like right now we're in a drought here, but brown hillsides, then with green farmer fields, and it's like what are those green farmer fields? Those are where they had water tanks that would catch the runoff water every time it rained. And so, it was just stunning. You know; here you can see this landscape that is otherwise looking to be unproductive, but here there's plenty of productivity; the farmers and kids are happy. All for the price of one cow they could build this little ferrocement water tank, fifty cubic meters.

Anywho, that's when it all came together for me a little bit and I was like oh, agricultural engineering, that's agricultural engineering, oh, and then how do they design these things? Oh, they really didn't design them, did they? They just kind of put them places and saw if they worked and didn't have any clue as to weather, how water and soil interacted and how this whole system might work and how many places you could put them. And then I did some calculations and I saw that at that time, for one billion dollars we could essentially have populated the entire Sahel with these tanks and made a transformational change in the ability for people to have reliable food, and then also plant trees and all that other stuff. So, it all kind of came together for me. It was like wow, that's cool, that's what I want to do. I want to work on water, I want to work on understanding how water moves an environment and hopefully have some utility for humanity.

And so, then I dusted off my thinking and saw that Cornell, Cornell Ag Engineering was, at that time, a premier place to study for international applications of agricultural engineering concepts. They had a very, very good water team. And so, I applied there. And some years later, actually, I did some more engineering as we were excited about doing our international work and we had a little consulting company, my wife and I, and it was doing fine. And so, we did that for some time and then I did electronics again for some time, just in design for Boeing; aircrafts and stuff like that, just to kind of get married and have some money, and then we finally went back to graduate school. So, I had a nice six year period between finishing undergraduate and starting graduate school.

And for me, again, it's a very important thing that students, and people in general, follow their passions and take the time to identify where their real callings are, and for me that worked very well. And when I went back to college, as I mentioned earlier, the degree itself was little challenge, because I knew what I wanted to do. I was there with a mission. And maybe I'll just take a moment to mention one other funny little story, which was that I called up Cornell and I said "okay guys, I want to get a professional degree in water so I can work on water projects, how long is it going to take?" and Mike Walter, who I still know and like very much, he was a professor; he said "well John, you don't know anything. You have no clue of mechanics, you have no statistics, you have no economics, you've got nothing, so really to have a great background in water and all the intricacies, it will take three years to get a master's degree." And I said "well, wait a minute, ah. Oh, what if I wanted to get the fastest master's degree possible? How long would that take?" "Well, you could do that in a year."

This is before they didn't—you still had to write a thesis, but "oh, you can do it in a year? And what's the fastest possible PhD you can get?" "Well, you can do that in two years," and I said "well Mike, what the heck are you talking about? Why would anyone—and I can take the same classes, right?" "Yeah." "Well, why would anyone do a three-year master's degree?" and I still ask my students that. And that's what I did, and I knew exactly—but by knowing what you want to do and by having the passion, and I suppose being somewhat impatient with people above—with authority figures, which my dad also imbued in us, that all adds together to be quite a motivational tool for getting out of graduate school quickly.

[0:40:40]

CP: Well, it sounds like Cornell was a positive experience overall.

JS: Yeah, oh yeah. Cornell was great. It did work out much as I had hoped. They had a very strong international program, but what I didn't understand was there were some key personalities there, and I want to say Doug Haith, Tommo Steenhuis and Yves Parlange and Wilfried Brutsaert who really were key mentors, and somehow I was fortunate to work with those guys, and that just kind of was the most—and then the peers, I still work with a lot of my Cornell colleagues, alumni. So yeah, it was a—and I think even in the history of Cornell there was a particular energy right then where there was still money in international work, it was still a lot of creativity, a lot of excitement. I don't know, there's—I suppose I should ask, but it was a pretty special time there.

So, I feel very lucky to have been part of that little cadre of students who were burning to make a difference, and I think that later, when I was a younger person, we were less concerned about making money in our careers, but more concerned about what we did with our careers, I think, and now there's more of a focus on making money and getting a job that pays. I was routinely broke. I mean, I was routinely out of work and had to scramble around, but if someone said "well, why don't you take a"—like at Mouse Systems, my colleague there said "John, you know you could be rich here. This is—you got it scoped out, things are going to go well." Well, it just wasn't, at that time that wasn't in our minds. It was like "no, no, I want to be employed, I want to have a job, yeah, or figure out a way to make money, but getting rich is not the issue here." And I think that at Cornell at that time it was that sense that everyone was there with a goal of actually making difference, and so there was a very good *esprit de corps*.

CP: Was your research at Cornell focused on this international development piece, still?

JS: Yeah, it was funny, I wanted that to be the case but it in no way was it. It was a bit tricky. I was accepted at Cornell but they didn't give me a fellowship, and so I "what's this about?" and so I flew myself out and brought my camping tent and I borrowed my brother's car, who lived in New York, I drove out there and set up my tent and went and talked to all the professors, said "do you have any opportunities?" and the very last guy, Doug Haith was the last guy I talked to, who I really had no appointment with, he said "yeah, I'll give you a fellowship." It was like "oh, okay, great," and "what are we going to do?" So, it wasn't quite that random. I wanted to recall from the water catchment tanks; I really wanted to understand the rainfall and the relationship between infiltration and runoff, and that's what I did with Doug Haith.

So, we did stochastic modeling of rainfall and then infiltration and runoff processes for nonpoint source pollution modeling. And I still work on that stuff. And so that was a great—and so it was aligned with my interests, but it was he had a—he was looking at nonpoint source pollution, which I had never really worried about. I was worried about water quantity. And so, I it's a slightly different application. And then we had really focused mostly on the movement of particles to water that might contaminate water supplies. So, we haven't in too much depth at the actual infiltration process, so then I really felt that we had covered a lot with Doug and it was great, but I wanted to learn more about the subsurface, and so then I had found that it was a project that Tommo Steenhuis was leading on fingered flow, subsurface water transfer processes in this, called unstable wetting fronts. And that had a very natural, physics-y kind of flavor to it, in a lot of instrumentation, and it was something that would expand my horizons a little bit from the stochastics.

[0:44:56]

And so, I did that for the PhD and then did, actually, a very brief post-doc at Cornell on a field. That was a laboratory study. So, the first one was very much on the computer, a simulation study, then there was a lab study, then I did my post-doc as a field project, looking at transporting the field, subsurface movement of contaminants. So that was, it was sort of addressing the international thing. At the midpoint I had tried to get funding to go to Yemen, and I was just that close, and so I could well have done my PhD in Yemen, but didn't quite work out. So, I ended up doing the infiltration.

CP: Was this your first exposure to teaching, at Cornell?

JS: You know, interestingly enough, I didn't have to teach at all at Cornell. "Have to"; I didn't get to. It wasn't part of the program. So, I didn't teach at all at Cornell. So, when I came here, that was completely uncharted territory.

CP: Well, let's talk about that. You came to OSU, you finished up at Cornell in '91, you came directly to OSU more or less, after post-doc?

JS: Right.

CP: How did that come about?

JS: Oh, that's a funny story. So, I had seen this department of Agricultural Engineering, and when I drove out with my wife to Cornell, it's a long drive from Seattle, and she said "well, what are you going to do next?" and I said "well, obviously I want to go do international consulting and save the world, so that's my next job, but there is this one groundwater position at Oregon State University that I, you know, that would be cool," because I really had enjoyed my time at OSU and I'd seen that the department had done s—and it's this one job, it had been held by Roy Brooks, who's a very famous figure in our field. And it's a cool department, also. So, I go to Cornell and da da da da, get my PhD, and then there's a wedding I was going to in Portland, and so of course I had a suit and so I fly out to Portland and call my brother Frank, who's at Stanford, and I said "hey Frank, I'm in Portland," and he says "oh wow, cool, hey did you hear there's a job in Civil Engineering at OSU?" I said "well, I'm in the market for a job, that wasn't quite what I was thinking of, but okay."

So, I called OSU and called Civil; they said "no, we don't have any jobs here." "Oh. Well, okay." "But maybe you were thinking of Ag Engineering? Well, I could transfer you." "Fine." So, she transfers me up to Elena Rutacil [?], who just retired very recently, and Elena says "how did you hear about this job?" It's like "uh, well a little birdy told me. I don't know, is there a job?" and she said "yeah, we haven't put out the ad yet," and I said "oh my goodness, well do you mind if I drive down and talk to your chairman tomorrow? Can I talk to your chairman?" And so, Andy Hashimoto was there, and sure enough I had a suit, I was all set.

So, I came down, we had a really nice chat the next day, and then they proceeded to kind of, in high academic style, take forever to announce this job and to go through the whole process. Well, of course I gave him my résumé on the spot and he added it to the file and that was fine. And I had to turn down a couple other jobs, because this was clearly [small gasp] sort of been wanting to do. And so, then we interviewed, and of course my wife, we went to the bed and breakfast, my wife says—the person just said "nice to meet you, oh, there have been such nice candidates," and Laurie just goes white, because she said "the other candidates?" "yes Laurie, there are other candidates."

But anyway, so we interviewed, and the committee deadlocks, apparently, and I get a call from Marshall English and he says "you know John, your publications, what's up?" I said "well, you know"—by then I had I think seven or eight publications; he said "no, you only showed two," "Oh! You've got that résumé from over a year ago, what the heck," and so I sent my new résumé and [snaps fingers] got the job. And so, it was by the skin of my teeth. But it was a fun story and it really was amazing. Again, a very lucky situation that—and I told my brother Frank and he told me about the job, and he said "oh no, no, I was totally messed up. It was a job in Economics." So anyway, it was all just a—it was all the wrong, it was all quite odd, but fortuitous, we could say. But yeah, so then I came in '91, I had that little kind of a six-month post-doc and just started doing my job, and yeah, it's been a great time since.

CP: So, you had been to OSU eight years prior, and I'm interested if you noticed any significant change in the time that you were gone. Had the university or the town changed much in the interim?

[0:49:56]

JS: Not really, no not really. I mean at that point, I think the university was at a stable population, if not maybe declining. And of course my situation was completely different. When I was there initially I was a footloose and fancy-free kid who was up in the lab; I'd work on my independent project and would go climbing and hiking on the weekends, and then I came back as a professor having to set up a whole research lab and having to teach and all these other things, and so the city hadn't changed but my life had certainly changed, and I had seen a lot in the world and things like that. So, I was in a different place for me.

Yeah, in fact you know how it is when you live in a—I lived in Corvallis I guess for nine months when I first was here, and I had my path and I had to do my thing, but mostly I was doing things out of town for on the weekends and things. And so, in fact the city was not that familiar to me. I mean yeah, I knew it, but it was a different level of kind of acquaintance that I made this time around.

CP: So, you were hired into the Bioresource Engineering department, as it was called at the time, if I'm not mistaken?

JS: That's correct, yes.

CP: What was the state of the department? And I'm interested in this particularly given that you were hired right after Ballot Measure 5 was essentially put into action and that the university was almost in a state of crisis at that point.

JS: Yeah, so that's true. Ballot Measure 5 had just passed, which had a significant impact on me through my wife, because through a joint hire thing she had a position in the Art Department as a drawing instructor, which she loved, and she was very, very highly regarded by students and faculty, but because of Ballot Measure 5, after the one year of funding had gone up, then she had to—she couldn't teach there any further. She's been teaching at the community college for well over a decade now, and so she loves teaching too.

So, that aspect had an impact on us, and I think the overall sense of going from New York, where to dig a hole you'd have twenty guys standing around with shovels and one guy digging a hole, maybe, and then here it was such a spare operation. It was really spare. Everything was trimmed down and efficient and thin, which is the way I like it. But I'll never forget the controversy at the time was they built the Oregon State Historical Museum in Salem and the carpet had cost like a hundred dollars a square yard or something like that. It was a good, custom-made carpet that was supposed to last for decades and decades, which I'm sure it has. Oh, this was a, you know, a complete blow-up in the news, like why are they spending so much money on the carpet? And I'm thinking at least it was something; you don't just have guys standing around with shovels.

But anyway, so it was a time of austerity here, but that was my main reaction. I had been lucky enough to write a grant before I got here. I got it funded so I was able to hit the ground here with some money and with setting up my lab and had some start-up funds which, by today's standards, are considered rather small. But I got things going, I was happy, there was lots of things to do, so I really didn't think about the Ballot Measure 5 at all. I just kind of go—did the things I wanted to do.

CP: You mentioned Andy Hashimoto was the department chair at the time, he went on to become an upper administrator here at OSU; I'm interested in sort of colleagues that were important to you, OSU people, if he was one, or of others.

JS: Sure. The shock of coming to OSU was considerable in that I had come at Reed, this was—by that point at Reed's history they had fifty percent attrition, so lots of people left. It was a rough environment. It was you do the work or you don't; get it done or you're out of here. And then you go to Cornell and it was pretty—it wasn't quite that obvious but it was also fairly competitive. But there was a certain, there was an intellectual vibrancy and kind of discourse that was really intense, and people were not afraid to talk. And there were disputes between faculty, which would, you know, ah, they wouldn't talk for twenty years.

You come to OSU, and I mean first guy I meet, practically, is Jeff Rodgers, who'd been the department chair in the forties, I want to say. Anyway, he was still coming and having coffee in 1991, so he was in his nineties by then. These guys were a family. They were really comfortable together, they were really supportive, they were a community, which is really different than what I had experienced before. Before, it was an intellectual hotbed of hotheads; this was a community of people who enjoyed being with each other and made the effort to make sure they would enjoy being together.

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So, Andy led with a very soft touch, and I—just facts for the record—I think I've had maybe, I don't know, in terms of formal performance reviews, they're typically—that I guess it hasn't been a problem, but it's interesting how that's done here. It's used as it should be, which is when there's an issue, you deal with it. But he very light touch, he just kind of checked in on me once in a while and I'd chat with him a little bit. He was really interested in making sure that obstacles were cleared out of the way, if they were obstacles, led faculty meetings very gracefully. And so, Andy was a very easy guy to work with and we have stayed in touch ever since. Not as much as I'd like to, but he's in Hawaii now and doing very well.

But there were two, I suppose, people who were quite influential. One was Ron Minor, and Ron Minor was an odor engineer, so it turns out that's a big deal. So, and he had a great sense of humor, and that's important; if you're going to be an odor engineer, you got to have a good sense of humor, otherwise there'll be a real problem. But he was a guy who really thought about life and really lived well. So, like if a proposal's due on the first of September and he's photocopying it the fifteenth of August, and I go why are you—I see him madly doing all these papers and stuff—back then we had to do it in hardcopy—you know; "Ron, what's going on here? You have a proposal due tomorrow?" He goes "oh no, no, no, it's due in a couple weeks." "But you're doing final assembly?" "Yeah, yeah, yeah, well I've got some visitors coming from out of town and there's the opera and you know, there's other things, and so I had to get it done a little early," and it's like oh my gosh, the whole notion, you know.

So, Ron was a guy who was thoughtful in life and strategic and did beautiful work and did it gracefully, and I had been much more, as I mentioned, kind of intuitive and perhaps spontaneous in that sense, and so it was really great to have Ron to kind of look—so, I would stop in in Ron's office quite often, actually. He had been the chairman before Andy, I think, and we just talked about things a lot and I'd ask him for advice. And then, so his advice was a big deal for me. Also Jim Moore, who was the chair after Andy left, was a guy who I stopped in on and liked to talk to about strategic decisions and ways of doing things, and we didn't always agree, by any means, but they were fabulous touchstones and always extremely supportive, and Andy as well.

The department was going through a lot of changes, and so as you mentioned, it started off as Agricultural Engineering and then about a year before—I think—I got here, they changed it to Bioresource Engineering, which was a pretty major change, and they threw out the power machinery group and other things kind of reformulated in a very dramatic way. And then, not so many years later, it became Bioengineering, because we were starting this new Bioengineering undergraduate program, and that was an important event in that it created friction which ultimately led to essentially the disruption of the department, where the undergraduate program was essentially moved to a different college, and much to our chagrin, and we really had hoped and we had really put effort into it, but that—we'd always taken, at OSU, for granted, to some degree, this sense of community and the connectedness we had. And taking it for granted is not a healthy way to support such a thing. So, that kind of hiccup really taught us a lot about how important it was to be communicative; to be listeners, not just talkers, and try to make sure that people were all taken care of.

And so, then the department once again, after that split, changed its name to its current name: Biological and Ecological Engineering, which is an interesting, unusual marriage. We have names but it really—and it doesn't very well describe anything that we do, except we have an ecological engineering undergraduate program, which was the first in the country, and it's been very successful, it was really fun to be part of. And then the biological engineering represents a lot of the work that a good chunk of our faculty do, so it's a name that fits, it's just you always have to spend some time defining it.

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In terms of this business of cultural features, one of the things that I don't think universities correctly do often, and it could be that OSU is in this camp of not correctly doing it, I'm not sure, is understanding who they are. And so, my experiences with Reed and Cornell being very extreme cases, Reed being kind of extreme liberal arts, extreme academics, and Cornell being extreme engineering and ivory—not ivory tower, but what's the football league, they call the—

CP: Ivy League.

JS: The Ivy League, it was the Ivy League football. So, it's kind of that culture of kind of this old-school kind of thing, we get to OSU and we're doing all sorts of stuff here, and what I think we're still not fully—what I think I try to always communicate to people at OSU is that the thing we can do is work together, and that is such a special and important thing, and it is particularly important right now, because if you look at the issues that the world faces, they are complex issues and they are multifaceted and they involve many disciplines. So, the fact that we can—I yesterday sat down with a geomorphologist and a snow hydrologist and me, and we have a project together and boom [snaps fingers], we're talking, we're doing, we're designing experiments collaboratively.

You know, same thing with fisheries and with economics and with social science, and these things just happen very fluidly, very gracefully. Of course with lots of challenges, when you bring that many people together, of just disciplines, but I have worked with microbiologists here, I'm working with Theo Dreher right now on the microbiology of a reservoir, I've worked with Peter Bottomley on microbial distribution in soils. These are things I could work on alone. And so, at OSU we had this ability to, because of the community-mindedness, because of the fact that that's valued, we can work on problems that other institutions can't put together a team on. Harvard, bless their soul, is never going to do the work we're doing. Nor will MIT, nor will Cornell.

And so, we have an extremely strategic opportunity, and we're making good on it. We're really doing the hard work right now. But I think that it's like no one quite has the single-word vocabulary to say this is what it is, but what's going to emerge, I believe in this decade, is that this is the environment that we need. We have taken the last however many generations of people who've been at OSU, have taken the time to make this place work in this way.

You're probably aware of the Kellogg where they got a big grant from Kellogg and Kellogg said "do something that will make the university better." And I don't know, what are you going to do about that, right? So, they re-envision it; department changes, this and that; no, what they did is they invested it in communication. Paul Axtell came in, trained three thousand OSU faculty to talk and to listen and to have a productive meeting, and he did it in a very emotional, very connected sort of way. That, I claim, was a pivotal point for this university. No one else, I don't think, would say that, but I claim it was. It was when this university learned how to have the sophistication in communication that corresponded to the sophistication of the problems we had to work on and the sophistication of the disciplines which were represented. That was pivotal.

So, that's the—the OSU culture, I've said a lot of good things about it, I mean it has it's flipsides as well. You can accidentally and easily offend people, because if you get in and you say "now, [makes quick chopping motions] we're getting down to the bottom of this, I'm going to dig-in," and I've actually become someone who I think I don't serve on as many committees as I used to because they know that if they invite me in the room there may be hard questions asked, because I really want to know, I want to know. And so, OSU's climate is not as comfortable with some of that deep probing where you figure out, on the fly, if there's been a fundamental mistake; if we're thinking in the wrong way, if we didn't—that's a little bit tougher here than it is at a place which is more thick-skinned and kind of where there are bullies, kind of situation.

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So, how do we marry that kind of very raw exploration of ideas to a culture that cares for all the people within it? I think that's our next challenge; I think that because we have to have the ability to really tear away what's not true and get down to what's really happening, and to do that and to take care of everyone in the process is not trivial.

CP: Well, that's interesting, thank you for sharing that. Well, so getting back to kind of the beginnings of OSU for you; you had never done any teaching, was that an easy transition for you, or did it take some time to become an instructor?

JS: Ah, it's continuing, it's a continuing challenge, continual exciting opportunity. I had some fabulous mentors. I had David Griffiths at Reed, has been awarded the Best Physics Teacher in the U.S. prize and all sorts of other things. He's, you know, you look it up and he's just a phenomenal teacher. And I had a series of fabulous teachers at Reed who were just kind of you knew you were in the presence of, not greatness from the scientific point of view, but also maybe, but primarily greatness in teaching. You know, someone who just was a master at communicating, with enthusiasm and directness and simplicity, complicated ideas.

So, I had some good mentors, and at Cornell as well, and so I simply adopted their approach, which is just classic chalkboard. You know, I just did the chalkboard thing. And then I've evolved; it turns out I'm a quick note-taker while a lot of students were having trouble keeping up with the notes. Okay, fine, so then we did overheads, and then I did PowerPoint and then I noticed that people's minds were not as fully engaged as they should be, so what I've done now is I've completely done the classic flipped educational model where I come in with a test, and it's sometimes shocking to people, but I come in—this last quarter was great, I had to miss the first two class sessions, because I was off in—I got stuck in Europe on a bad weather thing, and so I come in the first day and "here's your test," and they go "what?" And so, [reaches into empty shirt pocket] I normally carry pens, but I give them all blue pens; "you have ten minutes, do the test," and then I take their pens back and I give them red pens and I say "now, let's put the chairs all in a circle and let's talk, and anything you put in red you get a fifty percent credit for.

Well, they were—to give some preface, the reading assignments had been given by my designee when I wasn't there and they had been given links to all my videos, so what I did is I'd record all my lectures, so I'm really excited about using the time that we have together in a different way, and so lecturing, I was frustrated over the years, and no one asked enough questions. I wanted more questions, I wanted tough questions, and they weren't there. It was just quiet. You know, you lecture, you get two questions in an hour? Ugh, well why not just watch it on video then? So, that's what I did; I recorded them, they watched it on video and now we sit around talking, and we motivate it all by having this quiz, which I call "the two-pen testing method quiz," and we published that, and it creates this really exciting environment. The students are jazzed, they really are engaged, we get much deeper ideas, because they've already seen the basics. And this is at mostly the graduate level, but I also teach upper levels of undergraduate.

So, the teaching has been a continuing exploration. I feel like I had fabulous mentors, I feel like the technology and the opportunities are really exciting right now, and we are kind of hopefully plotting the course for the next generation, about how we can re-engage. I think there was a big disengagement with a PowerPoint kind of approach where there's all the stuff on the board and you don't know what to take notes on. That's a disengaged approach, but if we can create an engaged environment where they know what are they are supposed to know, they think they know it—by the way, all the questions on the test I give them in advance, so they have all their questions for the whole quarter. So, I'm only going to draw from those questions, and so they know—but the interesting thing is that once they're sitting in the—they know which part of the chapter we're on, they can isolate down to three or four questions.

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Once they're sitting in the room, all the sudden the depth of the confusion really becomes apparent, and then they kind of go "oh, I thought I knew this!" and that's when we have the conversation. So, that's sort of—so yeah, teaching was, it was I started very classically and I just taught a class the way I knew how to take classes, and I was fine at that, that was pretty, that's pretty comfortable for me. And so, I learned well in that environment. The other thing we do now, I give out homework. You know, you give out physics homework; "imagine there's a sphere and there's a charged particle, what's the field?" Well that's physics, but in hydrology we do the same, we imagine there's a dam and there's water here, there's no water there, how much water goes through the dam, that type of thing.

And you know, there's about thirty percent of the students who really get it and then there's about thirty percent of the students who kind of muscle through, and then there's thirty percent of students who are just like "this means nothing to me." So it's like yeah, this isn't too bad. So, what I transitioned to now is I give them all the semester's homework in a box, so they make their own experiments. They have the little test tubes, they have little capillary tubes, they have sand, they have sponges, they have measurement devices, and then they do the homework and they do the experiment and then interpret the experiment, and we get at the basic principles that way. And this is, again, the graduate level or undergraduate level.

And so, I think that we have some—well the fun for me is to keep on exploring, so it's not about how I started, it's just about not—a good designer, as we say, or good engineering, is that you're never satisfied. Anyone who really thinks the world is perfect now is not going to be a good engineer. You have to be eternally dissatisfied; you have to be eternally saying "oh, this could be so much better." And so, in the same sense that's what I apply to the education, is that it's like an engineering task, it's like this is certainly not as good; that we know that having a room full of really smart people quietly sitting, falling asleep, and the guy at the board trying to get their attention, is not a good model. So, let's just take that and let's now incrementally advance it. And so, I think that we're a very exciting place for education in that sense. I think we will make some really great advances.

CP: And on the research side, you came to OSU with a grant, you said. Tell me a bit about setting up your lab.

JS: Oh, well I was completely naïve, as always, and so I didn't know what to do. Luckily I had that grant that had to do some stuff, and so we bought some balances, we bought some other pieces and bits, and fortunately I ran into a couple of really great students early on; John Knudson and Floren Brandedorn were two of my first students, and they were fabulous and totally different style learners, and so I ended up mentoring thing—I had done a little bit of mentoring at

Cornell, I'd had some students working with me, and that's been parallel to the teaching thing, is learning how to be a good mentor is far from obvious. It's really a challenge. And so, the mentoring thing, initially I had zero success with my students, and I sat down after a month or two, which seemed like an eternity, I said "what's going on?" And then all the sudden we kind of got things going, and both those students ended up writing three papers out of their master's degrees, which was really nice. But it was again, it was they were totally different, and I was like oh wow, you work with people completely differently.

And so it just, it was really interesting for me right from the start. So, setting up the lab I was kind of, I was jealous of my brother Eric. Eric was at the same time a professor at University of Oregon, he still is, and he was showing me his lab layout. He's a molecular biologist, and so you know, "we'll have the centrifuge room here and we'll have electrophoresis there and we'll have, everyone will have their stations, each one has a refrigerator and they've got their little pipetting stand and everything." I was like "holy cow, you could just lay out a lab like that?" My lab layout was okay; leave a big space in the middle of the room, I want the middle desk to be on wheels so we can move it in case we need to do something like a big column experiment, you never know, and then yeah I'll need counters and I'll need sinks and I'll need some cupboards, and other than that it's like we don't know what's going to happen in here.

[1:14:57]

And so, it was a very, you know, we had to just follow our nose. When you're doing field hydrology and trying to develop new instrumentation along the way, literally there is no cookie cutter. So, we just kind of just went. And then, I was very fortunate that Larry Boersma, who's emeritus faculty here, still quite active, had a large lab space that he let me kind of borrow, and I later occupied. And so, that lab gave me all the freedom in the world, with a big—he had also designed it, by the way, with a big open space in the middle. I was like "oh, I'm not the only guy who does that." He does soil physics too and he saw the need; he had a big open space you don't know what you're going to do with. So anyway, Larry was a great mentor in terms of helping me kind of get started and giving me the facilities to help be successful in that sense.

And now my labs, I run a media characterization lab, which is an open lab that anyone on campus can use, and then we have a visualization lab and now we're making what's called an open source environmental sensor lab, which is going to be a 3D printer thing, which is working with the library actually, to make a new global repository for environmental sensing design, because it turns out that there's no market for most of the things we need, not a large market, so people have to make them themselves. So, this opportunity to be able to make things in three dimensions and publish those designs and have people modify them is very exciting.

So, we have a maker lab and then we have two other labs in the Soils Department for characterization and for special projects, and then we have an entire warehouse facility for our fiber optics work and our field work for the National Science Foundation. So, the labs have kind of blown up a little bit, and I am lucky enough to have a fabulous team that helps make everything possible. So, we have a fabulous technician and a great graduate student team.

CP: Do I understand that you did a project at Hanford early on?

JS: Yes, yes, very interesting project. The Hanford site, how the heck did that come about? But we—okay, so the Missoula Floods came through this area and laid down forty or more layers of soil, and I had gotten fascinated by layered soils, because layered soils, what happens is the fine-textured soil acts like a really good quality sponge and it holds onto liquid and the courser-textured soil then doesn't suck it up, and so the water can kind of stay stuck in the soil without draining down to the aquifer.

Well, it turns out that at the Hanford site, when they did their plutonium enrichment, they used these ridiculous solutions with saturated salt solutions with sodium nitrate, so I mean just take it, keep on dumping salt until it's crystalizing. Then during the Reagan administration they had the bright idea that their tanks were all full, so let's just dump the stuff out into the landscape. Oh, and they did that. So, they put in these infiltration galleries and dumped things out. Well, then these contaminants got into those layers, and the interesting thing was that I was doing math at the time, looking at the layered flow, and this was the classic example. The layered flow, with those high-salt concentrations; what happens is the salty water gets stuck in that fine layer and it's salty, and you know how salt attracts water. It's hydroscopic, so it takes the water out of the soil above and below it, which there is a little bit of water; even though it's a desert, there's water there, and it goes to the salty water, it dilutes a little bit and then there's more water there. What happens: it advances along the horizontal band.

Turns out that that layered flow is most efficient very slowly. If you do put a lot of water it just dumps through, but a little bit of water at a time. So, it turns out that that explained the dramatic spreading of a lot of the contaminants, because this layered system with the high salt gave rise to the self-propagating movement. Furthermore, it turned out the salts, as you dilute them, eventually they get more and more hydrated and the clay part of those get blown apart and then the clay part of those become mobile instead of being stuck. And that's called colloidal, facility colloidal transport. So, the radionuclides get stuck on these clay particles, the clay particles blow up and then they move. So, it explained not only why the plumes were expanding laterally much faster than was otherwise thought, but also why certain contaminants were traveling faster than we thought.

So, it was a really interesting project. And Noam Weisbrod, who was the post-doc on that project, and I, we just learned so much. It was really fascinating. And I've talked to people at Hanford and they're aware of these processes, and it led us to believe that there are certain ways to remediate a site in terms of controlling movement, which is—it's a long story, but yes we did work on the Hanford site and it was an interesting, engaging effort for several years.

[1:20:21]

CP: You have also developed a close relationship with Chile, colleagues in Chile.

JS: Right, and I'm going back to Chile in just a couple of days. Yes, some of our early foreign students in our department were from Chile, and just four years after I came here I was invited to go down to Chile to give a lecture, and Ivan Gallardo. And so, it was at the Agricultural Institute of Chile, so it's a national research center, and I've been working with those guys ever since. I'll be going down again probably for my twentieth visit. We're working on some real interesting problems of water resources. They have a region which is called the *Secano Interior*, which is a large landmass on the order of fifty miles wide by maybe four hundred miles long, where it gets between a half a meter and a meter and a half of rain a year, which is like the Willamette Valley-ish water, but it's this very strange soil. It's this clay soil, granitic clay soil that just seals up when it gets wet, and so then it all runs off. So, *secano* means dry, so it's this dry region that gets a lot of rain. It's a coastal thing.

Anyway, so we've been spending the last twenty years trying to understand the processes of that site and under—it turns out it was a surprise to everybody, but shouldn't have been, that when soils get wet they swell up and they become less permeable, but all the equations that people use say they become more permeable, and so we—it has to do with the scale. People were taking small cores, and small cores, it's true, they typically become more permeable as they get wet, but if you look at a landscape scale, it's different. So, we've recently—well that's just over the long time—been exploring how that landscape responds to rainfall and how other expansive soils—and we have expansive soils here in the Willamette Valley, as well—how they work, how it works, how they're going to be able to manage these water resources. And so, I'll be going down and giving some lectures on water resource management in that particular environment. And so, it's been a very productive, engaging effort in Chile. And that was my first professional overseas work from when I was a professor here.

CP: You also have done a lot of work with fiber optics in riverbeds and in trees.

JS: Right. Not so much in trees, but in riverbeds, for sure. So, one of the things that's underappreciated in this climate is the importance of sabbaticals, and so I went on sabbatical to Switzerland in 2005 and had the opportunity to really tackle some new problems. And so, we—I needed to measure, I wanted to measure glacier melting. So, I wanted to take the temperature of the glaciers, so I needed something that would take a temperature thousands of places and would be transparent so the sunlight wouldn't heat it, because anything—if you put a normal thermometer in a glacier, if there's sunlight it just melts, and it creates a warm spot.

So, well I thought we could do it with fiber optics, and I was half right. It turns out it was a much bigger challenge in terms of the glacier, but I then found out about this incredible way of measuring temperature with fiber optics, which was just blossoming at that moment, and so we've gone on to do a lot of work with these fiber optics, because we can make extremely precise, high-speed measurements of temperature, like every six inches along the fiber, and we can go for many miles. So, we can actually take hundreds of thousands of measurements a minute, and we now use them in rivers to see where the groundwater comes up; we use them in the atmosphere, we can see by heating the wire, we heat the cables with electricity, then when it's windy it cools it off. So, by comparing the unheated cable to the heated cable, we can actually get local wind speed, and of course local temperature.

So, all the turbulence and all the processes in the atmosphere can become visualized then, and that's worked; it's right now under revision for *Geophysical Research Letters*. We hope it's going to get accepted. But it turns out that the ability to take good data at ever increasing resolution in time and space is, just imagine, I always think of it like you wear glasses, if you rub Vaseline all over your glasses and you looked and you'd say "oh, it's kind of a, yeah, this is a well-illuminated room and it's kind of a greenish tint," and that's what you'd know, and then as you go to kind of a dragonfly model where you've got thousands of things, well wait, something's moving over there, I could eat it. Then as you go to human vision you really can pick out this richness, right?

[1:25:19]

So, we've been satisfied for many years with what we could make, which were little point sensors and things like that, and my strategy is that if we can add either one or two orders of magnitude—that means factors of ten—more resolution in time or space or precision, that typically leads us to a whole new understanding. So, I'm really engaged, and with fiber optics we're doing that; with streams, with atmospheric, with snow, deep bore holes, we're using it in the South China Sea, we used it in Antarctica, the Dead Sea. So it really has, it's just blown-open our understanding of a lot of fundamental, environmental processes. And that environmental sensing lab I mentioned earlier is going to do the same thing, I think, for a variety of other sensors that, as everyone knows, we're carrying in our pockets these incredible technological masterpieces of telephones with all sorts of sensors in them that are expensive, but not horribly so.

That same sense of technology has not been applied to environmental sensing really, and so we're going to do that. And I'm not saying that to be, I mean, to be dramatic, it's just that it's incredible that we have that. And so we *get* to do that, is really more what it's about. And so, we get to learn about the world, and this is going to go on for hundreds of years, we have so much more to know. And so yeah, the fiber optics thing was one of the outcomes of that Swiss sabbatical; the other one was wireless sensing technology, which we worked on there, called SensorScope. We worked on a bunch of—then atmospheric engagement with the snow, we'll understand that better. There's a bunch of fundamental stuff that we got to work on then. There was a big team of people and a lot of really great ideas, and we're still mopping up after that years later. So, a sabbatical can be a good thing or a messy.

CP: You mentioned the Dead Sea, that's an unusual place that you had an experience that received a little bit of publicity there.

JS: Yeah, well it was a—I don't know exactly how Nadav found me, but Nadav Lensky from the Israeli Geological Survey contacted me and said "hey John, could we use your technology in the Dead Sea?" And I guess I'm a pushover; I've always wanted to go to Israel, I've never had the chance, and going to the Dead Sea seemed like a fabulous opportunity. And so, we actually met once in San Francisco and then—I worked with a Swiss instrument maker to develop this whole platform, that Nadav made the platform and we came out and did everything together and had a—the Israeli working in—let's set aside politics; when we talk about the culture of OSU, the Israeli culture for ideas is really extraordinary. Everyone from technician to the head of the Israeli Geological Survey, who was there with us, everyone's ideas counted. It was this fabulous conversation. And so, I really learned a lot about how to do science there. It was just so much more respectful in a certain way than I had—we have an invisible hierarchy and it doesn't have to be that way with ideas. And so anyway, great time, and we were able to drop the cable into the Dead Sea.

The Dead Sea's a scary place. When I was there a helicopter came in and plucked an unfortunate person who had taken a mouthful of the Dead Sea and died. It's—that is what happens if you get a mouthful of the Dead Sea in you. So, we're out in the middle of the Dead Sea on this little slippery little platform, and we have no life preservers or anything, it's like "why don't we have life preservers?" "Oh, you'll float. The density is thirty percent more than water, you just float, it's no problem." "Okay." Anyway, we learned about ten ways we could die as well.

But we got the instrument put in and made some really interesting discoveries, and so we've published two papers and our third paper is going in—it turns, anyway, it's really fascinating how the Dead Sea with its hypersaline conditions layers, and get the same fingered flow process I studied in soils. A different variant of it occurs in the Dead Sea and it does this amazing stuff where there's all these fingers going down and up and salt crystalizing in the middle of the sea out of nothing, and it's a really, really fascinating environment, and I've been lucky to work with a fabulous team there.

And you know, I had my boots, they were dry and I took, the first time I went to the Dead Sea, I went to New York for a little Cornell retirement party and took my boots out of my bag and they're soaking wet. It's because the Dead Sea is so salty, just like that Hanford thing, it just sucked the water out of the air and rehydrated them. My boots were disgusting. It's a very weird material, the Dead Sea salt. It's not your normal sodium chloride.

[1:30:48]

CP: Well, back to Africa, you gave a talk in 2012, a Tedx talk about the Trans-African Hydro and Meteorological Observatory project?

JS: Right. So, that Nick van de Giesen and I, Nick was in Cornell, a graduate, and we were working in Ghana together in 2006, part of my sabbatical, and on—anyway, long story, on weighing trees, but we wanted to understand why satellites were getting the wrong numbers, and it turns out the satellite data that was available was wrong, it had problems, and I said "well Nick, where's the ground data?" and he's like "no Joe, we're in Africa, there's no ground-based observation, really." And it's like [makes incredulous face], and so we talked about it, I was like "this is crazy, this is crazy. You know, in this day and age when everyone has a cellphone here," even back in 2006, "what the heck?"

So, we kind decided over the next couple of years that this was a completely unacceptable situation and that we should—that it was just a kind of obvious thing that with cellphone technology across the continent, it should be feasible to make a small station that measures wind speed and measures rainfall and measures sunshine and measures the temperature and humidity and beams that all back to a database, and we could, you know, it should be fairly inexpensive. The sensors are cheap. Well, we've been very, very fortunate to work with Decagon Instruments in Pullman, Washington, Gaylon Campbell and his team, and we've—now the final design I think will come out in January where we have—or Decagon—has really developed this station that we had envisioned. It has an ultrasonic wind speed, so it measures the wind without any moving parts, measures the rainfall without any moving parts by counting drips. It measures the temperature, humidity, all those other things, plus it has the ability to measure soil moisture and groundwater level and other things.

So, we have a station that is extremely cost effective and you put a SIM chip in, it has this little solar panel, and this little solar panel, that big [makes a small square shape with fingers and thumbs], will call in every fifteen minutes and give the entire set of data; continuous records for all those parameters. And the communication costs right now in Kenya are running at around a dollar to two dollars per year, to run that cellphone. These are data that are transformative; these are data that farmers don't know whether to plant or not. We have a scatter plot of the satellite data, estimates of rainfall versus our measurer in Kenya and the correlation is .03, so the satellites explain three percent of the variability in daily rainfall, and the slope of the line is .2. That means that the satellites under-predict it by a factor of five, the amount of rainfall. So, if you don't mind being off by a factor of five when you had a prediction, and also that the correlation is just random, then you're fine. So it's crazy, the situation.

And so, we were working with the countries in Africa, we're getting a better understanding with each and every country, and then we agree to put in these sensors and then we give the data freely to the governments and freely to researchers and we sell the data to insurance companies and other people who need these data for commercial reasons. To run the whole network will be on the order of twenty million dollars a year. We are working in West Africa and East Africa intensively right now, so we got Rockefeller funding and USAID funding and European Union funding and some money from Sweden, et cetera, to start this process. And so, we were working in Uganda, Rwanda, Burundi, Kenya and soon Tanzania, Senegal, Ghana, South Africa, Chad, Nigeria, at this time. And so, it's a big project that is very demanding, and I'll be taking my next sabbatical, will be largely devoted to making this, pushing it forward. It's too big, really; it's much bigger than we had originally had thought it, but it is happening, and that's the amazing thing. And the stations are beautiful and the Africans are extremely supportive and the challenges are as big as the continent, and so we're daily working on that.

[1:35:24]

CP: And your career has come full circle, on some level.

JS: Well that's exactly right, that's exactly right. I had intended to work on Africa hydrology, and so it took me some time to get back to that, and it is very meaningful to me to try to do that. I don't know if we'll be successful. We're going to try our best. But yeah, it's very gratifying and I, you know, I'm sitting here at Oregon State and I do want to express how amazing it has been to have a university where I go to the administration, I say "you know, I got to work on this big project in Africa and it's going to—we have to set up this private—this nonprofit to run this thing, and so a lot of the grants are going to go through the nonprofit and it's going to be just a lot of time, and I'm sorry but it maybe won't bring as much money right into the university," and this and that, and OSU just said "John, go. Just do it" and "this is going to be good and we will support you," and they have been phenomenal. So, they've really given every bit of help that a university could to say "just do this thing John, and see where it takes you."

And equally true, Delft University in Holland has been amazingly supportive, from our Dutch side. So, Nick is in Holland and I'm in the U.S. and both universities have been great, and of course Decagon. And so, it's a remarkable team and I have every hope they will be successful in getting another twenty thousand stations out. And in addition will be, it looks like there's other countries that are interested, so I'll be going down there to Nicaragua later this month—well early September—and we'll be looking at putting stations around there too, because it turns out once you have the database all set up and stuff like that, then it doesn't much—uses the same technology. And we have, by the way, great collegial help on this from New York City College; Michael Piasecki and Tom Dietterich here in Computer Science. We've been lucky enough to get a million dollar grant from the National Science Foundation to use these data to understand quality-controlled data; how can we automate.

Our big challenge is you can't go visit these stations. They have to be good and they have to know they're good, or if they're bad then you have to strategically go in and get it fixed. So, how can we make an order of magnitude improvement in our strategy for maintenance? And Tom Dietterich and Michael Piasecki are pushing that forward. So, it's a really amazing team and it's just—and so it's a little bit daunting to wake up in the morning and say okay, how are we going to make this thing happen? But I think we're so far so good.

CP: Well, a couple of concluding questions for you here. I'm interested, as somebody who thinks a lot about water as you do, it's a topic that's very much in current conversation these days and I'm interested in your thoughts on sort of the future of water in a warming environment.

JS: Well, that's a nice small question, it should be really easy [laughs]. No, in seriousness there's a couple of things that are material here. Number one: the ability for air to hold water follows an exponential curve. At zero degrees it holds almost none, very little, and as you get warmer it holds massively more water, so one thing people have to really understand is that small change in temperature on the part of the curve where we live means a fabulously large change in the amount of water that's carried in the air. Now, anyone who's boiled a pot of water on the stove knows how much energy it takes to boil that much water. Well, think about it when we have a four-inch rainstorm, and think about how much energy is released or is in that water. I mean that rainfall, it's literally gigawatts per acre, that when it's raining it's gigawatts per acre, so it's a full nuclear power plant scale operation going on up there. So, the atmosphere's this huge conveyor belt carrying around that potential energy, and when you double or triple the amount of water there, that's the amount of energy that's being stored on that conveyer belt. So, amazing things can happen; hurricanes, tornadoes.

And the other thing is that when air can hold that much water, that means that if it's not fully saturated it could suck up extra water and not rain. So, that means that where it used to rain it might not rain anymore. So, this notion that we're going to have more extreme weather and that places that were wet might be dry and places that were dry might be wetter, but probably more in an intense way, is unfortunately the way I think things are going to play out.

Okay, that's all kind of rough. The amazing thing is we're looking at Oregon, we're in the middle of a record low snow year, we had three percent of our snow count. We had hoped that this would not happen for fifty years. Okay, we hope it doesn't happen again for another fifty years, but that's why I was sitting down with a geomorphologist and a snow scientist yesterday, Anne Nolin and Gordon Grant, to try to plot out our fieldwork. We saw this all taking place and we pushed and got some funding from NSF to—National Science Foundation—to study this current drought. And so, really interesting things are emerging. It's a little bit early to say, but it looks as if Oregon is, again, we know we're kind of unique but the high cascades—this is something Gordon Grant has stated for years—it's this very open volcanic system and water just [makes dropping motion and sound] goes in, and it turns out that we're darn lucky in that, because that's our reservoir, unlike California where it's a tighter mountain, a tighter rock system, so they have to have reservoirs to actually have water standing.

Ours, it goes [makes swishing sound] into the aquifer and then the McKenzie River comes out, and the McKenzie River just goes. It just goes, all summer long. It's lower this year than normal but only to a limited degree. So, we have this much more robust hydrologic system than almost anywhere in the world. So, western Oregon is, in fact, very, very fortunate in where we sit; next to the Pacific, we get a lot of rain, with this special mountain system that gives us a lot of summer water. It's, frankly, again, I have said several times since talking about I'm a very lucky guy; this is a lucky place to live in this next couple of decades.

So, that's all fine and well, this is a lucky place to live, but many people are not so fortunate. The biggest impacts on rainfall and water will be mid-continental. The coastal zones are buffered by the oceans, so when we see a one or two degree shift, they see a six or seven degree shift. Where we see a little or poor snowpack, they see nothing in terms of rainfall, maybe. And so, what we—we have a big obligation to future generations to, number one, be vigilant and put in place the public framework which can turn this thing around a little bit in terms of methane and carbon dioxide into the atmosphere.

But number two, we have to prepare ourselves, and so climate resilience is a big part of what I work on, and our African project is driven by the fact that we don't know what the climate was, so how could we possibly prepare for what the climate will be, and we feel a great urgency in that sense. It's every day we feel that, I feel, certainly, an urgency to address that question, because it's fundamental.

CP: The last question for you is one we've been asking everybody for this project: we've touched on this on some level, we've talked a lot about the culture of OSU and its positive and less positive components, but things have changed so much here in the last even few years, have changed in Engineering and all across campus, and I'm interested in your thoughts on sort of the direction of OSU, as this is a sesquicentennial project for 2018, as we look towards that and beyond, where is OSU positioned right now?

JS: Well, I think OSU's positioned well in kind of this single-variable, kind of bad/good kind of way of thinking of it, I suppose. But no one really knows. We know people need to learn things and we know that learning from people works. We also know that the internet and other resources are fabulously important and very powerful. Fortunately at OSU, people have the insights to make early investments in Ecampus and e-learning, and that's just essential. We have to do that.

[1:45:00]

I think that we are, again, extremely fortunate to be right on the Pacific Rim. It turns out that China's next-door in that sense and we're very appealing for internationals because we provide a safe and temperate climate, safe environment, so I think that our international programs, which have grown substantially of late due to some strategic decisions, is a natural thing to happen. Whether it's—I think we have to be very mindful at OSU to understand who we are, as I've mentioned. We are a place where people work together well and develop into a place that impacts an order of magnitude, or two orders of magnitude, more people. So, we cannot be satisfied with how we're doing things, just like in my early lecturing, getting one or two questions, now I can have a conversation where it's filled with questions and answers.

I don't—if we're satisfied with how we're doing now, we're in a world of hurt. We have to be absolutely innovative, absolutely unsettled in our drive to serve the educational needs for higher education of the world. And I think we're ideally positioned, we're well situated in terms of the infrastructure and the history of development. I think where we are not yet demonstrating excellence is in innovation itself. I think—so the Kahn Institute and some other players have shown some potential that we have not necessarily illustrated. So, I think that grand challenges are before us, I think we have the right soil, if you will, and the right mix of nutrients. We have to have some damn good seeds, and then those are—that means we have to really look for those opportunities that'll potentially grow into something very different than we have now. So, it's a big challenge. I'm excited for the next few years.

CP: Indeed. Well John, thank you for this, this has been fascinating, I really appreciate it.

JS: Well thanks so much, it's a great indulgence to be able to talk of one's life, so I appreciate that and I hope it's of some interest.

CP: Alright, well safe travels and good luck.

JS: Thanks.

[1:47:40]