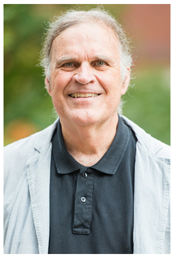

Ed Waymire Oral History Interview, July 29, 2015

Title
"Seeing the World in Mathematical Terms"

Date
July 29, 2015

Location
Valley Library, Oregon State University.

Summary

Waymire begins his interview with a lengthy and detailed recollection of his family background and upbringing in Illinois. In doing so, he discusses his parents' backgrounds, the major impact that his grandfather made on him as a youth, and his early interests in mathematics and weather. From there he recounts a series of adventures during the summer after his graduation from high school, a time period which saw him move to California with a friend and work as a door-to-door salesman. He then describes his return to Illinois, his academic progression at Southern Illinois University, and research on the properties of lightning that he conducted while an undergraduate.

Waymire next turns his attentions to his entry into graduate school at the University of Arizona, making particular mention of his serendipitous avoidance of military conscription through the U.S. government's declaration of a zero draft during the month that his draft number would have been called. In recalling his years as a graduate student, Waymire also describes the progression of his research on stochastic processes, the interplay between his mathematical work and concepts in physics, and his stint teaching courses at a university in Mexico.

The remainder of the interview concentrates on Waymire's life as an academic. He reflects on his first professional posting at Clarkson College of Technology, discusses the roots of his collaboration with Vijay Gupta on the mathematics of rain, summarizes the ways in which this research has progressed over time, and lends insight into his own mathematical perspective on the world. Waymire then shares his memories of coming to Oregon State University, characterizes the state of the Mathematics department at that time, and details the methods that he has used to improve his effectiveness as a teacher instructing students on topics that many find difficult to grasp.

As the interview nears its conclusion, Waymire provides his thoughts on the culture of mathematicians and expounds on his duties as an editor of mathematics journals. The session ends with Waymire's perspective on change in OSU's Mathematics department and his sense of the university's direction as it nears its sesquicentennial.

Interviewee
Ed Waymire

Interviewer
Chris Petersen

Website

Transcript

Chris Petersen: Okay, today is July 29th, 2015 and we are with Ed Waymire, a professor of mathematics here at OSU, and we'll be talking to Ed about his career and his association with the university, and we are in the Valley Library today. I'd like to begin at the beginning with you, Ed, if you wouldn't mind. Where were you born?

Ed Waymire: I was born in Alton, Illinois, which is in southern Illinois across the river from St. Louis, greater St. Louis area.

CP: Is that where you grew up?

EW: I grew up in that same area, yeah. That's sort of the start of the Lewis and Clark Trail, in fact. And in fact there's a little town, it's these days called Wood River, but it's also I think historically was known as Rivière du Bois, and it's actually the very start of the Lewis and Clark Trail. And they have now, sort of as they have in Astoria, they have this reconstruction of some of the boats and things like that and artifacts and so on. Yeah, so I grew up in that area.

CP: What were your parents' backgrounds?

EW: Well my family has rural beginnings. We would claim it comes from a larger extended family, which included my grandparents, that played a big role in our lives. And on my father's side, my grandfather, who had a big impact on me, he came from a relatively large family. But they had a rather tragic beginning with his parents; both of them died early and so the children, I think there may have been five or six children, they were all dispersed to different families. And it interrupted any kind of education or anything of that sort. So we used to say that he had a second grade education and my grandmother would then correct us and say, "well he didn't really graduate from second grade, so he didn't make it that far."

We come from this very strong work ethic and he did many, many things. He's amazing, one of the most amazing people of my life in terms of what he was capable of doing. And ultimately he met my grandmother and they settled in this area. And at the time he was employed—that was the beginning of Standard Oil Refinery in that area, and so he was employed initially as a ditch digger and then worked his way up into operations, and in fact into the management part of that. And so then they had one child, that was my dad, and my dad's story was that he was injured at birth. So what he had was nerve damage on his left side, so his left arm, his left hand would sort of vibrate like that, and he had a little bit of a limp on his left side.

And so he had a lot of those kinds of challenges, and so one that my grandmother would relay - just to give you a sign of the family that I come from - she would relate that when he was in high school, one of his best friends was working at a gas station and he was going to leave that job. And he had told my dad about it and said "why don't you go down and get it, because I'm going to"—and the reaction, I mean this was a sign of those times, but the reaction of the owner of this place was he said "you know, I don't hire cripples." That's basically what he told him.

So this was kind of symbolic of the struggles that he dealt with, but he overcame them all. And one of the big ones that made a big impact on me was that he went to the University of Illinois and he had been told, basically, that he needs to go in business or some area like that because he really wasn't going to be suited for doing physical work. And so he did and he got a degree in accounting at the University of Illinois, but he really overcame almost any obstacle you could put in front of him. He didn't see it as an obstacle but as kind of a challenge. And he was in the band through the university; he played trumpet, and that was a kind of right-hand thing.

But when he graduated he taught for a little while, and then at Shell Oil Company. So in this area where I grew up there were historically—they're not there any longer—there were oil refineries kind of like New Jersey. So there was an opening at the oil refinery and they told him that it was in the plant actually, in the operations of the plant, and that they didn't have any openings yet in accounting, but if he accepted that job then they could move him into accounting when something opened up. And to cut to the chase, when something opened up he asked could he stay where he was, because you know, there's so many psychological challenges and things like that that he was overcoming. So this was something that people said he wouldn't be able to do, and so that's what he ended up spending his career doing.

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So that was on my dad's side. And on my mom's side, she grew up in a very, again, poor and rural area of what's call Bunker Hill, Illinois; very small town, sort of like Philomath, or probably smaller. And she was in a family of seven, I believe, and they're all girls except one brother. And she went through high school and she graduated from high school but that was it for her, I think. But all of these people in my life, what characterized them was this - and you know this was the era of your children get better things than you have, and that's kind of your goal - but it meant having this kind of work ethic, and my dad making sure that I had summer jobs and things like that. So that's kind of that background.

CP: Yeah. You mentioned your grandfather; he played a big impact in your life?

EW: Yeah, because he's self-educated and he was known, he had so many skills that I don't have. I have one brother who actually—so I have three younger brothers and one of them actually got some of those genes from him in that he could pretty much do anything with his hands. And he was known in the community, that everyone was bringing things to be fixed. It didn't matter what it was, he could fix it. And he would show me those things but I couldn't get them, but he would show me. For example, he said "well you need to know how to lace the spokes on a bike," so he'd take all the spokes out and show me, because it's kind of an art to putting them back in. Then he would say "you need to know the firing order of the spark plugs" and he had this old '55 Chevy or '52 Chevy, and he pulled all the spark plugs out and say, okay, you know, because they have to go in, there's a certain order.

And I wasn't even interested in that kind of stuff but he was showing me that kind of thing all the time. My dad was once in an automobile accident when he was in high school and my grandfather - no one was injured but it dented the frame of the car - and my grandfather's just "okay, well we just," he built this scaffolding, lifted it up, straightened out the frame, put the body back on, and off you go. And that's just sort of the way he was.

But he also, he would teach me the things - I did resonate a little more with him. But he was very practical, which I'm not. He would teach me, for example, the multiplication tables. I mean, this was even when he was teaching me also how to ride a bicycle without training wheels. You know, this was before I was studying in kindergarten. And he would teach me—the person that raised him, when I say they were distributed, he was distributed to a German-speaking family, so he picked up German in that way. And then he would teach me poems and nursery rhymes, really, and prayers and things of that sort in German, and then he was teaching me multiplication tables.

I mean these things stick out to me because he's taught me how to convert Fahrenheit to centigrade and centigrade to Fahrenheit, I mean these kinds of things. And I think that he was showing me that those are things that were making him able to move up the ladder at Standard Oil Company, and so he was kind of giving me those practical advantages. And my grandparents, they probably lived definitely within walking distance, maybe two blocks from us, on my father's side. So this particular set of grandparents were really a big part of my extended family. And on my mom's side, that was sort of this every Sunday, going to that farm to be with her large family of sisters and all their children. And also, just sort of the example of both him and my dad, of just you can do what you set your mind to. I mean they kind of gave you—you just kind of grew up thinking that, although I knew my limitations.

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And then in many ways, I think about these kinds of things; a lot of it has more to do, probably, with my mom. My mom who was, I mean my mom had these very unique abilities. Some of us have said that she may have been borderline autistic in some sense. She was extremely impractical but she was able to do all kinds of calculations, she could keep umpteen birthdays straight. And she had these algorithms that she would go through, and a lot of times you would hear her going through her algorithm.

And so she had a very logical approach to the way that she did things, and I tend to have that side. You know, I don't have a very good memory, I don't have a good sense of practicality, but what I have, I think, is this sort of whatever mathematicians have; this sort of ability to sort of keep things straight and keep things in logical order. And somehow those neurons fire and allow you to function in a certain way that we seem to be able to function. I mean, there are many mathematicians that are practical; I'm just not one of them.

I mean I have this interest in the world and I try to understand it, but for me it really has to be expressed kind of in mathematical terms, and then if I can follow some kind of logic, deductive reasoning, then I can understand those things. But I think my grandfather was trying to, you know, he would have rather I be an engineer probably. He didn't care what I became as long as I was happy. But I was reading, as I mentioned earlier before this interview, that Dean Gilfillan, I was reading through his archives. He was very much more like my grandfather. He would have resonated with him. He had more of this kind of more practical and engineering view, even of mathematics, which for me is a little bit more, probably closer to an art form than it is to being something that the reason for its existence is practical.

This gets into a complicated area that I'm always trying to sort out because I also have these views; a lot of what I do is motivated by applications and so forth and I have this very strong realism connection to math. But when I try to explain to my wife; she likes to do Sudoku kind of puzzles and I started out doing those and I said "well, why am I doing this? This is kind of what I'm doing, I'm living this hobby." But it's that kind of sensation that people get from doing those kinds of puzzles and that kind of functioning of the brain, I think, that mathematicians enjoy so much and rely on. Hopefully that made sense.

CP: It sounds like you had math channeling into you from a couple different directions then, from your grandfather and from your mom.

EW: Yeah, yeah. I think I was more aware of my grandfather, but it's only kind of on reflection. And I look back over the way my mom functioned and all of those things, because I came from a background that was very supportive but never "you need to do this" or "you need to do that." And it was a very free kind of—I mean you need to work hard, you need to apply yourself and things like that, but it wasn't any particular direction like "you should choose"...

CP: Yeah. Something else that your grandfather was interested in was the weather, I've heard.

EW: Yeah, yeah. So in fact we're, every night, we're watching the weather. And I think that's the influences of coming up. He would tell me that the most difficult job that he ever had was shucking corn. He could shuck—he was kind of proud of it—he said he could shuck a hundred bushels of corn in a day, and that was kind of one of the standards of being really good at that kind of job, but he said it is extremely difficult. I've never done it myself, I can barely shuck one ear.

And so he comes from that era which is very - I mean, up until he got this job with the Standard Oil Company, everything had been farming, and so I think when you're in that you're always watching the weather and it had a big impact on you. And it did the rest of my—all of those things that impacted him, including the Depression, because he was very, extremely frugal, and because he could fix things he would find things, fix them and then sell them. If there'd been a Craigslist he'd be a multi-millionaire. But yeah, he had this ability to really fix anything.

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But all of that went into savings and to help support us, whatever they could do to help us, and then they made their investments and so forth, and they really did well, given from where they were and where they arrived. But those things had big impacts on them. He was always mindful of the Depression and he would tell stories about that era. He was born in 1900, so really it wasn't that he—it was during his working years that he was most exposed to it, early on. Of course we didn't worry about those sorts of things. We had other things to worry about.

CP: What sorts of things were you interested in, growing up?

EW: So you know, part of it I think - my dad, like I say, he got us interested in scouting and baseball and things. My brothers were back-to-back, except for the fourth one; he's nine years younger than me. So since we were back-to-back we could play and get along together pretty well, and my dad thought he was growing a baseball team, probably, and so he had us very early on, and we could do it. I mean we played catch. And then he became—I think these were things he wasn't able to do as a kid, and he became a Scout master, and Cub Scouts first, I guess, and my mom was even involved at the earliest stage.

And so we did those sort of normal growing up kinds of things. My dad, I remember—I tell my wife this story when we're back home there in the small town area, because the place is still there. I said, my dad, I remember when I came to try out for Little League baseball and it was such a disappointment, but I think it was a bigger disappointment to my dad, that I was too young. He brought me too early. I was seven or something; you had to be eight. And there was actually a bar right across the street and we went over there and I remember him buying me a soda. And next year we were back. And so we did those sorts of things. And I was reasonably okay, I mean I was coordinated enough and I even, I was the catcher. And eventually I ended up with a foul ball hitting my thumb and broke my thumb, and that sort of ruined me for baseball. This fear set in and I couldn't do it any longer. My thumb healed fine.

I was a little bit on the nerdy side. I had this kind of social group and friends like that and I felt like I fit in too, fairly well, but then I had this sort of nerdy side that I kept kind of protected. Because I did enjoy doing math things and that was kind of—in study halls and things like that, that's what I would do. And you know, you did have to—the social dynamics of growing up, you could become vulnerable if you were too much of an intellectual. So yeah, I kind of knew those things.

And I even have a story; a lesson I learned really. My dad would get us summer jobs working in Shell Oil Company and they would be kind of, they called them summer replacement jobs, and they wouldn't require very much in terms of skill. So what we had to do was, there would be barrels, empty barrels, these guys would fill the barrels with oil and then they would be labeled a certain way. And then they would have these various conveyer belts and you looked at the label and you matched the numbers and they'd follow the tracks, and it's very, very boring. So there was another kid that I was working with at the time and both of us were interested in calculus and we were learning that kind of stuff. And so when we would take breaks, we brought a book in, and it turned out to be a huge no-no. I mean these guys were so threatened by it that we really almost, we were physically threatened. We had to completely change what we were doing. And that was, again, I didn't really in my life experience anything as—that's the most extreme thing I ever experienced. But I knew you could be made fun of as a kid if you seemed like you were too nerdy or something.

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CP: But the interest in math was clearly there.

EW: Yeah, that was there. It's still there today. I mean, it's really remarkable, and I still have the same passion for doing those things. I think it's a function of brain wiring and stuff; I think it's just that I get pleasure out of doing that, and I always have.

CP: Were you expecting to go to college?

EW: Was I expected to go?

CP: Well—

EW: Or was I expecting to go? Both, in a weird way. My father had a principle — so my mom, my mom's view of all this, and my wife and I didn't have children, it's just one of those things, just we didn't, and I would tell this story to some of my friends who have children. But my mom always said "you know, when you're eighteen," she's done. That's actually how she viewed it. I mean, that's how she grew up. And, I mean, she's a wonderful, wonderful woman, one of the most giving and loving people in the world, but she saw her responsibilities up until eighteen and then you're kind of on your own, which is a good thing to hear from somebody because it made me think earlier on a little bit about, ultimately, I have to take care of myself.

And my dad, on the other hand, my dad's rule was if you finish college, I'm finished. You know, I will not ask anything more of you, because they asked us to do certain things; they asked us to have summer jobs, they asked us to do well in school, they asked us to do those things, and he put that in that same list. Alright, that was his view. And one of the big disappointments – actually, my mom, I still have this letter that I wrote to him because when I graduated from high school, it was 1967, Vietnam was raging, it was really a different time and the draft was there. And I had lots of friends that I'd known from high school that were not making it home, they were being drafted, people might get a year or two years that were being drafted and not surviving, and so it was that kind of a time. And my friend and I, a friend of mine, we decided we need to go to California.

And he had a sister that could help us get set up, and we didn't know what we were doing and we said "okay, yeah let's do that." And my dad had already lined up a job for me that summer, so that was kind of going against that grain, and it was a huge disappointment. My grandparents were okay with it a little bit, none of them quite understanding, but my dad was extremely upset. He was really mad. And I had to write a letter explaining to him that it just had nothing to do with him, obviously; I still loved him and all that, but I just had to do this, and I hoped that he would eventually understand, because he was probably as upset with us a few times in life, I've upset him, and that was a big one.

So then I did that and I left. And we get out to California and it's in the summer of '67, coming from this small Midwestern area, we don't know anything. And we ended up getting jobs and we would make enough—we got these jobs just out of the paper that were, it was called Family Record Plan, and what it was is you go door to door. This guy recruited us to his team and we went door to door, and it was actually a legitimate thing; it wasn't selling nonsense to people, but you would go door to door and you would ask them to subscribe to this. What it was, was they would get this record of their family pictures and so forth. And we had leads that were provided to us by this company, because they were watching the hospitals to see who was having babies and then we would go there and if we sold the things, in '67, then they would have to make a twenty dollar deposit up front. We were getting paid by the hour or something, or perhaps by the sale, but we were able to keep the twenty dollars on a sale, and that was all we needed. The first one to get twenty dollars, then we were off to the beach [laughs].

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And there were times when we needed more money and we got to work a little harder to build up some money, and paying for food and stuff like that. But we were pretty much living that kind of a lifestyle, and it was like, it was L.A. and it was really the summer of love, they called it; it really was a very unique time. But we didn't know very much about it. I remember this guy picked us up once. Well we had a, or my friend's sister had loaned us this '57 Chevy convertible and the top wouldn't go up, and the nights actually get very cold there. But we once picked up a hitchhiker and he asked us, could we take him to the 7-Eleven to get some Zig-Zags, and we didn't know what Zig-Zags were and we said "well why can't you go in the 7-Eleven, if they're selling them?" And he said "well, I've got a reputation with the owner, I can't buy them." And they're just cigarette papers, but they were for weed or something.

And this was completely off our—we had not been exposed to that. In Illinois, in those days, it's hard to imagine, but there was no—drugs had not arrived. So when we got to California we realized that they had, but we were not connected to it at all and were learning. And this guy was actually kind of this hippy guy and he was just, he said "I can't believe it, you guys are just so pure." Anyway, it was after that summer then all of the sudden all of this stuff, all of these life lessons came to play where my mom telling me when I'm eighteen—see, as far as she was concerned I was eighteen and I can do that or I can do whatever. My dad's request was kind of echoing and I was realizing I can't live my life like this, this is not going to—it's okay for now and I'm kind of glad we did it, but both of us, my friend and I, decided this is not going to work forever, and we've sowed our oats and now let's get back.

And so then I ended up going back and going to college and kind of following the right path and so forth, and it all worked out. I was fortunate that way, that I didn't get sucked into something that I shouldn't have, because I was pretty young. So I think this sense that I remember the strongest is that ultimately I have to take care of myself, and so ultimately I have to find something. I didn't know it could be math, because to me math was more of a hobby. In school the teachers would tell me that I, you know, they would encourage me and things like that. So for me at the time, I said, well, maybe I could be a teacher, a high school teacher or something like that. That's what I thought. And at least that—I had a job pathway that maybe I could take care of myself.

CP: So you wound up at Southern Illinois University.

EW: Yeah, yeah.

CP: Which I gather is probably pretty close to where you grew up.

EW: Yeah it's very close. And I wasn't on any path where I—there was no fire in terms of this is my passion, is to become this high school teacher, or anything like that. I was pretty much lowballing the whole thing. And I had scholarships and so forth, but I was still this—there was a lot going on, like I say, at the time, and so it was a very dynamic social situation. A lot of my friends that were going on to college because there was a deferment if you went to college too—there was not after you graduate. After you got your bachelors then you were eligible for the draft. So I was in college and I had a deferment, and I had friends in the same situation. And you think back to those times; this is the times of Martin Luther

King, the Kennedys, it was just—and you were always aware of social issues. And we were that baby boom generation, so we were a huge number of people of this age. I try to compare it to today and there are a lot of problems today of a similar type, but I don't think there's that critical mass of young people that there was in those days.

CP: So my notes say that you took a lot of math, physics, and philosophy when you were at Southern Illinois. You had an interest in fundamental ideas, it sounds like.

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EW: Yeah, I was trying to find myself I think. They had an honors program and the honors program allowed you to be pretty flexible in what you took, and math was for me the easiest thing to take. Math and physics too. There's something nagging me always about being better at understanding the world, because I didn't ever feel like I was very good at that, and I know I'm not very practical. My wife could tell you, I'm really not practical at all. And I guess I always thought, well, since I can understand math that'd maybe give me a way to actually see things that other people can see just more naturally. And so I think that may have been one of the reasons why I was interested in physics. It was kind of this challenge, and I think it always related, even as I'm saying this, also to my father. Watching him overcome everything and knowing that there was a way to do things, and he couldn't do it how everybody else does it but he found a way. So it may have been a little bit of that influence, I don't know. You know, I don't really know.

And philosophy, for me that was just the struggle to try to have an understanding of the world and my life from a logical standpoint. I struggled with that a lot and I think a lot of mathematicians have, historically, to the point that in nearly every philosophy eventually there would be some kind of Achilles heel or something. And otherwise I would say, oh yeah, this one would make sense and so would this one, and they might be opposing, and then I would get into these mental fights with myself. And finally I became this realist that "okay, this is not for me," it was too much of a struggle with my trying to do things.

And I ultimately, I've settled into my own view of the world from a mathematical perspective. It works for me. It's not one that I'm not capable of communicating in any scholarly way because it's probably full of holes, but it works as a functioning way for me to see the world and relate to it mathematically. I have less of a purist view of math than some of my colleagues, but it's a compromise actually, because when you get into the deepest foundations of math it's philosophically—and the depth of the logical arguments is extremely delicate and sophisticated, and kind of a place that I decided that wasn't for me.

CP: You did some research as an undergraduate on lightning?

EW: Yeah, that was my physics professor. So I was taking courses in the Physics Department, and these days we have at OSU - the National Science Foundation actually offers these undergraduates grants and we have one running right now in the Math Department of OSU and it's called Research Experience for Undergraduates, and we've had that now for several years. And in those days they had the same program, only it was called something else, but it was the same thing. I can't remember what it's called but it was in Physics also. And so one of my Physics professors told me that they had acquired that grant and that they were going to be - if I wanted to apply then he would be happy to my advisor for that program, and so I said yeah.

So this is one of these things where growing up in the Midwest, and you know the weather is all over the place and my grandfather—I had this sense about, that was something I wanted to understand. And he said "what would you like to work on?" And I said "well, I'd like to understand lightning discharge." And he wasn't an atmospheric physicist or anything but he said okay and sort of guided me on selecting some of the papers that were being written and that were mostly mathematical, and trying to express the mechanisms mathematically. And then he, being a physicist, he had his own style of things and he was always, you know, "it's all about resolving forces." And so we decided, with his guidance, we would look at the Coriolis Effect, the force that comes from the earth's rotation, and also the earth's magnetic field. And I mean these kinds of—actually this goes back to Benjamin Franklin, he was asking questions about how these things happen.

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And it's interesting, we weren't able to show that the kind of singularity that it would take would occur based on just the forces that we looked at. You know, it was a summer project and I learned a lot from him, and you just learn about what other questions do you need to be asking and answering in order to get to the one you're after? So he had told me too that - at the time I really wasn't that interested in too much of probabilistic things, which ultimately became my area of interest - but he told me that that would probably be something that we would need to take into account if we're going to try this. And since then, I've even looked to see what the status of that problem is, and it's still open today. So it's still a very important area of research, and it was a great experience for me. But then I finished there and that was in my senior year that I finished that project.

CP: So you decided to go to graduate school.

EW: Yeah. And like I say, now I'm eligible for the draft and so I have this issue in front of me. And so I went on a bus over to downtown St. Louis to do my physical, and I'm on the bus, half the bus is filled with people that were from my high school, and they were on the football team and all that kind of stuff. And we get over there and we're on the bus back; I'm the only one that was 1-A, I'm the only one that passed. All these guys had physical injuries from broken legs and they had, at one point or another, hurt themselves playing football or something. They all were 4-F. I mean there weren't that many people there, I'm making it sound like there were a lot, but it was a school bus and people were on it. And I just remember though that "how'd this happen?" you know. I couldn't believe it. Some of these guys, they could have picked me up and thrown me out of the bus, but they were 4-F.

So that was the deal that I was facing there, and then we had the lottery. They had started the lottery and my number was 142, and that meant, according to my local draft board, that I was going to be drafted in December. They could just look at the numbers and see how many people they were needing. So there was going to be no graduate school, was what I was told. And my brother, my second youngest brother, his number was like 361. It turned out that he wanted to be in the Army and he was planning to join because he wanted to get married and this was a way that he could do that and support his—and so we went to the draft board and asked if we could swap, but they said no. Can't swap numbers.

Anyway, so this was a big deal to me. But I tell my students a lot, and for me one of my great lessons that I've learned, is how important serendipity is. I tell students serendipity definitely plays a role in life, and it doesn't matter who you are. You also have to be able to recognize it when it occurs and things like that, and know when—that's the hard part of serendipity, but in this case it wasn't going to be that difficult. And I didn't know what was going to happen but I said, "well, I prefer to do math, that's where I get my greatest pleasure." And so I ended up going to graduate school. And I was very much attracted to going to Arizona at the time, because I have two aunts that go every year and they would tell me all about it and show me pictures, and for some reason I was drawn to that.

So that's what I did, and thinking "okay." When I got there I'm meeting new friends who were graduate students and some of us went through that together. And they were deferred, they didn't have to worry about it. And I was there on my own thinking that—I mean on my own, relative to those guys, thinking about what was going to happen in December. And I have this ability to block things out of my mind if they're too disturbing and I just wait till it happens and then I deal with it, and that was my attitude. And it just happened, just a freaky thing that, in December, there was zero draft.

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I mean, it was Nixon's big announcement that there would be zero draft. And at the time it wasn't clear why. People were saying that it had to do with the fact that it was when it was discovered that we'd gone into Cambodia in kind of this revelation, and people were saying that that was the pressure that caused this when Nixon just announced zero draft. And since then I've actually gone back to the Congressional Record, not saying I spent a lifetime on it; I spent a couple of afternoons just trying to look at what was going on. And it was an extremely, not surprisingly, but extremely focused effort to get out of Vietnam by almost both parties, both sides of the aisle.

They said, well Hatfield and McGovern had already proposed an amendment that they were cutting funding. I think that amendment might have passed but I don't really know. But you can look through all of that and you can just see that everybody, all the constituents of these congressmen are saying, "we've got to get out," and so there was huge pressure to get out. And it didn't last much—you know, once January started then the whole lottery starts over again, so then you have to go first 1 through—they never did get up to 365, like even in December they were only getting in the 140s, maybe

150s. So something on the order of half the available people. And so then it wasn't sure—it was the next year, I believe, that they ended the war and the draft and so forth.

So I just kind of, it just went through seamlessly. And it was a big deal, it was a huge deal. But at the same time, and not knowing what to do, I mean in those days people were doing one of three things that I knew of; one is that they'd be drafted and go, the other was going to Canada, and a third was that people were actually doing self-mutilations and things like that. And I was not interested in that. And Canada, I didn't know enough about Canada, and hadn't paid attention enough to know what that meant, and so it was one of these things. And I couldn't see myself going, so it was one of these things. I still to this day don't know what I would have done, I really don't. Well, and there were people that were just purely going AWOL. In fact, that was the fourth thing. And I knew people that were doing that, that were just hiding out. In fact, I had one friend that was hiding out in Portland. He eventually got caught and had to serve a little bit of time in a military prison, I guess. Then he was part of the regular military and then finished. He didn't get killed or anything.

CP: Well, serendipity. So you became a graduate student and were settling in. Tell me about that process a little bit. And you did a master's thesis with a fascinating title: "The Mathematical Theory of Birth and Death Process."

EW: Oh yeah. So that's fascinating but it's not as exotic as it sounds. It's a standard—it's now my terminology, but it's a standard mathematical terminology that involves the evolution of random processes. So it could be a population, but when an event occurs the population either goes up by one unit or down by one unit. So you get—that's the birth and the death. So you can think of a particle is born or a particle dies. But it's a fundamentally important stochastic process and my advisor suggested it to me, that as an entryway into learning how—learning something about the properties of the evolution of random processes, that would be something to work on.

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So that was that. And what I was really interested in, which that became a part of that, was on the evolution of interacting particles. And this may have traced back to my interest coming from cloud particles, but particles that, you may have one birth-death process evolving here, another one here, but they're correlated so that you have many of them. So you have, thinking of like - there are lots of examples on a microscopic scale. A lot of these things come from statistical physics, these sorts of models. And the mathematics of that was just beginning. In 1971 there were some pretty big breakthroughs in terms of how to extend what I would call the simpler things that I was doing in my master's thesis, to the things that eventually became my PhD thesis. And that had to do with, when you have lots of particles undergoing this kind of a stochastic process but they're doing it in an interactive way.

So one of the examples that I give is related to, for example, magnetic properties and matter, that if you think of a piece of iron, on the microscopic scale it's an atomic lattice, and from the magnetization point of view what's important are these things called magnetic moments. And they can, say, point in one of—they can point actually in many directions but let's say, for simplicity, two directions; a positively or negatively charged magnet. And if you expose the iron to a magnetic field, what it does is it makes those things want to kind of line up. So in the rest state, they're kind of just randomly distributed through there and it's not a magnetized iron which you put on a magnetic field. And then if you remove that magnetic field then what happens, often can happen, is that the iron will retain that magnetization. So now it's magnetized. Now what that depends on is the temperature of the iron, because if it's a very hot piece of iron that's a lot of thermal energy and that thermal energy is exciting these things to the point where you remove it, well its inert again, it's not magnetized. But if it's at low enough temperature so that it's not influenced by a lot of this energy, then when you magnetize it, it retains that. And that's something that's called a critical phenomenon. There's a critical temperature that if you're above that it won't retain magnetization and if you're below it, it will.

And the way that this magnetization has kind of - just like the ability to pick up nails - the way that that's measured is that you have all of these magnetic moments, say an array of them, and then you just add them up and divide by the number of them. And these are very large numbers of things you're adding up and dividing by, but that average magnetization is sort of the deciding—in other words, when you take that, it's going to have some value when it's being exposed to this magnetic field, but when you take it away it'll change. And the question is was it relaxed back to zero or not? And so very new, in probability theory, new methods were developed to understand these kinds of interacting processes, and that's sort of where—and it was a very extremely active field in probability, so there's always the risk of you have to get new results, so it was an exciting time. And I was able to get results that were eventually published and so forth.

CP: It sounds like there was a continuing sort of strong interplay with physics.

EW: Yeah, and that's kind of been true for my—that's why I say a lot of, what I just described to you. Because there's a mathematical representation of what I just described to you, I can understand it and it gives me a way, but a physicist could also just explain, based on experiments and so forth, what they see when they do all of this. And I don't relate to that so well. But I can actually compute these things and I can explain with pencil and paper exactly what I'm talking about. And so it gives me a way to understand those things.

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But for me, when I talk about the realism, is that I see math as something that is tied to human experience, but - and this is where the philosophies can become relatively deep, and I don't pretend to have a deep understanding of this - but because there's a platonic view of math as existing independent of reality and all of this stuff, and I don't try to go that deeply into this. But I do, just on the basis of my experience, I see that there are these phenomena and then there's mathematical expressions of those phenomena that enrich math and then try to feed back on the physics. But the richness from a mathematical point of view is that, once I have the mathematical framework, then it becomes less relevant where it came from.

And that's the other aspect of math is that it's been my experience, because I worked in so many different areas, that there's this commonality that once you abstract it into a mathematical framework, you know, I could have told you that same story in a social context. I could have said that you have all of these people and they have, instead of being positive and negative moments with the magnets, they have positive—if they have pro or con views of some situation. And then you expose them to some philosophy or some – well, actually, to some media - and you get them to start lining up in their views.

That's what happens. And it's very much like a magnet because in this magnetization in these models, what happens is that the interactions - they're called ferromagnets - and what happens is that if this arrow's pointing this way and if the interaction with its neighbors are such that if the neighbors are all pointing in the other direction, then the chance is they're greater than a half; that this one will flip its direction. And that's the way it works, like, if you're for a certain issue in Corvallis and your neighbors are all arguing on the other side, well you might have a tendency to flip. It's not just purely random; you're interacting with them. And it's true that these mathematical models are oftentimes applied in these various different contexts, because once you have that abstraction of structure, what are the basic mechanisms, you start to see it in various different ways and various places.

And that's really been a hallmark of what I have done in my life as a mathematician, is just sort of see that, "oh yeah, that sounds like this," and mathematically—math doesn't know the difference, math doesn't know, did this come from a magnet? Or did it come from a social context? Or whatever. It's just, as long as the mathematical framework is the same you arrive at conclusions within that.

CP: I want to ask you about teaching; you started to do some teaching in Arizona, and it sounds like you took to it pretty well. You spent a summer in Mexico as well, teaching.

EW: Yeah, in Guadalajara. Yeah, so teaching has been for me something I enjoy very much. I enjoy people, I tend to be more social, I think, than necessary. I mean, in my field in academia, you get the whole spectrum of types of people; I tend to be one of the more social types, I guess, and so for me teaching is an opportunity for social interaction too, and I think I've always liked that. I like teamwork, I like working with people. The opportunity to teach in Mexico came up; I was finishing my PhD, I think it was the summer I was defending or something, and one of the professors at Arizona had some kind of grant to go to Mexico to—and it was at the Autónoma, the university in Guadalajara, and it basically was mostly people with, faculty there had master's degrees, and they were trying to just sort of improve their backgrounds and so forth. And eventually some of them even came back to Arizona and finished PhDs at Arizona.

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But I was invited to be part of that, so that was myself and one faculty. We drove my VW bug from Tucson to Guadalajara. I don't think we could do that today, I'd be scared to death. But we did that, and it just gave me a chance to

—we were both learning Spanish while we were there, and then for my language exams at Arizona, we had a language requirement and mine was in French. You had to take the Graduate Record Exam in those days in your language, and so I took French. And I didn't really speak it, you didn't need to speak it; you only had to pass this exam. In high school I took Latin, it was kind of my foundation. I don't really have a good facility for languages but we were, at the time, trying to learn enough Spanish, and being there made it a little easier. And then my last lecture—I lectured in English but my last lecture I did in Spanish. I couldn't do that again, and I'm not sure how understandable I was. Yeah, that was a good experience.

CP: Well your first academic post was in New York.

EW: Yeah.

CP: Clarkson College of Technology. Tell me about how that came about.

EW: Yeah, so in those days, the job market wasn't so great in '76. I mean, right now the job market is pretty abysmal for our PhD students, and it was then at the time. But one of the faculty, you know, being a PhD student there I became friends too, I think, of faculty. But one of the faculty there was a relatively young guy. He wasn't that much older than me but he was a professor, and he had finished very early at MIT. And he was kind of one of my mentors, although he wasn't my advisor. His name was Herman Flaschka, and he's still there and—well Herman told me, he's the one who actually had gone to a conference and learned about this new thing going on with interacting particle systems, and he said "you might be interested in this."

And boy was I, but I already was working with Rabi Bhattacharya with my masters and then trying to find a new topic. I mean they're all very—everybody's helpful there, but Herman had a research collaboration at Clarkson, and he had learned about a position there and he recommended me, and that's how I got that job. Otherwise it was, like I say, it was a pretty tough job market. And going from Arizona to New York, and that's up in the Adirondacks, near the—it's right at the base, not far from Lake Placid. And it's just unbelievably cold. That was a special year. I don't know where you're from, are you from—

CP: I'm from Oregon.

EW: Oh you're from Oregon, yeah. So I met my wife there, that was the great thing that happened. But other than that, I knew I can't live in this kind of—at least I thought at the time. And my wife though, she really enjoyed that, and she grew up in Ithaca and she played on the hockey team. And she was very much an outdoors winter person. So she taught me a lot about how to deal with that, because I didn't even have, you know, I didn't have boots, I didn't have anything. That was really terrible. But both of us decided that we would keep our eyes open for positions. And I had some opportunities through research to go to different places, and while I was trying to find where do I want to actually be—and part of it was even coming back to Arizona, and I'd gone for a couple years at the University of Mississippi, in Oxford, Mississippi. And over this time I've had opportunities for various visiting positions and then this—well it wasn't very long; '81 is when I came to Oregon, and I've been here since then. Oh, I've taken a few excursions to visit places.

CP: Well if I'm correct about this, when you were at Clarkson you began an important collaboration with Vijay Gupta, is that correct?

EW: Yeah, that's right. So that was—

CP: This is on the mathematics of rain, which is another fascinating topic.

[1:00:10]

EW: Yeah, which actually - the way that happened was that my advisor, Rabi Bhattacharya, was asked by Vijay to collaborate. And Rabi was too busy and he told Vijay that maybe I would be able to do it. And so he called me and he just mentioned it and I said, "oh yeah, I would love to do that," and that got me back to Tucson in the summer. I wasn't married; my wife-to-be that I'd met there, she was actually going to, that summer, she had found a job in Yellowstone; she was going to be working there. So that was another reason that, at least we kind of went in the same direction. And so that turned out to a twenty-year collaboration. Vijay and I are still—we're not working together any longer. I'm going to see him, he just wrote to me and I'm going to see him at the meeting of the American Geophysical Union in San Francisco in December, which he goes to every year and I go to occasionally. Yeah, we're going to see each other then.

But he got quite, over the years, I mean we worked really closely together. Then over the years he eventually got to a point where he became more interested in sort of the infrastructure and even spent some time in NSF, and those are things that I wasn't so interested in, the administrative kind of stuff, although I've had my little bouts with that since then too. But at least when he was starting that, I wasn't interested in that aspect. And he's actually now retired and now he's back to doing research again. We'll see what we do, what happens.

CP: Is there any way to summarize a twenty-year project on the mathematics of rain?

EW: Oh boy, yeah. I'm still working on it. I mean it's a process and it has, from his point of view, we made a lot of progress, I think. And the question from—I remember when he used to ask me when we first started talking about what are we after here, he's a hydrologist and from his point of view is that, he said there are a lot of hydrologic... So what he's really interested in is water; stream flows and river networks and things like that, what happens to water when it hits the ground. And you have to know something about its structure and how much intermittency there is, both in space and time, because it's really a random kind of input into this network that will then just channel it out.

And what he said was "you know, there are a lot of basins in the United States, river basins, which are very heavily gauged with stream gauges and so forth, and so you can monitor all of that and you can talk about, if you know something about the inputs, then you can say something about the outputs." What was really driving his interest was, what if you don't have those gauges and what you really have is sort of the geomorphology of the land surface and the geometry of the river networks and so forth? How can you use that geometry? How can you use that kind of structure to integrate it with the rainfall inputs to say something about the outflow? And he would say "you know, around the world there are needs for that kind of thing, because in most places you don't have rain gauges and things of that sort."

So, I mean, these were extremely difficult questions to even contemplate, but there were some things that people were, in terms of rain—so the start was "okay, that's kind of the long-term." And eventually we got involved into river networks and things, but in the initial stages it was "okay, how do you represent that rainfall mathematically?" And there had been some really nice work on that at Berkeley, and that kind of gave us a starting point. And the summary of what all of that is, is that - the biggest impact – is that there are things that are called scaling sub similarities that exist in a river network. And they can be connected to similar kinds of sub similarities, scaling properties of the rain in ways that can tell you something about the amount of fluctuation that you can expect in river discharge.

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This is not an easy thing for me to try to communicate, I think. But this is where—part of the reason that, because I haven't been involved in that aspect where you're trying to summarize where was this stuff is used and how is it being used, it's in that context. It goes back to this prediction from the ungauged basins problem, and a lot of that kind of work is, from a practical point of view, is fairly well-developed, I think, although that's kind of—I'm giving you kind of the engineering summary, which is not so easy for me. Where I am, really, in my own research, is still trying to understand the physics of rainfall. And I have, now, current work on the so-called Navier-Stokes equations that describe the physics of the fluid motions and so forth and describe, hopefully describe, turbulence and the way that those patterns affect the same kind of patterns that you see in rainfall. And that's sort of where I am in my own thinking about this; still really just trying to understand it better. But there have been nice practical benefits of this that the hydrologists seem to be happy with.

CP: This might be a silly question but I'm interested in, living in a place where it rains a lot, if there's a particular romance for a rain shower for you; if you see it in a different way than most people do?

EW: Yeah, I—yeah it's interesting, like this is because—I mean it's a good question. But the way I see things is really only when they're formulated mathematically. That's when they become interesting. Now, once I see that, then I can make these connections; then I say okay, then I can start looking for that. For example, I mean this actually happened even going back to this electrification problem; one of the things that we recognize—this kind of seems silly, I guess—but when a singularity occurred in a certain equation, then what one should see; there's sort of this breakdown of this electric field, then there should be a higher intensity shower right after that. And then those were things that were being recorded experimentally and I go "oh yeah, that makes sense," because I could see it here. Over there; okay, just it's something that's out there happening, but here I can—so I tend to see the world more in mathematical terms, more than the physical reality is. And that's been sort of my experience of doing math. And then if that's what people see then I say, "okay, yeah, that's what you should see." It's that sort of a thing, I guess.

Sometimes I have this other area that I work in, in dispersion, where - these were experiments that were made at Lawrence Livermore Laboratory a few years ago. And I was at one of these AGU meetings that people were reporting this experiment where you imagine there's a column and the column is separated by an interface, and on one side there's these glass beads that you can think of like as the size of, say, a diamond on a diamond ring. On the other side are very fine glass beads, and you put water in so it's completely saturated with water and then on one end you inject a dye, like an ink, and it'll start spreading out through this system and eventually it will wind up on the other end. And so what they were reporting, they were questioning the physics. The physics that was presumably understood about these kinds of things was being due to Fick's Law, which if that were a pure liquid, if it were just pure water without these heterogeneities and you did this, then people understand that. And if you inject it on this end, it would take the same amount of time as if you inject it on this end and waited till it came this way.

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What these guys were reporting experimentally was a difference in the time. I mean, almost a symmetric situation: you inject here and wait for it to come out here versus if you inject here and wait for it to come out here. And one was always longer than the other, and they were saying that means that there must be something wrong with Fick's Law. The equations that you write down and so forth, not easy to analyze, but then they were actually questioning the physics, and so that I got interested in. And so we worked it out and said, yeah, mathematically it should take longer to go from course to fine than fine to course. And once I see that mathematically then okay, then either you're doing the experiment wrong, and that's what they're seeing, and somehow now it all makes sense to me. And it's a funny thing how I feel like "okay, I understand that." I don't understand it from any kind of experimental way, I just understand it here. But that's—whereas my grandfather probably could have understood it right off and explained it from an empirical point of view, I would guess. I don't know, maybe that's asking too much of him, but that's the difference.

CP: Let's talk about OSU for a bit. So you were in New York and then you spent a little bit of time in Mississippi and you were on leave in Arizona for a little bit as well. So kind of trying to find a home, it sounds like.

EW: Right, right.

CP: You wound up at OSU; tell me about how that came to pass.

EW: Well it just came—I was, like I said, so we eventually became married, so we pretty much bonded in New York, and a few years later we got married and then we were both, you know, we said okay let's see what else is out there, and I would be looking for various kinds of positions. And Mississippi, that was actually, they would have liked for me to have stayed there, but I was not so interested in that. And it was a real experience for both of us, and especially for Linda, coming from Ithaca, it was culturally quite a different place. And I say "okay, let me just kind of keep an eye open," and it just happened that this position opened up here and I was—there was a meeting in the American Math Society and I met some people from Oregon. And I'd never been to Oregon, although it turns out that my grandfather's grandfather was in Oregon, which was just a coincidence. And it turns out that Waymire is not as uncommon a name in Oregon as it is around where I'm from. We were the only Waymires that I knew, but out here there actually are some. There's even a Waymire Creek not far from here, from some of these early settlers.

So anyway, so there was a—and he's still here, my colleague Bob Burton was on the faculty, and he was the only person that was, at the time, working in this area of probability. And his field really is ergodic theory, but he was also addressing probability theory. And so the position was sort of, I think it was designated in that area. And then Bob and I met and we got along and started working together a little bit, and that's kind of—and that just sort of evolved here at OSU.

CP: What do you remember about your initial impressions of the university and of the town?

EW: Yeah, it was really funny when we were coming in here in the fall; we were in Tucson at the time and we were driving and we thought the place was on fire [laughs], the whole state's on fire, because by the time we got to the Willamette Valley, which was in September or late August, they were doing all this field burning. And we thought, "this is disgusting, Oregon's supposed to be this beautiful place and there's smoke everywhere." And I don't know in your experience; you've lived in the Willamette Valley, I mean you know about this, right?

CP: Yeah.

EW: Field burning now is completely under control, but boy, in those days it was pretty bad. And there would be times there'd be accidents on I-5 that were caused by field burning. So our impressions were not so great, of Oregon. We thought, "this beautiful place, they're destroying it environmentally." We thought this seemed like pollution. So that was my first—you asked; that was my first impression.

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We, you know, obviously Oregon's a great place and once we—and for us it was really a nice compromise because it's very much like upstate New York except not as cold. Upstate New York in that Finger Lakes area is a really beautiful area, as is here. And it just seemed like it was a good fit for us, and so we did stop looking and thought that—then the test was to get tenure and all that, because...

CP: How would you characterize the state of the department when you arrived?

EW: I think it was in good shape. I mean it was an active faculty and I think that the general motto of most departments, and certainly with this one, was that you always want to—well, my colleague Ralph Showalter says you always want to raise the average. As you keep moving on you just sort of want to, every generation of faculty, as you hire new people you're just trying to improve the average. And I think it was already pretty good when I arrived here. There was an extremely good faculty. Kennan Smith was a very well-known person in an area of analysis that - likely the most well-known person. He came here from University of Wisconsin. His story was that he once got upset with the department - this was before I got here - and he left. He said "I'm leaving, I'm going back to Wisconsin," and he got there and went "what did I do?" He was able to get back, he was that good.

And Ron Guenther and John Lee, Bill Firey, quite active people in the department. So I felt like it was a very healthy—my colleague Bob Burton himself, you know, it was an active research environment that had a lot of concerns, though, about education and teaching. Yeah, so I felt like it was a very healthy environment to be coming into. So I was happy on lots of different levels. So Vijay and I were working still and he had moved to Colorado by that time, so we were—I was going to Boulder sometimes on a leave or something like that.

CP: So you're on the tenure track, you're doing your research, which you talked about a little bit; I'm interested in the teaching piece of it. Specifically, math is a subject that so many people have a really hard time with, and you've talked about how your brain seems to be wired in a certain way that allows you to see the world mathematically, but how do you teach people? How do you get them over the hurdle with some of these things that are so difficult?

EW: Well, I think you try to offer different perspectives on things. So I try to vary my explanations and how one looks at different things, and these days, as you're a teacher, what you find out over time is also how you relate to students' changes. When I was starting out when I was really young, I think the students kind of feel like you're one of them and you have a certain rapport with them and you relate to them in a certain way. Then you get to this point—the hardest part of my teaching career probably was this period where, okay, now I'm their parents' age, and so I'm kind of the enemy, by definition. And you have to get through that. And then you get to the grandparent stage, which I'm kind of now, and they're very polite to me all the time. It's kind of unsettling.

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But I also tell students that what's important for them to know is that sometimes the way that someone explains something to you, they may not be hitting the right way to explain it. And they should be evaluating that, you know, is it really making sense to you? Just because I'm saying it doesn't mean that it has to make sense to you. And so maybe I have to try to say it in a different way. But maybe you just don't resonate with my way of seeing things, and maybe it's not consistent with—and in most cases you're better to find someone else. I don't mean that in a rejecting way, just that sometimes —it happens with me on my own; I deal with all kinds of mathematicians. Some mathematicians I do resonate with, I understand their flow of thinking; others, they just have a way of looking at which I'm not connected to. Because I think over time what happens is that you're building up—I have this view of, you're building up these connections with all your experiences, and it has to do with math too, and all these mathematical connections that you have.

Just two days ago I was working with a colleague and we were trying to solve this problem and I said, "well you know, it just occurs to me to do this thing," and the reason it has occurred to me was I had success with it in the past. Otherwise it's kind of an off the wall kind of thing. And it worked for what we were trying to do. But you're building up those kinds of things. But if somebody throws something in there that's not even closely connected to your own experiences and brain wiring, you're not going to understand it. And sometimes that happens with students, in particular, because of the way they're developing that.

So one of the things I shoot for is trying to get as varied a view of things as I can. But you know, there's also what I tell—I mean this is from my own experiences too, that in learning, when you're sitting there and you're in the classroom and so forth, one of the easier things to do was to just sit there and listen and things make sense, kind of what we call the nodding agreement, you know; the "yeah, yeah, yeah, yeah." But then there's another element in all of this, the hard work and the really creating those thoughts yourself. So I try to get students to realize it. And I use a lot of metaphors, like homework. You know, if you go to Dixon and ask somebody else to lift the weights, you're not going to get very much out of it. You've got to do the work. And so a lot of it is that, and I try to be that kind of a coach. I mean "here are the things that you really need to do to get stronger in this area, and I think you can look at it as an athletic event, if you want. And if you don't do it, you're probably not going to just sort of get it by osmosis, you know. It doesn't work that way." So that's kind of my teaching.

I had another—one of my former colleagues who passed away, grew up and born and raised in Thailand, brilliant guy, but he received—and his English was not good, but he received the Graduate Teaching Award from the college, as well as the Undergraduate. And he was telling me once, I asked him "Larry, how do you do this, how do you—how are you getting these awards?" He said "well," he said "it's like linear algebra," he said, "so you know I have to teach them about linear combinations." And he said, "so I talk to them about—I put it in the language of McDonalds and a Big Mac and a combo." So I'm not that extreme but there's that human side of trying to connect to people. I think that's important.

But I had the opportunity to observe a lot of teachers, too, in my department, and we have some excellent ones. And one of the things that really distinguishes some of the best is the same thing that distinguishes—this is what I've come to realize—that distinguishes great actors and great comedians and all this stuff; it's the timing. And I've seen it. There are these guys that get these recognitions, and I've gone to their classes, and I see there's this innate timing in teaching calculus about, when do you say that this is what you need to know or that this is how this works, and so forth. And it's very, very close to the same kind of timing that I think great comedians use. I mean, this is not to do funny things, but—or actors is a better metaphor, maybe, and musicians and things of that sort.

[1:25:31]

CP: I have a couple questions about the culture of mathematicians. There's a stereotype of the mathematician as sort of an isolated thinker who's toiling in abstraction and living in a different world from most, I wonder if you could give us a sense of different work processes for your colleagues.

EW: Yeah, there are people like that and there is a spectrum, and one of the great examples of the other side of that coin is of someone who's a Hungarian mathematician named Paul Erdös.

CP: Yeah.

EW: Do you know that name?

CP: Mhmm.

EW: Yeah, and in fact you can have an Erdös number. I think my Erdös number is three or something. But he was someone who fully, his whole life was spent in collaboration. Of course also that means when you're working in collaboration you also are leaving that—you're coming together and you're trying to sell what we know right now and you kind of disband and each one's thinking. And so they come back and "I've got an idea" and that idea may trigger another idea. That is the format in which I tend to work. I enjoy that a lot. I mean, some of the things that if you—collaboration is just a great thing. Sometimes somebody will say something and it's exactly the thing that you need to trigger some neuron here that is not triggered in them, and then it works that way, it's kind of like a jam.

But then there are other mathematicians who require sort of complete solitude in the way that they like to approach those things. And I know some of them and have great respect for them, and it's a different style. I think it's true of all the disciplines in academia, probably, not just math. But for some reason there is a stereotype for mathematicians and there is a nerdiness, I mean all of those things are real. And it's funny—I always talk about *One Flew Over the Cuckoo's Nest*, mainly from my wife, because the point of the movie when they escape or something, or they don't escape but yeah, they—you saw the movie? And they all go out to a boat or something, I think they're in a boat, and she would tell you that could just as easily be me and a bunch of my colleagues out there.

You know, it's a very funny thing that there's a—because math is the way it is, I think it's it just a mental thing, and almost like it's a, very much a childlike thing too. I mean if you're hooked on it when you're young you stay hooked on it in the same way and you have that same fascination. And the idea of waking up in the morning with solutions to problems, that's a very common thing to happen. And it also has its dark side, the side where you just start struggling, and it can be very depressing sometimes to be working on a problem and just not getting anywhere and just not thinking you can. That happens, and it's kind of a little bit of a roller coaster like that. But the elation when you get those Eureka moments, that's pretty good, the endorphins are pretty good. And I think that's, whether you're doing it in solitude or with other people, I think that's a common element. You know, I have some really, really dear mathematical friends that are extremely reclusive. And I think they grew up that way and that's just how they maintain their life and that's how they're most comfortable in doing things and just kind of the way that... And I think with myself, growing up in the environment I grew up, with my brothers and all that, I just grew up in a more social environment. And I see it all, I mean I don't feel unique that way.

[1:30:20]

Paul Erdös kind of is much more extreme than me in that area. And my advisor is very interesting in that he's told me that he doesn't have the ability to ask a question of anybody, in the sense that if he can't do it he won't. I'll ask somebody; if I'm stuck on something I'll ask "you guys have any idea on how to deal with this?" He won't do that, he has to figure it out himself. And he's an amazing person but—also he can work with other people and things like that. He tends to be a little more reclusive left on his own, probably, but people seek him out, and he's very giving that way. But he just doesn't have this—if he doesn't know, he just struggles with it till he gets it. I'm probably more impatient than him.

CP: Well another, probably, stereotype that Erdös will put the lie to, but the idea that a mathematician's best work is done when they're young?

EW: Yeah, I don't know if I, I mean I don't think I agree with that, but...you know there are examples that, I don't know, did that come out of—whether that originated with Einstein or something. Because in 1905 Einstein published four of his biggest papers ever and he was young and was very creative. And then when he was older and struggling with this theory of general relativity, I mean, had said things like well, this was something that he couldn't do now because he had spent his career. And he never did get it or anything, and that may be—I mean there's probably partial truths in that respect, but I think there are a lot of counter examples to that too.

At least in my, you know, there's also when you go to the extremes like where if you're looking within mathematics at some of the greatest contributions to have ever have occurred, they may have been by younger people. Like if you've never done that before but sort of made a file or something and looked at what are the greatest contributions to have occurred and at what age did they occur. It's possible that that's what you would find. But the thing is that most of us in the...when you talk about the kinds of contributions that are truly earth-shattering—see, we don't have the Nobel Prize in math. We have the Abel Prize, which people have made major contributions in order to achieve. In fact if you look at the most recent Abel Prize, was to, you know, *A Beautiful Mind*...

CP: Oh, Nash.

EW: Yeah, John Nash. And that was based on his PhD thesis work. Actually, no it wasn't; his Nobel Prize in economics was based on his PhD thesis work and then his Abel Prize was based on work that occurred shortly after that, which is even greater than what he was able to do. I mean from a mathematical point of view it was a much greater contribution than—but these are kinds of things that stick out for all time, I mean that every mathematician knows about. Those kinds of contributions, maybe those are the ones that occur at—they require this kind of strokes of genius that very few people are capable of, and maybe those who are younger. I don't know if that's true, well we can...

CP: Well something that you've done a lot of is be engaged professionally with journals as editor.

EW: Yeah.

CP: Take us a little bit through the process of what that means, to be an editor of a mathematics journal?

[1:35:02]

EW: So we have the, you know, it's a peer review system, and so knowing, being—it's sort of being aware of what the, as an editor, being aware of what the frontiers are sort of in your field, kind of overall. So my area of specialization is in probability and stochastic processes, but that itself is a fairly large area. But it's certainly, I wouldn't be able to do that, because an editor of a journal of algebra, for example, or journal of geometry or something like that... But within my field of probability, it's because I think those of us who are eventually getting these kinds of appointments are people that—because I do have lots of connections with people around the world working in probability. So there's this sort of network of expertise. And I have this view, I'm not a narrowly focused mathematician, so I'm capable of receiving paper submissions in those areas and then basically knowing where to send them for review. Or at least I have associate editors and I would know which associate editor to pick, who would then pick reviewers and so forth.

So it's kind of having that broad sense of things. And then as an editor your responsibility is that you get a submission and initially you have to look at the submission and see if it's maybe a quick rejection, that you can determine on your own that this is known or not particularly relevant to the main interests of the journal. So it's that kind of thing. It's one of those jobs that I was happy to have done, but I'm very happy to not have to bear that responsibility. It's a daily responsibility; journal submissions coming daily and you just are sort of keeping up with that. Kind of could just say it's stressful, I mean, say it like that.

And by now I'm an associate editor on a couple of journals. And just this morning, in fact, I was just sent a paper. I'll just give you an example; this is an associate journal in business, because I was kind of upset this morning with it. The editor, the main editor, sent me this paper, asked me to review, and I'm an associate editor so that means I have to find a reviewer. And I knew one, I knew a perfect one for this, but this is a delicate process because it's time consuming, people aren't being compensated, it's all part of the way that the system works. And so I don't know this guy personally, he's a young person, but I knew of his reputation and I sent him this paper and I said "would you please referee this?" And it's all now through the, you know, we've got their own computer system. And so he responds that he actually would be, it is an area of interest to him, but he said, he's talking about his time constraints. This is a normal thing. And so you have to—but the idea is, what's most important is to get that kind of input.

Well somebody else in the journal, one of the managing people or somebody, I don't know what, they saw this and they ended up writing to him just quickly saying "would an extra month be okay?" or something. They said something very quickly. And you just don't do that, because it opened up this whole thing, "I need nine"—he comes back, "I need nine months." So the thing is that you just, the person—and so now I wrote back to these guys saying "whoever this is, I don't know who this managing editor is, but you really torpedoed this whole thing, because now I have to find another." Because otherwise I would have kind of worked with him. Because what they'll do is, if you give them these black and white kind of situations, then they go extreme and so forth. But you just try to say "you know, we really need your expertise and we need for you—and we'll probably want to work with the person, because you're"—it's just there are ways of dealing with it and that was not one of them. So that's part of it, that's one of the headaches of the job. It's not easy to find people who are reliable and expert enough and all those things.

CP: Well, a couple questions in conclusion that draw on your length of service here. I'm interested in your perspective on how the Math department has evolved over the time that you've been here.

[1:40:01]

EW: Yeah, it's an interesting question. It's important too, and OSU, not just the Math department but we went through really tough periods economically, in the state. This year may have been, hearing what we are hearing from the legislature and so forth, may have been one of the brightest years since I've been here. Really if you go back, there was a period of time when the university, the legislature was just, we wouldn't register on their radar even. And they kicked the can down the road with this PERS business, and they would say—I mean it was obvious at the time even that they would say "well, we're not going to be able to get raises and so forth," so we were losing people. But then they would say "but we'll do this." Well, one of these days you're going to have to pay for that, and they just kept kicking the can. And I think Oregon got itself into a lot of trouble that way, and hopefully they'll be able to come out of that.

But what happens was, we went through a period where we had a lot of retirements and we weren't replacing them. And so it got, not too long ago, when we looked around in the Math department, we were all full professors, maybe even one or two associate professors; I think there was a time when there were no assistant professors. And it's terrible, because you need that vitality and youth in the department. They are so important; post-docs, young assistant professors, all of that is the life of the university and departments. And we're now coming out of that. I think we now, we've been able to hire; in the recent years we've been able to hire some assistant professors, and so we have now a little bit better spectrum from assistant, associate and full professors. And you just don't want to have a bunch of old guys in there.

And I feel about myself, I'm active and I'm still getting research grants, and when that's over then I'll move on too. But it's really important to have young faculty, and that means being able to hire and be competitive in hiring, and it's a good time to be hiring because it is, the job market is in favor of the universities. And like I said, I think for the first time, it looks to me like in the legislature they're starting to get it. Like it's been, frankly, they just haven't been getting it. They haven't cared, unfortunately. I mean there are a lot of pressures on legislatures and so forth on where they have to put the money and so forth and make the decisions, and there was a time when prisons were the big deal; okay, we have to build up the prisons, and then education was suffering as a result. And Oregon still has lots of issues to deal with, but I try to be optimistic. I tend to be more optimistic than anything else.

CP: Well that feeds a bit into the last question, and that's just where you see the university as being positioned right now. This is a sesquicentennial project, the sesquicentennial's three years from now. Where do you see OSU heading in the next few years?

EW: Yeah, on many fronts I see it, like I say, I am optimistic about—you know, in academia we have to be careful speaking with too high regard for any administrators [laughs], but honestly, I mean since I've been here, I think Ed Ray has just been really excellent. And I don't know him but he's brought a sense of what he calls the academy, the scholarship, an emphasis on that, and one that I think has been very healthy. And I think the people that he brings, that encourages that. And I think that certainly as a state, Oregon has so many great resources, and education is the key to life. So I think the prognosis is pretty good if this year is sort of representative of where things are going to be going in the coming years. I think it's on a much better track than it's been on ever, and I'm kind of optimistic. Hope I'm right.

CP: Me too.

EW: Yeah.

CP: Well Dr. Waymire, thank you for this. It has been a pleasure for me and I appreciate you taking the time to share your memories and insights with us.

EW: Yeah, thank you.

CP: Thanks very much.

[1:45:33]