



TRANSCRIPT

Key Conversations with Phi Beta Kappa

Genetics Researcher Janet Westpheling on Inspiring the Next Generation of Scientists

She knew early on she wanted to be a scientist. Today, her research at the intersection of academic and industrial microbiology addresses some of the most pressing energy issues of our time. The University of Georgia professor speaks with Fred about her upbringing, her work at The Center for Bioenergy Innovation, and her role as an educator and champion of scientific inquiry inside and outside of the lab.

Fred Lawrence: This podcast episode was generously funded by two anonymous donors. If you would like to support the podcast in similar ways, please contact Hadley Kelly at hkelly@pbk.org. Thanks for listening.

Hello and welcome to Key Conversations with Phi Beta Kappa. I'm Fred Lawrence, Secretary and CEO of the Phi Beta Kappa Society. On this podcast, we welcome leading thinkers, visionaries, and artists who shape our collective understanding of some of today's most pressing and consequential matters. Many of them are Phi Beta Kappa Visiting Scholars, who travel the country for us visiting campuses and presenting free lectures that we invite you to attend. For the Visiting Scholars schedule, please visit pbk.org.

Today, it's a pleasure to welcome Dr. Jan Westpheling, Professor of Genetics at the University of Georgia, where she teaches undergraduate and graduate classes in genetics and trains students in her research lab. Professor Westpheling's current research is focused on engineering bacteria to help produce environmentally-friendly biofuels in a sustainable way. Her research and teaching activities bridge the gap between academic and industrial microbiology. Welcome, Professor Westpheling.

Jan Westpheling: Thank you. It's great to be here.

Lawrence: You have been engaged for some time in very significant both industrial research, academic research, and I do want to get us to all that, but I also want to start with the journey that brought you there, and I wonder if there was a moment when you said to yourself, "I'm going to be a scientist."

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Westpheling: Yes. I was four years old and I've been a science nerd my entire life. Before I went to school, I used to watch this program called Mr. Wizard.

Lawrence: Mr. Wizard! We all grew up on Mr. Wizard.

Westpheling: We all grew up on Mr. Wizard.

Lawrence: He was wonderful. Hey, Mr. Wizard! How does it work?

Westpheling: Oh, exactly. So, he used to do experiments.

Lawrence: Right.

Westpheling: And he would show you how to do things and they were much more sophisticated than I appreciated at the time, but I remember those programs and I decided before I went to school that that's what I wanted to do. I wanted to be a scientist. I wanted to understand how everything worked at the molecular level. So, yes, my father thought it was a great idea. My mother laughed and said, "There, there, little girl. You'll be fine." But all through school, I didn't come from an academic family, and I grew up in a small cotton farming community in the South, so my school was pretty primitive. But I always had this vision in mind that I wanted to be a scientist and I didn't really get much feedback from my teachers at school, but I did from reading books on my own and going to the library. And I just found it fascinating, you know? Really, from my earliest memory.

Lawrence: So, along the way, growing up in that small cotton town in the South, did it ever occur to you this is just a mistake? Or you always knew that you were going to find your way through it and you were going to find a way to be a scientist?

Westpheling: Well, let's just say that I was not encouraged. As a woman, the expectations of my community is that I would marry a cotton farmer at 18 and have a few kids, and I don't know. But I just never envisioned that for myself, and so I was discouraged by even my teachers. I remember my high school English teacher told me once that it wasn't a good idea to be smarter than the boys because nobody would ask you out.

Lawrence: You know, we're talking in the period following the passing of the great Justice Ruth Bader Ginsburg, and in many ways what's powerful about these stories, I know you're not close to Justice Ginsburg's age, but what's powerful about these stories is the way in which they tell us not so very long ago how different this all was. I mean, I think it's fair to say that today a young woman in middle school or high school showing promise in science, not only is she going to find a mentor, but she's probably going to find somebody who's going to say, "You know, these are the kinds of colleges that'll have scholarships for people like you, and this might be a good path for you." And I'm guessing that you didn't have anybody playing that role for you.

Westpheling: No, but that's one of the joys of my job now as a university professor, is you still see people who don't recognize what's possible for them. Even now, you don't really see what's possible, and they come from rural places, and they don't come from academic families, and so even now you can see that they need a leg up and they need someone to say, "You know, you can do this. You know, you can go to Harvard Medical School. You

can go to graduate school anywhere you want, because you're just as good, and don't let your own reluctance to try stand in your way."

Lawrence: I think just putting a label on it sometimes... My daughter is a fiction writer, and she would tell you the story of a very important teacher of hers when she was in ninth grade, I guess, and she had always kept a journal and whatnot, but she wrote something for this teacher who called her in after class and he said to her, "You're a writer, aren't you?" And she was speechless. And he said, "No, no, no. It's all right. You're a writer." And she said that she heard the words coming out of her mouth, "I'm a writer."

And I think that role that you can play for somebody is incredibly powerful, just lifting the sights to say, as you said, "You could do this." But let's take it back a step here. You didn't exactly go to a cotton mill school. You went to Purdue University and majored in microbiology. What was the route to Purdue?

Westpheling: Well, I drew a thousand-mile circle around where I lived and I thought, "Okay, I'm going to go at least a thousand miles away." And my parents divorced when I was in my early teens, and I lived with my father part time in Indianapolis, and so I knew about Purdue. And I applied and was accepted, and I thought, "Well, that's it. I'm definitely going to go to school at Purdue."

I'll tell you, since you love music, I also love music, and the first time I ever saw a violin in person... I mean, a real violin that wasn't on television, I was a freshman in college.

Lawrence: Wow.

Westpheling: And I went to a concert, a live orchestra concert, and I was just struck. I was speechless.

Lawrence: You said, "If the world has got things like this in it, I think I'd better stick around."

Westpheling: Yeah, I think I better stick around. And then I thought, "You know, what have you got to lose?"

Lawrence: Phi Beta Kappa, we obviously talk about the importance of a broad-based liberal arts education a lot, and sometimes people think of that just in terms of the curricular piece of it. Obviously, the curricular piece of it is important, but here, about to engage in deep studies in the research sciences and microbiology as a major, part of what your best-understood full-blown education is includes going to a concert and hearing live music.

Westpheling: Absolutely. I fell in love with all kinds of things I didn't know existed when I was growing up.

Lawrence: When you were studying at Purdue, did you imagine this was going to be a path that would lead in an academic direction as opposed to an industrial direction? Or didn't you know?

Westpheling: When I entered Purdue, there were seven men to every woman, so the ratio was seven to one. And I was the only woman in more than half of my classes. And so, I didn't really

understand when I entered Purdue what the opportunities were for... But by the time I graduated, I knew I was going to graduate school. After I graduated, I started school when I was a little younger and I graduated in three years from Purdue, so I was almost 20 when I graduated, and I decided I was... I needed to take, to slow down a little bit and think about what I wanted to do. So, I took a job at Eli Lilly as a research technician for two years, which was absolutely fantastic. And my mentors there were just extraordinary people. Of course, they were all men, but they were so encouraging, and my boss said to me one day, he said, "So, what are you going to do when you grow up?" And I said, "Are you unhappy with my work?" And he goes, "No, no, no." He said, "But you can't... First of all, you don't deal well with authority, so you really have to be your own boss."

Lawrence: And I presume he knew what he was talking about when he said that.

Westpheling: He said, "So, you really should go to graduate school." And one of the consultants for our company was an English scientist named David Hopwood, who I was too naïve to understand at the time - he was really the geneticist of the entire field of streptomyces biology.

Lawrence: Yeah. David Hopwood's a pretty big deal.

Westpheling: Yeah. He's a pretty big deal. He's a fellow for the Royal Society and a pretty big deal. So, I got to interact with him, and he actually asked me what my plans were long term, and I said that I was going to go to graduate school, and he said, "Well, would you consider my lab?" And not even realizing at the time what he was saying to me, I said, "Absolutely."

Lawrence: Wow.

Westpheling: Quit my job and moved to England.

Lawrence: So, let's talk a little bit about the work that you've done, starting in I guess 2006, when you took a leading role in the BioEnergy Science Center, The Center for Bioenergy Innovation, which is supported by the Department of Energy, right? And has done a lot of work regarding environmentally-friendly biofuels. What has that project been like and how has it developed?

Westpheling: So, if you want to solve a problem like energy, it means that you have to bring in people of many disciplines, and many ideas, and people who would never really interact with each other. So, I interact through the center with plant biologists, crystallographers, fermentation technologists, chemists, bioinformatics people, and so you bring all these people, and put them in a room, and you say, "Okay, think about this and come up with some ideas." And we design pathways. We engineer these microbes to convert something like switchgrass, which is a sustainable, environmentally-friendly crop, to convert that directly into ethanol.

Lawrence: So, tell us about the particular advantage of bioengineering switchgrass in order to produce fuels like ethanol.

Westpheling: Well, switchgrass is different from something like corn, okay? So, there are a million reasons why corn is not a good choice. Growing switchgrass, you get seven times more energy out than you put in. With corn, it's basically a wash. And so, switchgrass will grow in the median of highways. It'll grow to be two stories high. You plant it, you mow it, it comes back, you mow it, it's a perennial grass. You mow it, it comes back. And so, it's cheap energy, doesn't require a lot of energy to grow, doesn't require a lot of energy to harvest and use, and plant biomass is one substrate. But there are lots of other kinds of chemicals that are made in bulk from microbial fermentations. Things like lactate. Lactate, the world is spewing with lactate. People are paying you to take lactate off their hands.

And we're also working on a mechanism to convert lactate into jet fuels, into long chain carbon molecules that will eventually be used for things like plastics, or even high energy fuels. So, bioenergy is more than just plants. It's taking renewable resources, and they can be chemicals, they can be materials, they could be waste plastic in the landfill, and converting them to things that are useful.

Lawrence: How much of this has already been used in the private sector in energy production?

Westpheling: Well, there are corn ethanol plants, and so corn is an easy substrate, because corn is already primarily sugar. And so, switchgrass is not. Extracting the sugar materials, the carbohydrates from switchgrass, is a lot more complicated. But there are corn-to-ethanol plants. DuPont, there are several that are commercially viable, that are making ethanol. The ethanol being produced commercially is right now made primarily from corn.

Lawrence: In the long term, is the plan to be able to either augment that with plants like switchgrass or even replace?

Westpheling: Replace is the goal.

Lawrence: And how much of that do you think will be driven by government direction and how much of that will be that the market will ultimately simply take us in the direction that besides being environmentally friendly, also sounds to this non-scientist like a simply more efficient result?

Westpheling: Well, it's political, pure and simple. It's not a scientific decision. It's whether the government is going to invest in this until it's viable for industrial process. Right now, it's not. And so, for example, if there were energy taxes, if there were emissions taxes, that money could be used to support this to make it commercially viable. So, it really depends on the political will of making this economically viable.

And you know, natural gas is very cheap, and so right now bioenergy, biofuels can't compete economically. It's just not cost effective with things like natural gas. But there's still some science hurdles to overcome to make it economically competitive.

Lawrence: So, if you were trying to pitch this to an investor and the investor says, "Look, you just told me natural gas is cheaper, so I don't see why I should be listening to the rest of your pitch." How do you turn that person around?

Westpheling: Ask them if they have grandchildren.

Lawrence: Yeah.

Westpheling: Whether they want their grandchildren to be able to take a deep breath when they're adults.

Lawrence: So, this is ultimately an argument that starts environmentally but ends up in actual efficiency.

Westpheling: Yes. Yes. That's a good way to put it.

Lawrence: So, students who work with you in your lab, are they coming at this from an environmental science point of view? Are they coming at this from an industrial science point of view? Are they coming at this from a genetics point of view? Maybe all of the above?

Westpheling: Pretty much all the above. Most of the students who come into my lab to do undergraduate research are either in microbiology or genetics, so we use basic genetic concepts. And so, you could come into my lab and learn a great deal about how to work on fruit flies eventually, so we learn a lot of basic genetics. But if you're also in my lab and you want to do graduate school in bioenergy, or you want to go to a national lab as a postdoc, or you want to get a job at an industry in bioenergy, those are all paths that I can facilitate for my students. But the undergraduates come in and they get a very strong genetics background education.

So, it's all of the above.

Lawrence: This being Phi Beta Kappa, one of the things that we're famous for is book awards and book lists. Our readers are fascinated with book lists, so I'm going to give you a chance to help write the curriculum for the general, serious, non-science major, what she or he should know about genetics and bioengineering. You got a couple of good recommendations that the general intelligent reader ought to take on to become educated on these issues?

Westpheling: I love Stephen J. Gould's books. The Blind Watchmaker is one of my all-time favorite books, because I think they're more thought provoking, and they're more... It's more about science as a field of interest, as an intellectual pursuit, than something as specific as biofuels.

Lawrence: Lewis Thomas's Lives of a Cell make your list?

Westpheling: Yes. Yes. And I'm embarrassed, I'm sure as soon as we're finished with this I'll think of 10 that I'd require of my students.

Lawrence: Well, I think that people like Stephen J. Gould and Lewis Thomas as just examples of scientists of pretty high standing whose writing is both serious but accessible to someone who's willing to apply her or himself. I mean, it's not meant to be simple. It's

not dumbed down. But at the same time, the barriers to entry yield pretty nicely to somebody who's prepared to really take it on.

Westpheling: Oh, and E. O. Wilson. E. O. Wilson's biographies are the best. You know, in the end of one of his books, he said if he could do his life over, he'd be a microbiologist, because he appreciated the diversity of the microbial world and at the end of one of his books he said if he had it all to do over, he'd be a microbiologist. And I said, "Well, it's eventually... He saw the light eventually."

Lawrence: It took him time, but he got there.

Westpheling: It took him time. I went to E. O. Wilson's final lecture at Harvard. I was a postdoc at Harvard. And his final lecture at the bio labs, it was at the museum across the street where his office was, and he gave his final lecture to his final class, and I went to it. And we all dressed up like fruit flies. And I had wings made out of coat hangers with Saran Wrap, and I drew the veins in the wings.

Lawrence: How fantastic. Say, I understand that you have worked to develop education programs in the sciences with elementary school students.

Westpheling: Oh, I'm so glad you brought that up. It's one of the things I'm so excited about.

Lawrence: Yeah, tell us about that.

Westpheling: So, when we received our first five-year grant from the Department of Energy to form the BioEnergy Science Center, we formulated a virtual center that brought together the best and brightest people from all over the country in their disciplines, and that NRC proposal went forward to DOE, and then that was used as the roadmap to institute the BioEnergy Science Centers. And I spoke up and said, "Look, there should be an education component to this, because educating the general public is critical to the mission. If we can't get the general public involved in this effort, it's not going to be successful."

And of course, you know when you're in one of those meetings and you open your mouth, they say, "Okay, you do it."

Lawrence: That's it. You just became chair of a committee.

Westpheling: Just became head of education and outreach for the BioEnergy Science Center.

Lawrence: There you go.

Westpheling: Here's a budget of \$2 million, think of something useful to do with it. And so, I thought to myself, "How do we best reach the general public?" So, I contacted a children's museum in Chattanooga, Tennessee-

Lawrence: This is the Creative Discovery Museum?

Westpheling: Discovery Museum. And they're a children science museum, and I went to see the director, and I said, "Look, I have these ideas of how to put together this curriculum, but I don't know anything about elementary education, and your museum does this. You do

outreach. You do science lessons. So, can you help me?” And it started in Chattanooga, Tennessee, and then it expanded nationwide through science museum hubs. And we would have science nights, where the kids would bring their parents, and we would reach 300 or 400 people in one of these science nights. And the kids, having learned the lessons in schools, would teach their parents, and their grandparents, and their older brothers and sisters, and we have a website. If you are interested, I really encourage you. If you go to BioEnergy Science Center, BESC Education and Outreach, it’s still up. And there are lesson plans, so if you’re a schoolteacher in rural Iowa and you want to develop a curriculum to teach your students about switchgrass and the economics of bioenergy and biofuels, you can go to this website and download it, and you can also download a kitchen science materials that you can buy at Walmart to do it in your class.

So, we used to have Ask the Scientist, and I would have a scientist from the center be online, and the kids could come and ask them any question. And we’re talking about people like Lee Lynd at Dartmouth and Charlie Wyman at U.C. Davis.

Lawrence: Major people in their fields.

Westpheling: Major people in the industry. And they would sit in front of their computer for two hours and answer the questions of fifth graders, and they were happy to do it. I must tell you that of all the things I’ve done as an educator, this is one of the most exciting and rewarding things I’ve ever been part of, because it just enabled so much of what I... I felt like I was giving back something that I needed so badly when I was a little girl. You know, a little kid can go to a website and read about things and download these things. It doesn’t matter where you grew up or where you go to school, whether you go to a Title I school in the middle of nowhere or a magnet school in a big city. I can’t tell you how absolutely wonderful this was.

Lawrence: So, at long last, you had become Mr. Wizard.

Westpheling: You know, somebody said that to me once, and I said, “If only I could aspire to something that ambitious.”

Lawrence: Well, who’s to say how many discoveries will be made because of some little boy or some little girl who’s going to get lit by that experience?

Westpheling: Oh, yes. There are just so many great stories. We went to this classroom once and they asked the kids who the scientists were in the room. There were a bunch of adults from the Creative Discovery Museum and a Chief Scientific Officer at Oakridge National Lab. I dragged him all over the country to do this, okay? And all of the kids identified him right away, and then they started choosing men in the room. And finally, Brian said, “Well, Jan Westpheling is the other scientist.” And this little girl stood up and said, “I didn’t know women could be scientists.”

Lawrence: There you go.

Westpheling: And I thought, “Oh, God.”

Lawrence: And a door opens.

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Westpheling: Yes. And you know, there are moments like that in education when it's all worth it. It's just all worth it. It's not just that you've given something back, but what a gift to think that you've actually been able to share your passion for something with someone who's going to be a lot better than me, smarter than me, more contributing than me, and you know, as David Hopwood once told me, you don't pay back to the people who've helped you. You pass on to the next generation.

Lawrence: And each one passes it forward and that's how the chain of discovery actually proceeds, and each of us, if we're lucky, has got a role in it. You have most certainly played that role and we're delighted to have you as part of the Phi Beta Kappa family playing that role this year. Thanks so much for coming in and sitting down with us on Key Conversations.

Westpheling: I'm just honored to be part of this.

Lawrence: This podcast is produced by Lantigua Williams & Co. Cedric Wilson is lead producer, Virginia Lora is managing producer, Michael Castaneda mixed this episode. Hadley Kelly is the Phi Beta Kappa producer on the show. Our theme song is Back to Back by Yan Perchuk. To learn more about the work of the Phi Beta Kappa Society and our Visiting Scholar program, please visit pbk.org. Thanks for listening. I'm Fred Lawrence. Until next time.

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