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NARRATOR: At first blush Radia Perlman comes off as your classic computer science genius. She developed the algorithm that runs one of the internet's foundational protocols, and is referred to as the mother of the internet. She is also a cybersecurity thought leader. Yet, in this podcast, you'll learn how in nearly every other ways Radia defies the stereotype of the internet coding geek. She even confesses to being a non-gadget wonk that can barely operate her own cell phone. How has her atypical background led to her accomplishments, including over 100 patents, and what advice does she have for women entering this field? Listen and find out.

JO LEE: Radia, thank you so much for coming and joining us on this podcast. Why don't we kick it off by you telling us what you're doing in the cybersecurity space today?

RADIA PERLMAN: Well, one area that I think is under-- is neglected is when you have malicious components. So people think about designing something that's robust even if some if the components fail, but they're thinking of failure in terms of it just halts. But what happens if they continue working, but they become malicious and they're doing the wrong thing? So that was what my thesis was about many years ago. Which was how to design a network even if some of the switches were giving wrong information in the distributed algorithm that computes the forwarding tables, or flooding the network with garbage. Or forwarding packets off in random directions, or are doing everything perfectly but throwing away packets from one particular source.

So this is an interesting issue in a lot of different systems. So something I had designed fairly recently was how to store data with expiration dates. The particular design that I did was not only scale-- the other thing that tends to be neglected is usability. So if you have a system that works-- assuming that the human does the right thing. This is-- and it's insecure when the human does the wrong thing.

So there's actually a quote I wrote in my book that I'm quite proud of, which is-- humans are incapable of securely storing high quality cryptographic keys, and they have unacceptable speed and accuracy when performing cryptographic operations. They're also-- they're large, expensive to maintain, difficult to manage, and they pollute the environment. It's astonishing that these devices continue to be manufactured and deployed, but they are sufficiently
pervasive that we must design our systems around their limitations. So every time I hear users need-- we need more training of the users, or users shouldn't click on suspicious links. It's what's a link? What's a suspicious link?

So, again, things have to be designed so that you don't depend on the users making choices that they can't possibly make decisions about.

JO LEE: So, how did you wind up focusing on this usability aspect? I mean, you mentioned that it was connected-- or your work now is connected to certainly what you did your-- your work on your PH.D. Work. But why use-- like how did-- there's so many things you could have focused on. Why on user error and how it can ripple through a system obviously very negatively.

RADIA PERLMAN: Well, partially because I personally do not enjoy gadgets. So I barely know how to use the smartphone that I finally got. It sits on my desk and makes funny noises. I don't really know what it's thinking. I can barely make a phone call on it.

It's-- so I was always good at, sort of, the logic and the theory of things. But I don't, with glee, dive into learning how to do some new thing. My daughter, when she was in high school, was so proud of me-- because she knew I had this book and had seen me give lectures and stuff. So she was telling all her friends, my mommy is a famous computer scientist. She knows all about computers.

And then they would call me up, and say I'm trying to install the printer and I get this ever message. And I had to explain to my daughter there was nothing that any of her friends would ever want to know that I had a clue about. So I like to design things for people like me. That it should just work. You know, it's amazing the kinds of things that you-- that engineers design.

So I was installing an email client, and it asked me do you want POP or IMAP? And I happen to know those are two email protocols, but why would I care? And it turns out it's like super important. You have to choose the one that the server is using. How am I supposed to know what-- which one the server is using?

So, yeah, that's basically one of the reasons for usability-- which is that it's incredibly neglected. And I think that you can make things wildly insecure by just shrugging your shoulders and say, well, the users are using it the wrong way.

JO LEE: Well, I have to say-- I feel like it's incredibly brave for the person who is referred to as the mother of the internet to confess to being mystified by the smartphone. As so many of us are.
So I just really appreciate that. Like there’s hope for us.

But having said that, I mean, I think it’s an interesting point that you’re making. That this is-- your sense of usability comes from your experience, and this is an opportunity to talk about the fact that you have a very Renaissance-y background, interest in so many things. Yes, math. Yes, science. Classical piano, arts. How did you wind up here and, if you don’t might also saying, how does that breadth-- what does that give you? What does that add to what you do? What is the advantage of it?

RADIA PERLMAN: Well, I do weird things sometimes. So, you know I have these books, and they’re serious textbooks, but they’re quite funny. You know the cryptography book. It’s-- how could a book on cryptography be funny? And I spent way too much time thinking of interesting quotes, and random jokes in there. But--

JO LEE: Wait, I’m sorry, this is a book that you wrote on cryptography.

RADIA PERLMAN: Yeah, I co-wrote that book. And then I have a book on Network protocols as well. So the one that I wrote on layers-- the underlying layers of networks that help them self organize-- that one’s called *Interconnections*. And the one that I co-wrote, that is on cryptography and how you use it in protocols, is called *Network Security*.

JO LEE: OK. Sorry, I didn’t mean to derail you. You were talking about how you wound up with this broad background in computer science.

RADIA PERLMAN: Right, so in high school I just sort of knew that I-- the right thing to do was to try to get straight A’s in everything. Which meant that-- my weakness is I can’t remember anything. So other people could get a good grade by just remembering what the teacher wanted them to say, and repeating it on a test. Whereas I had to learn things, like understand them really deeply. So that on the test I could derive them from the two things I could remember.

So that was very good for deeply and cleanly understanding science and math, but it didn’t help me with history where we had to repeat meaningless names and dates. So I spent most of my childhood memorizing all the things I needed to do in order to-- I would get 100 on the history test and 10 minutes afterwards all of it was gone from brain, because if I had to retain it I’d have to forget something more important, like my name or something.

JO LEE: OK, I just have to say, I don’t think you’re alone there, but OK.
RADIA PERLMAN: Right, right. So I always knew I was going to be like the best student at any science math thing through high school. And I wasn't pleased about it. I had this fantasy that someday some boy would do better than me at math or science, at something at math or science, and my plan was to fall in love with them and marry him.

But despite doing so well at these things, when I first took a computer programming class—which is where a high school teacher noticed that she could sign some of us up at Stevens Institute, which was a local college, and she would drive us there after school. So I walked into that class, and everyone was talking about how they had built ham radios when they were seven. I had no clue about what a ham radio was. I never took anything apart. I assumed I would get electrocuted or something.

And then people were asking words with-- asking questions with fancy words like input. I had no idea what that was. And so my mind turn-- closed down and I got nothing out of that class. Which makes me a great teacher because I understand the sense of panic that can prevent people from learning things. Yeah, self confidence is a lot of it.

So I was-- I went to MIT. I was perfectly confident in physics classes, math, all that kind of thing. But I tried to stay clear of computers. Until there was a class-- I was taking a physics class, and a TA said to me, I need a programmer for my project. Would you like to be my programmer?

And I said, well, I don’t know how to program. And he said, yes I know. That’s why I’m asking you because I have no money to pay you, and if you knew how to program I’d have to pay you. And, to be perfectly, brutally honest, I had a boyfriend at the time who knew how to program so I felt it was a safe way to learn. So that’s how I learned.

And so yeah, there’s nothing really to it. It’s actually sort of fun. But yeah that-- oh, and the reason that I wound up in network protocols was that I went to graduate school in math, and everything was fine. I knew how to take all the classes. But I had no idea how to write a thesis, and I had no advisor.

It was supposed to be up to us to find an advisor. And I would try to knock on doors of professors and they would say, well, I’m a big important busy person, which was not very encouraging. So my perception at the time was everybody else had gotten into graduate school because they were smart, and I had just gotten into graduate school because I studied
really hard. I couldn't imagine doing original research. Just some other species did that.

So when I had done everything but a thesis, an old friend said are you enjoying grad school? And I said, well, not really. And he said oh, well, come join my group. And that happened to be designing network protocols. And I discovered I loved it. Now, as it turns out, 10 years later I went back and finished my PhD. And it was so much easier at that point, because I just had self-confidence.

JO LEE:  We're just about out of time, but quickly. So you made this leap through the private sector and through graduate school, but I'm going to imagine through a lot of that you were-- you experienced a lot of gender imbalances-- probably that's putting it very mildly. Any advice for women who want to enter this field?

RADIA PERLMAN: It's a fantastic field. And if you have different skills than other people it's a real plus. So if you can actually explain things, if you're actually sort of a good peacemaker-- all these things are-- if-- all these things are absolutely wonderful skills. I often ask women why they don't go into the field, and they say oh well it's boring. They sort of picture sitting in a cubicle all by yourself writing code.

And some people enjoy that, and that's what some jobs are, but it's such an incredibly wide field. Now I've also asked very senior women, who were on the technical path and then they switched to management. And I've asked them why did you switch to management? And I was hoping they'd say, well, I'm just so good with people, or they really needed somebody. Every single one of them said, quote, "I wasn't smart enough to stay on the technical path."

Which is quite heartbreaking. So, yeah, the difficulty in the field. It has nothing to-- I mean, it's gender correlated, perhaps, but there are some people that just sort of get by with bluster. You know, they just sort of act important and all that. I've yet to meet anyone like that who's actually any good.

And I've met-- people like that are both male and female, but it turns out to discourage a lot of people who would otherwise be really good. They get sort of frightened of those people who sometimes act very much like bullies.

JO LEE: Radia, I so appreciate your pearls of wisdom. Couldn't resist that pun. Thank you so much.

RADIA PERLMAN: Great. Thank you.
NARRATOR: Thank you for listening to this podcast. For more information on future podcasts, program news, and upcoming events please visit Brown.edu/cybersecurity.

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