

An Interview with Kandice Tanner

By David Zierler

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ZIERLER: Okay. It is March 18, 2020. This is David Zierler, oral historian for the American Institute of Physics. It is my great pleasure to be here at the NCI with Dr. Kandice Tanner. Dr. Tanner, can you tell us your job title and your affiliation here at the NIH?

TANNER: I'm currently a Stadtman investigator. Here the investigator is the equivalent of a tenure-track position at the National Cancer Institute. I also hold adjunct assistant professor at University of Maryland College Park.

ZIERLER: Okay. All right. So let's start right at the beginning. Tell me about your birthplace and your family, early years.

TANNER: So if one tunes into this oral history, I want it recognized that I don't have an American accent. I was born in Trinidad and Tobago, which is a small island off the coast of-- Well, it's a twin island off the coast of Venezuela in the Caribbean. I grew up... I went to school there, so I did all my matriculation from kindergarten, primary school. We follow a British sort of type of curriculum, and so essentially I completed the equivalent of secondary school years there before I came to the US to pursue my undergraduate and graduate degrees.

Now in terms of background, my father was an engineer. My mother actually stayed home with me for seven years before she went into the workplace. I have a younger brother, and I would say for the most part that education was always encouraged in school. Now when people say that all their life they knew they were going to be a physicist, that's not the case where I'm

concerned. All my life my mother knew I was going to be a physicist, and that's how I ended up in the field.

ZIERLER: Your mother knew you were going to be a physicist.

TANNER: My mother, yes. It wasn't my father; it was my mother who decided that I would do physics. But you know, physics was the endpoint. How the system is set up in Trinidad is that you have to do a very competitive exam at 11 years old to get into secondary school, so it's not that... If I could liken it to the US, from what I understand, here you get allocated a school based on where you live.

ZIERLER: Mm-hmm [yes].

TANNER: In Trinidad, at primary school—so primary school is from about 5 to 11 years old—you are not forced to go to a particular primary school. You could also pay to go to a private primary school. But essentially how secondary school assignments are determined is by this national exam that you take. You break it down into English, math, creative writing, and science. So based on your placement in this exam, then you get assigned schools.

ZIERLER: Now what kind of engineer was your father?

TANNER: I would say he was a more manufacturing engineer because he worked on like plants where he would build the instruments and service them and then become like a plant manager. So if I could...because it's kind of weird. He's a mix between, I would say, electrical and mechanical engineering, but I would say more mechanical than electrical.

ZIERLER: And did he do his education in Trinidad and Tobago?

TANNER: Yes, he did.

ZIERLER: Now you say your mother was the one who decided that you would go into physics. At what point did she encourage you in that direction?

TANNER: So when I got to secondary school, I didn't know exactly what I wanted to do. I was good in math, so I remember I placed... I was a top math student when I was 11 based on this exam that we took.

ZIERLER: And this is a coed school, boys and girls?

TANNER: No. So that's an interesting point that you bring up. I went to an all-girls' school up until my A levels when I went to the all-boys school so that I could do further math.

ZIERLER: You went to an all-boys' school...

TANNER: I went to an all-boys' school.

ZIERLER: ...because that's where you placed into. I mean that's...

TANNER: I placed into girls' school for up until Cambridge levels, but then A levels, the advanced levels, this is where you really specialize into what you're going to do for university.

ZIERLER: Right.

TANNER: And I wanted to do physics, maths, and further maths, and that further math was not offered at my girls' school. So I had to go to the boy school to do it. So the boys' school allowed six girls to come to there.

ZIERLER: Six out of how many?

TANNER: 1,200.

ZIERLER: Oh my goodness!

TANNER: Right. So it was definitely eye-opening to go from an all-female environment to an all-male environment.

ZIERLER: Now did those six girls band together or not necessarily?

TANNER: Not particularly. I think we split three and three, you know? Some were more interested in actually dating the guys, and I did not fall into that category. In fact, I think I was

more tomboyish, so up to now, most of my friends from that year... You know, they say that I am still the same person 20 years later.

ZIERLER: What message did you take away from the fact that your talents and aptitude could not be met in a girls' environment?

TANNER: I think that, you know, it really came down not so much from that it was a difference between aptitude in male and female students. It was more so about which schools had the best resources, and that particular boy school that I went to historically had had the best resources. One could say that's a leftover from colonial days when they probably focused on the physical sciences for...or I would say quantitative sciences more for boys versus girls. But I would say that the girls' school that I went to was highly competitive. We also won scholarships. In fact, the boys' school made us switch over to become full-fledged pupils of the boys' school because the girls would come and win the scholarships, but then the girls' school would get credit. The female school would get the credit and not the boy school, and they got sick and fed up with that, like, "Okay, no. You're not coming to take our classes and then go back."

ZIERLER: Right.

TANNER: "You're going to be associated with us so when scholarship list comes down, we get credit instead of your girls' school," right?

ZIERLER: Right.

TANNER: But I would say that, you know, there is less of that of, like, "Boys do this and girls do that" in Trinidad. I think, quite frankly, the girls outperform the boys until maybe university when it starts to...when the boys catch up.

ZIERLER: Now being in such a minority, did you find that to be an advantage or a disadvantage or it depended on the situation?

TANNER: I think that my personality back then—I've mellowed out quite a bit since then, you know? When I went to the girls' school, we had been trained. In fact, I spoke to my mother this morning. She was complaining about how I changed when I went to that girls' school, how I was much more submissive, right? [Laughs] I was quieter, you know, meek, and that when I went there, I turned into this lioness. It's really because that particular school that I went to really told us that we were the best every day, and you know, it's sort of like a cult. It's hard to explain because I don't see that type of environment when I came to the US. So I don't want to give it off as if it's a negative point of view, but it reinforced in all of us that we were special. Now I don't know if you could call it brainwashing—whatever you want to call it—but there's a reason why the woman from that particular school runs the country. Like the current president of Trinidad and Tobago, the first female president attended the same high school, and if you go through any of the top female leaders, they also come from that school. So right or wrong, whatever diet they fed us—or what do they say, ambrosia?—whatever they gave us made us very much... They gave us some leadership skills, I would say.

ZIERLER: So it sounds like you did put it to your advantage.

TANNER: Yes. So when I went there, I was ruling the boys in some ways. I mean it was not as if I was subservient to them or anything.

ZIERLER: And you didn't feel shy about raising your hand in class or anything like that.

TANNER: No. In fact, they used to call me Killer K because I had no problem... I had no problem... [Laughs]

ZIERLER: Asserting yourself.

TANNER: Not only that, you know, we would have physical fights because the guys would fight each other and then they'd think they could... And we had another girl who is actually a

Harvard-trained now radiation oncologist. She also came from the same secondary school. We would not back down. We would fight back, so in some ways we gained their respect. So they didn't look at us as girls anymore, right?

ZIERLER: Right.

TANNER: And they still don't. But I would say that being in that environment also told me that I could survive when I came to the US because physics in the US is so male-dominated that I'd like to think that if I'd not gone through that, I probably would have been more susceptible to the gender imbalance when I came to the US.

ZIERLER: It served you well in that regard.

TANNER: It definitely served me well. I could say that every stage on my career was sort of defined by those two years that I went to that boys' school.

ZIERLER: Now when you entered, were you specifically on a math and science track, or was it just exposed to everything?

TANNER: No. So at A levels, you only do three subjects, plus general paper, and the reasoning behind that is that you are now becoming specialized to what you intend to pursue at university.

ZIERLER: Okay.

TANNER: So if I had stayed in Trinidad to go to University of West Indies, I would have gone to... I would have been eligible only for engineering track or medicine, but even not medicine because I had not done chemistry and biology at A levels.

ZIERLER: Right.

TANNER: So it's less flexible than the US because here you could change your major. You could do English as an undergrad and then go to med school. You cannot do that in our system.

ZIERLER: So you have to make up your career decisions a lot earlier in life.

TANNER: At 14. So that's why my mother came into play, right?

ZIERLER: Aha. So of all the things that you were good at, why physics? What did she see in physics for you?

TANNER: I was good in languages and science, and I didn't want to be a medical doctor. At least that much I knew I didn't want to be, and in Trinidad, you know, parents push you to go into either medicine or engineering because it's the highest-paying jobs, right, and I didn't want to do medicine. But I liked languages, I was good in science, and so forth. So my mother made a deal and she said, "Look. Anybody could do languages outside," because you could go to a language school, but to have access to the real lab classes, that wasn't available in all schools, and my school had at least the lab requirements of physics, chemistry, and biology. So she made that deal. She was like, "Look. If you focus on science and you hate it, I will pay for you to go and do languages afterwards," so that was the deal that she made, and that was it.

ZIERLER: But that was sciences generally.

TANNER: Right. But I was good in math, so physics came easy, right, because back then physics is just applied math. So that's essentially how I filtered down. So by the time I got my results—and again, I could have done either one. My teachers wanted me to actually do languages because they wanted a scholarship that year in languages. You know, again, my mother was like, "That's not your problem. You're going to go to the boys' school." So she decided, again, I was going to go to the boys' school.

ZIERLER: She had very strong opinions about your education. I wonder if she was thinking about her own experiences when she was your age, things that were maybe available to her or not available to her?

TANNER: I don't know. I think that... It sounds as if she's dominant, but that's how our parents are, right?

ZIERLER: Yeah.

TANNER: I think it's a Caribbean trait, parents in the Caribbean are very definitive in playing a role in shaping their children's lives.

ZIERLER: Yeah. I wonder if culturally you could speak... I mean in this country, the idea of having a serious conversation with a 14-year-old about what track they're going to be on for a career is usually unheard of, so what is it about sort of the Trinidad and Tobago culture where that's a normal course of events?

TANNER: Because you don't have enough spaces for everyone, right? So out of the 2,000 or so students that do the national exam at 11, the types of schools that I went to, there are very few slots, so it's only a high-- Like the girls' school I went to has only ~100 slots.

ZIERLER: Right.

TANNER: Everybody wants their children to go to those schools, right? So if it that--

ZIERLER: It's competitive from the beginning.

TANNER: It's competitive. So you maybe assume that 50%, roughly 1,000 girls, 1,000 boys, you only have 100 slots for... There are probably like maybe 12 or so they call the prestige schools, and you don't have space for everyone to get in. So that's why everybody wants their children to get into that school. Then once you get into those schools, there are not enough spaces for physics labs, so even if you want to do physics, if you don't have the grades, you can't do physics because there aren't enough for the 100 students. I mean I think they've gotten better since I was in school, but you were always being triaged, so people knew that from the get-go. So it's a highly competitive environment, and even though it sounds barbaric, like they print

your primary school results at 11, so everyone knows what school you're assigned. For me, children used to have like panic attacks because how you found out your results were not private when I was growing up. It was that the principal called the entire school assembly, and then she would read out your results in front of everyone. In fact, I was so afraid because I wanted to get in a school so badly that I wasn't there. I went with my friends to the mall. My mother found out what school I was assigned to because her cousin worked next door to the school and could hear it on the intercom. So she called my mother who called my father, and by the time I came back, my father came and like flung me up in the air because it's seen as a prestige thing in Trinidad. It's seen as this... Like you know when your daughter or your son goes to these types of schools, it's as if you did such a good job. And I guess it's the equivalent of saying if your child... You know, there is a distinction like if your child goes to Harvard or something like that, so it's seen as like some...

ZIERLER: Yeah. But this is at the high school level, not at the college level

TANNER: Exactly. It's at the high school level, right.

ZIERLER: Amazing.

TANNER: But it has its advantages and disadvantages in the sense that if your child does not access to certain extra lessons, because people pay to do extra lessons, and so for to be extra competitive for this exam and so forth, then you get left behind, right? Not everyone blossoms early.

ZIERLER: Now socioeconomically, these elite schools, are they available to basically everybody in the country, or are they really more for the middle and upper class families?

TANNER: Theoretically, they are.

ZIERLER: For everybody.

TANNER: But the reality is that it's really mostly the upper class and the upper middle class go there.

ZIERLER: How strong were the class divides in your view when you were growing up? Very clear?

TANNER: Yeah. I mean Trinidad is a very much class-oriented society. It's not racism, per se; it's class. I always tell people, "We don't particularly care what you look like as long as you have money." But I would say that it's easier to move between classes once you get into the system. So if you come from a lower class and you get into these types of schools, it's easier. Now you're socializing with that class and it carries through the rest of your life.

ZIERLER: Right. How did you see...or your parents, how did they see themselves in that system? Upper class, upper middle class?

TANNER: Well, I would say that I would go back and forth because my parents got divorced, right, it depended on which parent I stayed with.

ZIERLER: Because they had different-looking standards.

TANNER: Well, they had different incomes, right? But having said that, I wasn't different from everyone else.

ZIERLER: Okay. All right. So toward the end of your high school experience, are you thinking at this point that you're going to go to the United States, or how does that happen?

TANNER: Nope. I had no desire to come here. I had none. As I said, I was very content. I had everything. I had like, you know... According to my mother, I had a ton of fun. She used to complain that I wasn't focused.

ZIERLER: But you kept your grades up, too.

TANNER: I had kept my grades up and everything, but I had no desire. I was very much, you know, involved in lots of activities.

ZIERLER: To the extent you were thinking about it, the assumption was you would stay at university at home.

TANNER: Yeah. I had already gone. I had already applied. I got in for my first choice. I was going to do mechanical engineering at University of West Indies, but what happened is back then, the US embassy would have a college fair. I had taken the SATs with my classmates, as it was common in the school I went to.

ZIERLER: It doesn't actually play a role in admissions?

TANNER: No. To get into University of West Indies in Trinidad or Cave Hill or whatever, Jamaica, whichever campus your particular field of study is, has to do with your A levels, what subjects you took, and what grades you have. That's it, and then they will rank. Based on how many slots are available and the way your grades lie, where the cutoff was, then you would get in. That's it. So they'll ask you, "Put first, second choice, third choice." Say like you want to do engineering. They'll do blah, blah, blah, and then if you get ranked for a first choice, then you get your first choice and so forth. But it has nothing to do with SATs.

But anyway, so my school sent me, sent the class to go to the American embassy as an outing. There was a woman from South Carolina State there.

ZIERLER: But the school was not Catholic.

TANNER: The school was Catholic.

ZIERLER: Oh, the school was Catholic.

TANNER: Yeah. They call them denominational schools where it's assisted by one given religious body, by the government also funds. So I went to an Anglican school for the girl school and then went to a Catholic school for the boy school.

ZIERLER: So the church and state divide is a little different there. There is state support for religious schools.

TANNER: Yes, some state support. So that goes back to... When you said like if it's available to everyone.

ZIERLER: Right.

TANNER: So 20% of the... If you go to those types of, I would say, religious-associated schools, 20% of the admission has to be of a given religion, either Catholic or whatever. That's the way of what I would call the not-so-smart upper class people to actually get in [?].

ZIERLER: Yeah, mm-hmm [yes]. The back door entrance.

TANNER: Back door. Okay. But we knew who they were and they... [Laughs] So sometimes, especially at girls' school, we would say, "You only got here because of..." Right? [Chuckles] And boys' school, same thing. We'd be like, "Yeah, we know you're not that smart. You only got here because of..." So in some ways it backfired on them.

ZIERLER: And your family was Catholic?

TANNER: No, no. We were Anglican. So when I went to Catholic school, I didn't... I was excused from the mandatory religious training for the Catholics. So they didn't force you. So we had a free period then.

ZIERLER: And your other physics teacher? You said you had two really...

TANNER: And then... So I did extra lessons. So I had normal and then I'd go to Mr. Bahal. He was a teacher at another school, and you paid him money and he would teach you...

ZIERLER: Above and beyond.

TANNER: Above and beyond. So those two people were instrumental. Both of them were excellent, one in that Father Lai Fook, we had to derive everything from scratch and if there was a mistake... So I went from getting like 100% to 0 in his class. [Laughs] At first it was traumatic because you know...

ZIERLER: Yeah. You thought you were really good this whole time.

TANNER: Yeah, but he would just... Even if you got the right answer, he would say you did things “the unintelligent way.” [Laughs] So even if you got it right, he would say this was unintelligent and you would get a zero.

ZIERLER: This probably served you really well in the long term.

TANNER: Exactly. Exactly, but back then it was traumatic because I’m like how do I go home and explain to my mother that I have an average of like 10% now? [Laughing]

ZIERLER: Right. Right.

TANNER: But it was only... Like it took me about a year to come to terms with “Actually, no. I’m learning a lot from this man,” right, because to sit down with a genius like that is like it really stretches you.

ZIERLER: Where was his training?

TANNER: He did his training in Oxford, I believe (England). He was also some genius back then, and then he was trained old-school, you know? So he brought it for us. You know, after a while, the same girl that I talk about, we were like, “Wait. Hold on.” Then he realized that we responded to him and then he would come and give us more attention. We still got... I probably never got more than 20% out of Father Lai Fook’s class up to this day.

ZIERLER: Out of 100.

TANNER: Out of 100.

ZIERLER: Oh, boy!

TANNER: But 20 was still like a high point for me because I went from zero! [Laughs] So it was still like, “Whoa!” because in his mind it was the inefficient way of doing this problem because--

ZIERLER: What kind of physics was he teaching you?

TANNER: No, he was teaching math.

ZIERLER: Oh, math. Just math.

TANNER: He wasn't teaching physics. So it would be that say you take four pages—I mean like four to work on the solution. He would go and do it on the board in three lines. So if you couldn't get to his level, you get a zero. [Laughs]

ZIERLER: Wow! High expectations.

TANNER: Yes! Extremely high expectations. Anyway, having said that, it was very useful.

ZIERLER: So let's get back to this fateful day at the US embassy where you met this rep from South Carolina.

TANNER: Yeah. So I was about to leave and this woman was like, “Hey! Are you interested?” I was like, “No,” and she's like, “Well, do you have five minutes?” I didn't want to be rude because I was like, “She did ask me just for five minutes.” She's like, “What's your SAT score?” and I told her. Then she's like, “Oh, I'll give you a full scholarship to come to South Carolina State,” and I'm like, “Yeah. Okay, fine. Whatever.” So she was like, “Come back tomorrow.” I was there with another girl from the class and I was like...and she told both of us to come back the next day. I'm like, “Yeah, whatever.” So I didn't pay it any mind, but that girl used to get a ride with us, with my mother, used to drop her. She mentioned it to my mother and my mother is

like, “Well, why didn't you tell me?” I’m like, “Because I don't want to go.” You know, who says that? That sounds like a gimmick to me.

ZIERLER: Yeah.

TANNER: And my mother was like, “Well, just show up.” So my mother and I and the same girl and her parents showed up the next day, filled out the form, because I think she really wanted to see like if our scores were what we told her. Then two weeks later a FedEx package came and I had a scholarship from...

ZIERLER: Wow.

TANNER: So that was it. I still didn't want to go, and again, my mother, she’s like, “Look. Defer your placement in university for a year, and if you don't like it after a year, you can come back home,” and that was it.

ZIERLER: Now did you have any concept at this point of what a historically black college was?

TANNER: Absolutely not. No. It was a shock. I mean now in hindsight I understand why you need to have it, given the racial unrest at this country. I didn't expect it.

ZIERLER: Yeah, which might also suggest you probably didn't have an appreciation of American history in general so much...

TANNER: I mean, we studied American history and that. Like I knew about the Stamp Act and what the Boston Tea Party and that kind of stuff, so I knew about the American Revolution.

ZIERLER: Right.

TANNER: I mean I wasn't naïve to think like interracial relationships here were like supreme or whatever, but I didn't think it was so embedded in the...because I know *Brown v. Board* [*Brown v. Board of Education of Topeka*] and stuff like that. So I assumed that a state school would not...because as a state school, right, would have some minimum standards.

ZIERLER: Right, and this is 1998. It's not 1898.

TANNER: Right. So I'm thinking that it should have some bare minimum. I had zero appreciation for the divide, right, and it was simply an eye-opening experience.

ZIERLER: Did you think that by coming to the United States that there might be career opportunities that wouldn't otherwise be available?

TANNER: No, I had no...

ZIERLER: It wasn't like that.

TANNER: I had no... So most of my friends came to school and used to go to Canada. We didn't come here to stay. It's just you go get your education. If you choose to go abroad and you go back home...

ZIERLER: Right. And you didn't look at any other schools. This was just they offered you the scholarship and that was it.

TANNER: Yeah. I had no—because I had zero interest.

ZIERLER: Yeah.

TANNER: Right? Again, my mother was like, "Well, just go see. At least you'll say you left."

ZIERLER: Had you been to the US before?

TANNER: No. That was my first time to the US.

ZIERLER: And no family here? Nothing like that.

TANNER: I have my grandmother's sister... Well, back then she lived full time in New York, but now she spends winters in Trinidad. So my parents came to shop, but they left us behind. So no, I had never been. This was my first time in the US and a small town.

ZIERLER: So you fly in, you land...

TANNER: I'm not a crying person. When my mother left me, I cried like a baby because I was like, "What hellhole am I in?" I've never seen that level of poverty in my life. I was just like, "Oh my god. This is awful." But anyway, I came with my friends from high school because the woman recruited 25 of us.

ZIERLER: Right.

TANNER: Well, not all of us were from the same high school, but a few of us, like my really good friends. We're still friends up to this day. So at least I had friends. If I had no friends, I probably would have left.

ZIERLER: Now when you got to campus, socially how were you regarded?

TANNER: We didn't interact.

ZIERLER: You didn't.

TANNER: No. We didn't interact with the others until maybe my sophomore or junior year.

ZIERLER: And that was going both ways? People didn't want to interact with you and vice versa?

TANNER: They thought we were arrogant, and we probably were, you know.

ZIERLER: There's a larger context.

TANNER: And we were incredibly privileged. I think it dawned on me when I went... I used to volunteer in a school after, like after school or whatever, and I just walked around. I asked the students. They were like maybe ten years old, and I said, "Hey, what do you all want to be when you grow up?" and everyone was like, "I want to be a truck driver. I want to be a football player. I want to be..." and I'm just like...

ZIERLER: Yeah. Different mindset.

TANNER: I'm like... I asked the student who said-- "Why do you want to be a truck driver?" He's like, "Well, they told me that I'm bad, and this is all I could do and at least I'll make money." In my mind, I'm like, "Who told you, you were bad at ten and it sunk in?" So that's when I understood that being black in this country as a child, in some ways you're not really encouraged to do...to be excellent. Or you're pigeonholed into like being an athlete or performer or something like that. Again, these are perfectly good routes, but these are not the only routes. That to me was mind-blowing and that's when I realized that when we—meaning like my friends and I who came from a country where we didn't have to define ourselves by what we looked like... I mean I'm not saying that we're perfect and that we don't have our own issues, but that definitely--

ZIERLER: You probably didn't think about race that much growing up, right?

TANNER: I mean I think we thought about race to the extent that we knew we were black, you know, so we were very much black. It wasn't as if we didn't identify with our race; it's just that it wasn't a factor in terms of our success to some extent, right?

ZIERLER: There wasn't a dual identity probably in this country, like you can be American and also African American. You probably didn't have that.

TANNER: No. They've only started that recently in Trinidad, I would say, in the last few years. But growing up, no, it wasn't. I can't say that it affected my ability to perform or do well or be perceived, right, so I would say that... Here it's institutionalized and here it starts early. They destroy kids early here.

ZIERLER: Did you ever get the sense why South Carolina State recruited so aggressively from your country?

TANNER: So because our SAT scores. Apparently, in order to continue receiving state funding, they had to show an average of a given SAT score, so they--

ZIERLER: Oh. So your group just bumped the whole thing up.

TANNER: Just bumped it up, yeah. Yeah.

ZIERLER: What was your sense of the quality of the education?

TANNER: We had a professor from... She's a Latina. She did her PhD in Berkeley in physics. She went to MIT. No. Undergrad, Berkeley; physics PhD, MIT physics. She taught us extra separate from the group.

ZIERLER: But you stuck it out. I mean you finished. You finished at South Carolina State. You did all four years.

TANNER: Yeah, yeah. But the thing is that, you know, I only came into my end of junior year, senior year, so she basically taught us everything in that. So we would stay after class and she would give us extra separate from the others.

ZIERLER: Right. Was your major physics?

TANNER: I only went into physics because the best school that I got into was a physics school. I didn't get into a good engineering school.

ZIERLER: Which was what?

TANNER: I wanted to go to Georgia Tech.

ZIERLER: So you graduate and then what are you thinking? What's your next move?

TANNER: Well, again... [Chuckles] You know, you can see that my life is "again." There's always going to be "again," you know? Again...

ZIERLER: [Chuckles] You could go back home, right? This is an option for you?

TANNER: Yeah, but at that point in time, I decided I want to do my graduate work. I said that I would go home and be a professor, but I would get my degree and go home. So again, my mother decides, “Now which...” because I applied to engineering schools and I applied to physics schools. But I only applied to a few physics schools. I had done research at North Carolina State over the summer, and I was only exposed to condensed matter physics. I had a project there, and I was like, “I’m going to go there.” I liked the professor I worked with. The project was working. I’m just going to go there. So I think I only applied to that physics school. I applied to four engineering schools, and I got into... I didn't get into Georgia Tech, but I got into Clemson, something else, something else. So I was like, “Well, look. I’m just going to go physics. I enjoy the research. I’m going to do a PhD in physics.”

ZIERLER: So physics was kind of the fallback for you.

TANNER: It’s like I enjoy the research, you know? That’s when I realized I was research-driven. I enjoy the research. I used to go in... Even as a summer student, I used to be in the lab all the time on the weekend and then the advisor would come in. He’d be like, “Why are you here?” you know? I’m like, “I’m running my experiments,” you know? So obviously he was like... Now I understand why he was excited when I was like, “Okay, I’ll come back.” He was like, “Yeah, yeah, yeah. Sure!” I didn't understand how rare it is to get a student, summer student who come on the weekends willingly, right? But that’s how I was. I was always in the lab. I loved research, and so I was like, “I like the advisor. I like the lab environment. I’m going to come here.”

ZIERLER: So at this early stage you knew it was more applied physics that you were interested in, not theoretical.

TANNER: Yeah. I was never interested in theory. Never. Never. That much I knew. That much I knew. When I did group theory when I was in further math, I was like, “Why in hell am I doing this?”

ZIERLER: I mean it makes sense if you also had the interest in engineering that you would have the applied physics...

TANNER: Yeah. There was some math and so I was like, “Okay, fine. Yeah. Why do I care about this?” So even then I was just like, “Okay. Yeah, I’ll do it.” I could solve it, but I was like, “I don't particularly care about it.”

ZIERLER: Right.

TANNER: Anyway, so I...

ZIERLER: University of Illinois. This is where it ends.

TANNER: No! I commit to North Carolina State, right?

ZIERLER: Oh, okay. Right.

TANNER: And then there used to be an annual conference that the National Society of Black Physicists would have, and my school used to drive there. I go there again minding my business, and my friend, another Trinidad guy, he was obsessed with Urbana-Champaign. Everything in his... He was obsessed. Everything was Urbana-Champaign, Urbana-Champaign for him and I used to be like, “Oh, get away with your Urbana-Champaign!” because I was going to a nuclear engineering program that I dropped out of because I had to go to UW-Madison. They sent me there during wintertime and I was like, “Oh my god! This is awful! This is so cold!” [Laughter]

ZIERLER: Madison in the winter is about as cold as it gets! [Laughs]

ZIERLER: Well, we’ll get to that. You’re still young at this point.

TANNER: Yeah! I was incredibly young, too, you know?

ZIERLER: Sure.

TANNER: I was like, “Oh my god! This is so cold!” Then the thing is I didn't know how to dress for winter, so you know... [Laughter] So I had all the wrong clothes. I didn't have a hat or gloves, and I was dying of a cold and I'm like, “I can't live here.” But anyway, long story short, there's another Trinidadian guy who introduced him to this professor from Trinidad at Urbana-Champaign, and he was looking for students to recruit. So he spoke to my friend who was obsessed with Urbana-Champaign and asked when he was graduating.

ZIERLER: Who was this professor?

TANNER: This is Philip Phillips. He's like, “No, I'm not graduating, but she is.” He sends me over and he asked me... He asked me a question, you know, some quantum mechanics question. Like this is now 12:00 in the morning, okay?

ZIERLER: 12:00 in the morning? What's going on?

TANNER: They used to have this party and everybody... The fact is everywhere, we just stand there. You know, even when the party was done, then stand around. This is 12:00 in the morning and this man is asking me a quantum mechanics problem. I don't know. I guess I solved it very sufficiently because I was like...and then he's like, “What school are you going to?” I said, “I'm going to go to North Carolina State.” He's like, “You should come to Urbana-Champaign if you're going to do condensed matter physics because we're number one.” I was like, “Yeah, yeah, yeah. Fine.” Then I came back and my mother spoke to the people at university because they're like-- Remember I'm going to go back home.

ZIERLER: Right.

TANNER: Back then, there was an agreement with University of West Indies and Urbana-Champaign, so her friends advised her to send me to UIUC.

ZIERLER: Yeah. For sure.

TANNER: So they're like, "Send her to Urbana-Champaign. Tell her." So even though I committed to go to North Carolina State, I emailed them and said, "I'm sorry. I'm going to go to Urbana-Champaign."

ZIERLER: There's an interesting divide here because as a 13-year-old, 14-year-old, you seem to be hyper-focused on the quality of the school that you get into, and here you're totally oblivious to the distinctions...

TANNER: Totally.

ZIERLER: ...between North Carolina State and University--

TANNER: Urbana-Champaign.

ZIERLER: I mean it's a world-class physics department. Why were you so disconnected from these distinctions, do you think?

TANNER: Because I think that if you are not advised correctly, you just go with what you're exposed to. As a foreign student, even when I went to the annual physics conference and asked for...like the ability to work in labs, I couldn't work in any lab because-- They'd get super excited when they saw my GPA and everything, But then when I'm not a green card holder or a citizen, I can't.

ZIERLER: Right.

TANNER: So for me to get to North Carolina State, they gave me the opportunity. They had to find soft funds to pay for me to go.

ZIERLER: And you probably felt a degree of loyalty because they wanted to work with you.

TANNER: Exactly! It was some level...and on top of that, he found money for me to come.

Everyone else was like, "Oh, I'm so sorry," and that was it, right?

ZIERLER: Right. Right.

TANNER: So it goes back to like even like I... I have a precedence as an undergrad, and I did 90% of the work. I didn't even understand that because the professor asked me, "Okay. Well..." to decide authorship, and I said, "Oh. Well, let's do alphabetical," right? [Laughs] And the person who is the first author on that proceeding didn't even show up for the summer, right? But that's how clueless I was back then, right? Again, it comes back to what type of exposure you have. Yes, I had educated friends and like my family members and stuff, but no one was in academia in the US. No one understood.

ZIERLER: Right. Right.

TANNER: So there was very little guidance in terms of what defined...like what you should look for if this is the type of career trajectory you want to pursue.

ZIERLER: Now when you got to Illinois, at what point did you realize this is the big leagues, this is really different?

TANNER: Day one.

ZIERLER: Day one.

TANNER: Day one.

ZIERLER: What happened on day one?

TANNER: I mean it's just that when they started the coursework, I was like, "Okay..." I saw the syllabus and I'm like, "Oh, they're going to complete the book."

ZIERLER: Yeah.

TANNER: I got this discipline that I didn't know.

ZIERLER: Right. No room for that anymore.

TANNER: No. Not only that, I had a discipline now because I had never failed in my life, and I was like, “I’m not going to fail now.” So just whatever, and again, going back to the training I had at the girls’ school and everything, I was like, “I am not going to flunk out,” and that was it.

ZIERLER: Yeah. Now coming to Illinois, which is just a state school, what kind of diversity was there among the graduate students?

TANNER: There were no black students.

ZIERLER: No black students.

TANNER: No. I was the second. That’s how it was, so I was the second guinea pig.

ZIERLER: Yeah. At what point did you connect with Enrico Gratton?

TANNER: So I actually... So the good thing about Urbana-Champaign is that they offer... The first year you teach, right? Everyone has to teach.

ZIERLER: Intro physics 101?

TANNER: You teach whatever you feel comfortable, so I taught 101 and 102. So I taught the premed students. The good thing about that is that then the first semester they have the seminar series where professors who are looking for students give an overview of their lab like every Friday. I think that’s when the seminar was. Then you have like a match process. Like you choose who you want. They choose who they like based on, you know, when you meet with them, and then the department head will do like a sort of match-up to see who you match with and that’s how you started. So I, again, was not exposed to biophysics. I knew condensed matter physics, so I was torn between Gratton and John Weaver . He was the chair of the material science. I. But then I was like, “You know what? Let me stick with what I know.” So even though Gratton wanted me, I ended up going with material science because I was like, “Let me just stick with what I know.” I spent the summer there, and the project I wanted to do with him,

it was a scanning tunneling microscope. There were like four graduate students in line waiting to get on this project, so I was like, “Okay, I’m...”

ZIERLER: Yeah.

TANNER: Then there was another project where he was using TEM to characterize these complex hybrid materials. So I’m there assigned to this guy, and I’m like, “Okay. So we’re just depositing these materials and then looking at them with TEM. Okay, so what are we going to do next?” He’s like, “Oh, we’re going to go down the periodic table,” and I was like, “God. There is no way in hell that I’m going to do this for my PhD.”

ZIERLER: Why not? Too daunting?

TANNER: It was boring as hell. Right? Because I really wanted to do the STM project, right?

ZIERLER: Why? What was exciting about that to you?

TANNER: To me it was new, novel physics. The material characterization was different. I could see more of an application. You know, just randomly going down the periodic table didn't seem like any thought process to me, and I was like, “Uh...” Then I kept on thinking, “You enjoyed the biophysics.” I went to the department head. I’m like, “Hey, I want to switch,” so He’s like, “Well, you could go to somebody else in materials.” Well, I was like, “No, I’m going to switch to Gratton’s lab,” and he said to me, “We didn't bring you here to do biophysics. People who can't do physics do biophysics.”

ZIERLER: Oh, ouch.

TANNER: So he’s like, “Go back and think about it and then come back in a month,” you know? I came back in a month and I was like, “Yeah, I’m going to switch to Gratton’s lab.”

ZIERLER: What do you think he meant when he says people who can't do physics do biophysics?

TANNER: I mean he... In most physics departments back then, you know, it was a clear hierarchy. The theorists were top, the theoretical, and then... Let me clarify. The theoretical condensed matter physics was on top, then the other theorists, and then the experimental condensed matter physics, and then the people who did high-energy physics. I mean there's this whole hierarchy, and then, you know, they didn't consider biophysics physics back then, except for a couple of people and basically people who they respected are the ones who did more from a statistical mechanics point of view, right?

ZIERLER: Right.

TANNER: So they wouldn't even call it like biophysics. They'd call it nonlinear stat mech or something like that.

ZIERLER: What was Gratton's research focus at this point?

TANNER: So he had two labs. He was doing mostly the fluorescence-based or fluctuation-based spectroscopy methods, and then what I did my PhD on was the photon migration [???] light transport in thick tissues. So in their mind, they were like, "This is not physics. This is more biology."

ZIERLER: Yeah. What was your biology background like?

TANNER: Zero. I had zero because remember, I had...

ZIERLER: Right!

TANNER: I had zero.

ZIERLER: So you were learning on the fly? Were you teaching yourself out of textbooks? How did you gain literacy in biology?

TANNER: I read a lot of papers. You know, I read a lot.

ZIERLER: What was Gratton's background?

TANNER: He actually was trained as a theoretical physicist. [Chuckles] So he also had no biology background. [Laughter] So it was comforting.

ZIERLER: And at this point... I mean, ultimately we're leading to the NIH.

TANNER: Right.

ZIERLER: Was there something about biophysics particularly of your interest in engineering and applied physics that you thought, "This is really something that I can apply ultimately to help people"? Was that part of the thinking at this point?

TANNER: For me, it just had to make sense. You know, I just couldn't deal with the abstract. I couldn't just deal with character-- Even when I was in condensed matter, the reason why I wanted the STM project is because I could see the applications in terms of being able to look at novel materials that are like for TVs or stuff like that or something like that. I could see there was like some long-term application. So for me, it's not about understanding physics alone. It's like how could I push it somewhere else, you know?

ZIERLER: Yeah.

TANNER: But I would say the switch to human health only really came like when I was starting my post-doc. I'm like, "Look. If I'm going to do this, let me at least work on a problem that may be useful."

ZIERLER: Right. Yeah.

TANNER: But that was not there when I started with Gratton.

ZIERLER: Do you remember the title of your dissertation?

TANNER: Yes, actually, because back then I had... As I said I've... But you have to understand like I defended a month after my 26th birthday, I had this sense of humor back then. I did my thesis work on a cat, a living cat, so I called it "Catology." [Laughter] It was spectral...some

deconvolution of spectral photonics of a mammalian brain, photonics, something like that. But it was “Catology,” you know?

ZIERLER: Right, right.

TANNER: I dedicated the thesis, my dissertation, to the cat and my mother, so that should tell you...

ZIERLER: In that order. [Laughing]

TANNER: I think so! I mean the cat had to give up time. [Laughs] I couldn't graduate without the cat.

ZIERLER: Who was on your committee?

TANNER: So Paul Selvin was the chair of the committee.

ZIERLER: Oh, not Gratton.

TANNER: Gratton advises, not the chair, at Urbana-Champaign. He's just there for, I guess, like a defense lawyer, but not really...

ZIERLER: Right. [Laughs]

TANNER: But he has no voting power. So Selvin was the chair. Philip Phillips actually was the theorist because you had to have a theorist. I had an outside person because I did more neuroscience, so Monica Fabiani, she was a neuroscientist, as the outsider. I'm trying to remember who was the fourth. I think the chair of the department who told me... He was on that committee to make sure, right?

ZIERLER: Mm-hmm [yes].

TANNER: But to follow up to not make it seem as if he was like a complete asshole, he did come back and say, “I now understand why you switched,” and he was like, “If I had to start in physics, that's probably... I would probably do biophysics now because you have more

opportunities there.” I actually had a good relationship with him, we were always transparent with each other and I valued that immensely.

ZIERLER: That’s great.

TANNER: So he turned--

ZIERLER: So maybe you taught him a bit of a lesson there.

TANNER: Yeah, because I think in some ways, biology has so much physics that we need to uncover, right?

ZIERLER: Right.

TANNER: We’re not even... We don't even understand... We’re at the tip of the iceberg with that.

ZIERLER: Right.

TANNER: So to me, it’s a shame that we don't get more, I would say, like hard-core physicists into biology now because that’s what we need.

ZIERLER: Right. What did you understand as your contribution to the field with your dissertation?

TANNER: I think one of the aspects was really being able to go into this non-diffusive regime. We were using a lot of the mathematics that had been applied—Boltzmann transport equation—and if you look at how energy is dissipated in stars from the core to the outside, it’s a very restricted part of, oh, I would say, space that we’re able to solve this particular equation, right? We were applying it for understanding how light is transported in the brain. One of the major problems with being able to solve these equations is that we do not understand the paths of the photons as they travel before we detect them, so meaning that the absorption and scattering

processes between collisions, so before it gets absorbed or gets scattered, in terms of understanding these mean parts in tissues that you don't understand the properties to begin with.

ZIERLER: Right.

TANNER: We can only have this sort of like approximation because diffusion approximation, assuming that the photons are fully randomized before detection, and then you could solve it.

ZIERLER: Yeah.

TANNER: Based on the size in terms of between detection apparatus and, I would say, the source, in order to be able to look at the temporal and length [?] scales associated with neuronal activation, we simply could not apply that diffusion approximation.

ZIERLER: That was a technological shortcoming or a theoretical shortcoming?

TANNER: That was simply a physical because simply if you place detectors...because we were looking at it in, I would say, a transmission...not transmission, but like this, side by side, right?

ZIERLER: Yeah.

TANNER: That the closer you bring things together, right, and the overlap of this particular detection and of this particular excitation is such that the photons are not going to be fully randomized before detection.

ZIERLER: Right, right.

TANNER: So you need a new type of analysis. So what my dissertation did was being able to not care about how close these source detector pairings were, and not have to understand what's going on here because I would use my spectral components to identify how much absorption is taking place, to identify how much scattering is taking place.

ZIERLER: Were you the first black woman to defend in this area at Illinois?

TANNER: I was the first black woman defending.

ZIERLER: Did the department make a big deal out of that or not?

TANNER: Absolutely not.

ZIERLER: They did not.

TANNER: Urbana-Champaign is not that kind of place. [Chuckles]

ZIERLER: For better and worse.

TANNER: It's still the best place I have done science. Urbana-Champaign is not... You put your pants on just like everybody else.

ZIERLER: It's just about the science.

TANNER: It's just about the science.

ZIERLER: Okay. So you defend. What's your next move? What are you thinking at this point?

TANNER: Again, you know...

ZIERLER: Again! Here we go! [Laughter]

TANNER: Again. I know! I guess that's going to be the story of my life: "But again..."

ZIERLER: You don't have a plan on the day after you defend yet. You don't have your post-doc in place.

TANNER: No, I have a plan, right, because I hated Urbana-Champaign for the weather.

ZIERLER: Sure.

TANNER: So before I defended, Enrico decides to leave and go to Irvine where he retires.

ZIERLER: Right.

TANNER: And California... So he takes me out with him.

ZIERLER: He says, "Come with me."

TANNER: Yeah. But before, he takes me out with him. You know, I give a talk because there's Beckman laser Institute. So Bruce Tromberg, who actually is at NIH now...so full circle.

Everybody's coming full circle. I'm giving a presentation on behalf of the photonics group because I had no idea he had planned to move then. But he was saying, "Oh, we're going to visit," and I didn't realize he was planning to move when I went out to give the talk. So you imagine all this time in the US I'm suffering in small town, small town, small town, and you take me to California. It's sunny, beaches there.

ZIERLER: Yeah!

TANNER: I feel like I've gone to nirvana. [Laughter] And then Gratton, when he announces he's going to leave, I'm like, "Please don't leave me here!" because at that point in time, my experiments are done. I was just writing up my thesis, and he's like, "You know, you could come," but then I have to fly back to defend, right? Then he's like, "Well..." But I wanted to do fluorescence with him before I left, and he's like, "Well, you graduate. When you graduate, you can stay with me for a year and do a project in fluorescence and then you leave," and that was it. That is how... I had no other plans.

ZIERLER: Now when you joke around and you say that he retired up there, how long was he actually--

TANNER: He is still active now.

ZIERLER: So it wasn't a retirement at all.

TANNER: No. That's his idea of retirement.

ZIERLER: Just going to California.

TANNER: Just going to California, exactly.

ZIERLER: Mm-hmm [yes]. Mm-hmm [yes]. So it was one year that you were in Irvine.

TANNER: No, it stretched on to two years, you know, because I wanted a paper out, but at the same time... I think that's when you asked me like when it really dawns on you, like, "What am I going to do next?"

ZIERLER: Right.

TANNER: So the person who was instrumental was Bruce Tromberg, actually.

ZIERLER: Yeah. What was he doing at this time?

TANNER: He was a full professor back there. He was the head of the institute, and the project I was working on, I had to build this joint microscope that did optical coherence tomography (OCT), SHG (second harmonic generation), and two-photon microscopy, but make sure that they are...color collides in the same axial plane, right, which was technically a bit challenging due to the differences in scattering processes. So it's trying to combine what I learned in terms of scattering, all this scattering background I had for my thesis, but really bring it into having a way of noninvasively identifying scattering processes.

ZIERLER: Now we really haven't talked about your skills with instrumentation up until this point. Did you rely on your interest and skills in engineering to help you put these...

TANNER: So I built my stuff myself, and that's the thing about Urbana-Champaign. You find that most of us... built your own microscope, and that's what Enrico's group was good at. For me, I had to... Of course, we bought a spectrometer and so forth, but... You know, I remember filing down cables and stuff like that to make sure that you had uniform length going into the brain of the cat and stuff like that. The multi-photon SHG/OCT set-up certainly was not a turnkey system, you know? So definitely you had to go in and set it up, align it, everything, yourself.

ZIERLER: North! You go north.

TANNER: So Tromberg, you know—because he saw me and he’s like, “When are you going to leave?” You could tell he was kind of like, “You’re here too long.”

ZIERLER: He was impatient with your career.

TANNER: No, Bruce Tromberg.

ZIERLER: Right.

TANNER: No, but he wasn’t... No, he had nothing to do with me. He didn’t pay me or anything like that. He was just observing from the outside.

ZIERLER: But he just saw where your ultimate potential was and where you should be headed.

TANNER: Yeah, I would say that. He was like, “When are you going to leave?” I was like, “Look, I think that I need to learn some biology because I’m being used as a technical person.” You know, people were using me to image stuff, quantify their stuff or whatever, but when it was time for me to give my input and I’m like, “Oh. Well, you should do this experiment,” and they were like, “Oh, please. Go sit down. We’ll handle the biology here.” I told him that, because I had an experience with an external user. “But who is going to take me? I have zero biology,” and then he said, “You need to go to somebody who is famous.” I was like, “Well...that’s easy to say,” right? [Chuckles] He’s like, “You know, you need to go to Mina Bissell’s lab,” and I’m like, “Okay...” So he like writes her and I wrote her and she wrote back and said she had a two-year waitlist. So about two weeks later I saw Tromberg in the hall again. He was like, “I thought you were supposed to write Mina.” I was like, “I wrote her and she told me that she had a two-year waiting list. Then he’s like, “Okay, I’ll email her.” Then I get a message from her to fly up and...

ZIERLER: What was their connection?

TANNER: I have no idea. I have no idea.

ZIERLER: But he was able to bump you to the top of the list.

TANNER: Essentially. I go for this interview, and by that time, I realized, “Okay, I probably should go,” so I also applied to a guy who had started his lab at Harvard and he gave me a position. Then the guy who I ended up splitting between Mina and Sandy Kumar at Berkeley, I also saw him and he offered me an interview. So anyway, I went to Harvard. I got that job offer, and then I went to Mina and I got that job offer. Then she calls back and she says, “You physicists are a lot of problems, you know.”

ZIERLER: Yeah. What do you think she meant by that?

TANNER: She said that we... I mean if you... I mean this is on record. She said that we're arrogant and we think too much. We don't do enough experiments, right? So she--

ZIERLER: [Laughs] And this probably rankled you since you were so interested in applied physics anyway. You were really doing stuff.

TANNER: Actually, I was just like, “You know, you biologists say these things, but then you still come and talk to me, so give me a break. Apparently I'm not that bad after all, right?”

ZIERLER: Now this is such an interesting institutional partnership. You have DOD, you have Cal Berkeley, and you have the Berkeley lab. What's the arrangement between these institutions?

TANNER: Exactly. I look like I'm all over the place, right?

ZIERLER: Yeah.

TANNER: And it's not. So what happened, because she felt like we...

ZIERLER: What was her affiliation?

TANNER: She was LBNL mainly, but also had appointments in Berkeley. But because I'm a foreigner, to get me in faster, I had to go to UC Berkeley, right?

ZIERLER: Mm-hmm [yes]...to sponsor you?

TANNER: Yeah, because I was already at UC Irvine.

ZIERLER: Right. It's an easier transition.

TANNER: It's easier. For Berkeley I would have had to go and do background checks to get in a national lab.

ZIERLER: Mm-hmm [yes]. Right.

TANNER: So the arrangement between... So I had to be split between Sanjay and Mina. So that's why my affiliation says UC Berkeley for the first three years.

ZIERLER: Yeah.

TANNER: Then I got a Department of Defense fellowship. They consider you the PI, even though you're a post-doc.

ZIERLER: Right. I mean as a P-- This is a big step up.

TANNER: Yeah, it's a big step up. That's why I would say that was most transformative in my career, getting that post-doctoral fellowship.

ZIERLER: Right. Right.

TANNER: But I was working for her from the start, but split.

ZIERLER: Yeah. Then where is DOD in this? They're just providing the...

TANNER: The funding. Yeah.

ZIERLER: So that's it.

TANNER: That's it.

ZIERLER: There's no other relationship with them.

TANNER: No.

ZIERLER: Did you have to go through a clearance process because you were affiliated with DOD?

TANNER: No. No, no. It was just the money. It was just the money, so nothing. This is just a normal like grant application, like the NIH and so forth.

ZIERLER: Right. And now this is your first time dealing with cancer research at a sustained basis?

TANNER: Yes, yes, yes, and this is the first time when... You remember when you said, "When is it going to click?"

ZIERLER: Right.

TANNER: So in Urbana-Champaign it clicked I was in big leagues research-wise. It didn't click for me I was in the... You know, like I was still in this sort of I don't know what headspace up until when I hit Berkeley. That's when I realized, "Oh. Okay. No, I'm..." That's when I was like, "Oh my god. I have not been strategic up until this point."

ZIERLER: Right. Right.

TANNER: That's, I would say, the day I showed up in Berkeley is when I realized... Because Urbana-Champaign, I would say that the science is the science. Yes, Selvin had had the *Science* paper, you know, showing hand-over-hand. It was one of the top 50 scientific breakthroughs for that year, whatever. I mean it's not like people didn't do good science in Urbana-Champaign; it's just the emphasis was on the science. It wasn't on the impact factor. Like I didn't know what an impact factor was until I went to Berkeley.

ZIERLER: Right. Right.

TANNER: They were like, "Oh. Well, what's your h factor?" I'm like, "What?" and then someone told me, "Well, you're not even a good physicist because you publish in *Biophysics*."

I'm like, "What? Why would you even say something like that?" They're like, "Because the impact factor of *Biophysics* is 3," and I'm just like... It didn't even dawn on me to look at impact factor of a journal, and that is what I would say Urbana-Champaign was... I can't say that people looked at that. I mean, people wanted to get a paper in PRL...

ZIERLER: Because in Illinois it's all about the science. It's not about the politics.

TANNER: It's all about the science; it's not about... I would say... As I said, it still remains the best place I've ever done science, and in some ways it's kind of sad that others don't have that experience because you could psyche yourself out of science if you end up in a lab that publishes in journals that people perceive as less than.

ZIERLER: Right.

TANNER: In some ways, I was fortunate that I was shielded from that, but definitely when I got to Berkeley, I realized, "Oh... I'm going to be judged on this basis from now on, so I need to jump into that league now."

ZIERLER: Yeah. You're focused specifically on breast cancer or it's all kinds of cancer at this point?

TANNER: It was breast cancer.

ZIERLER: Why was that? This was your choice or this is what the project was?

TANNER: No, this was what the lab worked on, and you know, for me, I came from the point of view of I wanted to understand why it is that there is a racial disparity where like non-white women—I mean, not just black women, but non-white women—got this aggressive form of cancer, right?

ZIERLER: Right.

TANNER: So that was sort of like my... It piqued my interest like, “Wait. Wait. What?” you know? But nevertheless--

ZIERLER: But this is clearly... I mean these are environmental factors at play, or you're looking at other things as well?

TANNER: No. From the point of view of what I look at is even just basic understanding, right, so I'm not even at the stage where I could point to like if there... People have looked at genetics and diets and so forth, but for me, fundamental questions had not been answered, and that's what my research was focused on as a post-doc.

ZIERLER: Right, right. And yet still I'm waiting for your “I went back and I took biology classes.”

TANNER: I still haven't taken biology.

ZIERLER: [Laughs]

TANNER: I don't want to be corrupted.

ZIERLER: So everything that you're learning, you're learning in the lab, essentially.

TANNER: And I wouldn't... One thing, Mina's lab had a fantastic breadth. Back then it was about 30 of us and everyone had their own projects. So I would learn so much from just seeing other people, and the first few months—I would say probably the first six months—I spent so much time on Wikipedia just trying to be up to date with the acronyms, right, because the jargon was completely unfamiliar.

ZIERLER: Right.

TANNER: So I had to... I mean it was humbling, but I literally would spend nights just reading reviews and asking people questions. So of course I don't know what I'm talking about. But some of them took me under their wing and they taught me. So I can't get mad at that, you know.

Sometimes I sound more like a biologist now. People still ask me... You know, some people ask me, "Do you have a degree in physics?" That was how thorough my jargon change was. Like I learned everything because they don't... Biologists won't respect you if you don't speak their language.

ZIERLER: Right.

TANNER: Same thing with physics, right?

ZIERLER: Sure. Sure.

TANNER: So you have to learn.

ZIERLER: Were you the only physicist in the lab at this point?

TANNER: At the time, yes. She only has one at a time or so. I was the second one. So I always benefit from somebody coming before, you know? [Chuckles]

ZIERLER: Did you understand... I mean your lack of literacy in biology aside, did you understand the way you approach the problems differently than your colleagues because you were a physicist, because you were coming from a physics background?

TANNER: Yeah, and that's what, quite frankly, gave me the advantage that they didn't have, right, because they would... Again, that is why I'm not interested in taking a biology course, right, because I think that--

ZIERLER: This is like pure learning for you.

TANNER: Right, yeah, and going back to Father Lai Fook.

ZIERLER: Right, right.

TANNER: So you know...

ZIERLER: And so how did you relearn or how did you see how other people were doing it?

TANNER: They were just so set in that it had to be one way, even when the data were telling them something else, and I'm like, "That's not what your data are telling you. Why does it have to be that way?" They're like, "Well, because!" I'm like, "Because what?" right? Who said so?

ZIERLER: Yeah. Now are you thinking along the lines that you're part of sort of the fight against cancer, that you're really part of something bigger in terms of working towards a cure, or are you not thinking in such large terms at this point, or even up to today?

TANNER: What, at my post-doc level?

ZIERLER: Yeah.

TANNER: I was just trying to understand a basic question, you know? Like how do cells know which way is up and down, to boil it down, and how do they orient themselves in tissue? The reason being is that once this goes awry, this is one of the stages of neoplastic or cancer progression. So could we understand that basic context? So that was it. To me it's a very fundamental question that I wanted to understand because I was like, "What do you mean? Nobody knows this?" because in my mind, I would think somebody...

Then I started to read others and then Ken Yamada who is here at the NIH, because I started to read any literature like, you know, and his name came up. I would literally have stacks of his papers there. So when I came to the NIH, I was so... I don't fan-girl over anyone, I couldn't even go talk to him, right, and then finally I spoke to him like after years I was here. He's like, "Why didn't you come talk to me before?" I was like, "Come and bother you?" you know, because he was instrumental in me really committing to biology.

ZIERLER: What was so compelling about his work to you?

TANNER: He does the most beautiful experiments. They're clean, they're elegant, and they're straightforward. They're clear-cut.

ZIERLER: But he's not a physicist.

TANNER: He's not a physicist.

ZIERLER: He's a would-be physicist.

TANNER: I don't know because I hate...because I don't want to fall into this camp of people who like to say physics is better than biology because it's not. It really comes down to your science at the end of the day, you know, because there are some really crappy physicists and there are some really excellent biologists. To me it's about the experimental design is what really...

ZIERLER: Right. So in asking these fundamental questions about why cells do what they do, did you move the ball forward at Berkeley? Did you help answer those questions?

TANNER: Yeah. So I made this discovery that they would undergo a very specific type of motility to establish this sort of gradient and then use that to form multi-cellular tissues, and that had not been discovered before. The theorists got interested because now they could sort of predict how different types of tissues are formed.

ZIERLER: Are you thinking in terms of clinical value or therapies at this point or you're too separate from that?

TANNER: No, absolutely not. No, at that point I'm just thinking just basic understanding.

ZIERLER: Right. The discoveries that you made at Berkeley, did they ultimately have clinical value?

TANNER: To some extent...theoretically they can, but I never pushed it in that direction.

However, by observing what the tumor cells did differently from the normal cells in establishing these types of multi-cellular tissues, it dawned on me that maybe we're getting a glimpse of what

cells would do in different types of environments. So let me back up for a second, and how does this relate to cancer?

ZIERLER: Yeah.

TANNER: So normal cells in any tissue adopt very specific geometrical arrangements. Cancer sort of... The first signs of cancer, at least from an architectural point of view, they lose this very precise organization, and the architecture becomes more chaotic and so forth. Having said that, once cancer progresses to the point where the tumor cells now leave that primary organ, they have to go into blood vessels to be able to be transmitted to other organs to form new lesions. So my reason was that by looking at these formations of microtissues in these in vitro settings, we have a clue of what cells may do in different environments.

ZIERLER: Different environments in the body?

TANNER: In the body, yes, and here... If it is then... We may have a chance of understanding the initial stages of the establishment of these secondary legions, and this is where people...why it's called metastatic disease, because the tumor cells have spread. This unfortunately means the cause of lethality in cancer patients.

ZIERLER: Metastatic cancer is what's the main killer.

TANNER: Metastatic cancer, yes, is what kills. Right. So my idea was if we use these environments and we understand the physical properties, the physical principles that govern how they adapt to these different environments, then it gives us a clue of what may happen once these cells leave and go to different organs, and then gives us a platform to stop the successful implantation in a different organ. So when I started my lab, this is where I was going.

ZIERLER: This is what got you to NIH.

TANNER: Yes.

ZIERLER: So what were the circumstances? Was NIH like this was the be-all and end-all for you after Berkeley, or you had other options that you were considering?

TANNER: So I had other options because...

ZIERLER: I mean you could have gone the academic route, right?

TANNER: So I had offers from schools as well.

ZIERLER: Did you look at NIH as just one of several academic jobs you were looking at?

TANNER: No, I wanted to come here.

ZIERLER: Or is it something different here?

TANNER: I wanted to come here.

ZIERLER: You wanted to come here.

TANNER: Yeah, I wanted to come here. This is my dream job.

ZIERLER: Why?

TANNER: Because I knew if I had gone to a physics department anywhere, I would have had to do more physics-physics. I wouldn't be able to do animal work, and I wanted to go in vivo.

ZIERLER: You're pulling away from the physics-physics at this point.

TANNER: No. I didn't want to be constrained because at the end of the day and I knew to be competitive I had to go in vivo. The physics departments just didn't have the sort of infrastructure for me to do that. I would have to collaborate, and I had learned from collaborating that he who holds the samples holds the power. [Laughter] I learned that early on!

ZIERLER: Right. So what did you know of NIH before you actually got here in the sense that its reputation preceded it? How did you know that these things would be achievable here?

TANNER: I knew... I did some research. I knew that I would be able to go into animals and that would be part of the “environment.” I wouldn't have to worry, and I thought that I would have access to patient samples.

ZIERLER: Which is what? These are biopsies from patients?

TANNER: These are women who had breast reduction surgeries, so you're getting excess tissue.

ZIERLER: Not cancerous.

TANNER: No. This was normal. Right. Some people, you could get cancer, but I was looking at just normal, right? It was only because I had that connection—again, going back to what types of connections and so forth you have.

ZIERLER: Okay. So you came here, and were you looking at the tenure clock here like you would at any other academic institution, or did you understand it as its own process?

TANNER: I had my own goals.

ZIERLER: Yeah. And so here, what were you thinking?

TANNER: Here I was thinking I could find me focused on science and not be a black person.

[Laughter] I know that sounds bad, and it's not like I'm trying not to be black. But you know, I was looking forward to just being...

ZIERLER: You have your research focus and you're a scientist!

TANNER: That's it! I would like to. I was super excited when I came here. I was like, “Yeah, I could just go back to being a scientist.” [Laughs]

ZIERLER: Did that turn out to be the case?

TANNER: Yes and no. Yes and no.

ZIERLER: Are there things that you can accomplish here that you feel like you can't accomplish anywhere else?

TANNER: Absolutely, absolutely, absolutely yes. Absolutely yes. With someone with my background trying to do what we do now, there's no way I would [unintelligible].

ZIERLER: By background, you mean your physics background.

TANNER: No. I'm talking about not even from a physics background, from the scientific point of view. I knew for us to prove that what we were doing is relevant, we had to go in vivo, into mouse model or animal model, and I had no animal training before I came here. So I started that from scratch here.

ZIERLER: Mm-hmm [yes]. Do you see your work here as a continuation from what you were doing at Berkeley, or are you on to different things entirely here?

TANNER: I think I've taken a hard left.

ZIERLER: A hard left.

TANNER: A hard left.

ZIERLER: What does that mean, a hard left?

TANNER: I feel like in Berkeley I was more only focused on trying to understand, as I told you, this fundamental up and down, but now I've gone really towards like how is this going to be impactful in cancer, right?

ZIERLER: So now you're much more concerned about clinical value and therapies.

TANNER: Yes, yes, yes.

ZIERLER: Are you working with MDs who bring you tissues from patients that are...

TANNER: I mean I'm here. I'm immersed in the NCI. I follow, I see what's going on,

ZIERLER: So is the NCI... Can you explain a little bit about the NCI's relationship with like the clinical building, with the hospital? Is it two totally different worlds, or there are opportunities to interface?

TANNER: There is an opportunity to interface if you wish. I collaborate with a few people outside of NCI who bring more like clinical samples and that kind of stuff. I think, again, NCI is really a good place for specific types of cancers .

ZIERLER: What types of cancers are you focused on these days?

TANNER: These days I'm doing breast cancer and glioblastomas. I have an Italian collaborator that provides me with patient-derived glioblastoma tumors.

ZIERLER: So I guess at this point we could start asking some of the bigger questions, philosophical questions, right?

ZIERLER: So I think it was 1972 when Richard Nixon famously declared "the war on cancer," right?

TANNER: Yes.

ZIERLER: You're young. You have hopefully many decades of research and accomplishments ahead of you.

TANNER: As long as I survive corona.

ZIERLER: That's right. That's true for all of us.

TANNER: Right.

ZIERLER: Do you think, first of all, just the word "war"—do you think that that's an appropriate word to use? Because whatever we call it, you're clearly on the front lines of it, but is "war" something that you feel comfortable using?

TANNER: I think that that's cute to have these types of slogans. If it is that that's the terms that we need to be able to generate some level of enthusiasm, sure. But from my personal experience, again, I'm not a medical doctor and I don't pretend to know everything about cancer. But seeing the complexity of cancer, I think that one should also focus on management.

ZIERLER: And you're talking about eradication within an individual.

TANNER: Yes. I think that one should aim for stable disease such that the treatment does not kill the host and that the disease does not progress.

ZIERLER: Does that suggest that the word "cure" is problematic also?

TANNER: Now it depends on if you think cure is 100% eradication. I think that the most exciting thing in terms of treatment is immunotherapy, right?

ZIERLER: Yeah.

TANNER: Immunotherapy has shown probably the most promising approaches to what I would consider a full cure in that you can eradicate the presence of disease that can be detected with current imaging modalities.

ZIERLER: Are you involved in immunotherapies?

TANNER: So that's one of the interests, as soon as my tenure is cleared, I would like to pursue, to understand like below the threshold that we can image clinically, are we really curing disease?

ZIERLER: Now that's interesting. That gets us back to sort of a political question. Clearly you're very excited about immunotherapies, but it seems that this tenure issue is a wall between you and that. So what does that mean in terms of your tenure considerations?

TANNER: I need some time to think. I have very superficial ideas, but I plan to get that tenure monkey off my back and take like two weeks off and go think more deeply about...because as I said, I have some ideas, but...

ZIERLER: What will tenure allow you to do that you can't do now?

TANNER: Think.

ZIERLER: Think.

TANNER: Mm-hmm [yes].

ZIERLER: Because you have pressures on you now that don't allow you to think?

TANNER: Yeah. I think that tenure is more or less a game that you have to check these points and try not to upset too many people along the way, that they're neutral at worst,—at best, excited; to be able to achieve this milestone. Then I think that you could think a bit more. Probably others have different experiences, but that at least for me [is] what I'm looking forward to.

ZIERLER: What is it that you understand about cancer that makes you think that eradication is not the way to go forward?

TANNER: So let me put it from the perspective of like where a lot of progress scientifically and treatment-wise has been made, like HIV, right? HIV in the '80s was a death sentence, right, and it's simply due to this virus essentially hijacking your immune system, right? But now I would say, what, that was in the '80s? So almost 40 years later or so you see that you have stable disease, right?

ZIERLER: Where it's not eradicated, but it's something you can live with.

TANNER: Right. But that's only due to one viral particle. Yes, the virus could mutate and so forth, but that's it. Cancer is tissue-specific. What drives a cancer... So let me go back to something else that people may know in the mainstream. BRCA1 is a mutation that is a germ-like mutation, meaning that every cell in your body, if you have that mutation, has it. But yet you only... If a woman, you may get breast cancer or ovarian cancer; men, you get prostate cancer. Now why don't you get cancers from all different types near organs even though you have that mutation?

ZIERLER: Because it's in every cell, you're saying.

TANNER: It's in every cell. It's a germline mutation.

ZIERLER: Right. So theoretically it should be everywhere.

TANNER: It should. Well, why not? So cancer is a tissue-specific disease. So what drives breast cancer? Even with a given mutation and so forth, it's not necessarily seen, but not the type of breast cancer and a different type of mutation.

ZIERLER: Right.

TANNER: So you can have... Yes, genetic factors play a role. Epigenetic factors also play a role. Your organ environment, meaning if you have something that's more fatty versus non-fatty, plays a role, so on and so forth. So it's a very complicated issue, even at the organ level. So trying to say that you are going to apply one treatment that will cure all breast cancers and so forth is just not possible.

ZIERLER: So I wonder, then. You know, physicists, theoretical physicists, talk about the unified theory, right?

TANNER: Right.

ZIERLER: Do you think there's such a thing as a unified theory of cancer?

TANNER: If there is one, we don't understand enough to form one.

ZIERLER: Are there fundamental mysteries of cancer that you see will always be mysterious, at least in your lifetime? Are there things that simply are beyond our understanding or beyond our capacity to know?

TANNER: I would never say that because I think that it just depends on who's looking at the problem and so forth. So I would never go as far as defining like, "Oh, yeah." No. I do think that trying to understand these principles, we would benefit from having some hard-core theorists in the field, like the ones who focus on the other types of physics. I do wish that they would take a look at cancer and bring some of their insights.

ZIERLER: I know that you're involved with the Biophysics Society [Biophysical Society].

TANNER: Yeah.

ZIERLER: Is this something that you would want to be involved with in terms of bringing more physicists into biology?

TANNER: I try. I try. You know, at some point, just get a few of them excited about something. I think it's an untapped pool, right, because at the end of the day, I'm an experimentalist. But a great theoretical mind just getting excited would...or even seeing some of the data from the experiments.

ZIERLER: Right. So broadly thinking, what is it that physics brings, can offer to biology that biology doesn't offer itself? Is it the analytical perspective?

TANNER: No, because there are some biologists that are very, very analytical. I think it's just about the field of understanding of approaching a problem from, I would say, fundamental principles, right, because I explained to you earlier on that the equations that we started off with for understanding like transport in tissues were being used by astrophysicists to understand energy dissipation in stars. So there is a sort of cross-fertilization from other physical phenomena that allows you to then tackle something that-- I mean on the surface, what does light transport in a brain have to do with photon fluxes in a star?

ZIERLER: Right.

TANNER: Equations ended up being comparable. So I think that just being able to have exposure to that level of if you do astrophysics or biophysics, whatever, you have a pool of phenomena that you could tap in and say, "Hey, this looks like this." Or you go across the hall and you talk to your colleague who focuses on, I don't know, neutrons or whatever and they're like, "Oh! Oh, that graph looks like this graph," and then you have suddenly an equation to start

from, right? I think that's where physics really has the ability to take off, where I don't know necessarily if... There is some overlap in developmental biology, I would say, and maybe some aspects of cancer biology, but I don't know if they overlap sufficiently such that if, I would say, a molecular biologist talks to [unintelligible]. I don't know if that overlap exists and I think that's really where the issues lie.

ZIERLER: I want to rephrase my question on the mysteries one. Do you think that the Socratic concept of the more you learn, or the more you know, the more you know you don't know—do you find that to be the case in cancer research, that the mysteries become more obvious because you didn't even know that they were mysteries before a particular discovery?

TANNER: So I guess mystery for me is probably not a term that I would even really identify with, right, because I look at it from the point of view of, “Okay, this is an unknown. How could I really try to figure it out?” I think that's what our strengths are, at least the strengths in my lab would be, because oftentimes we do experiments and people would be like, “Why would you do that?” They would expect it to fail, and that's how we learn new things, right?

ZIERLER: Yeah. Right.

TANNER: So I don't know if mystery is a right term versus not being fully committed to “It has to be this way,” right?

ZIERLER: Yeah. So I'll switch course with that, and I think this will be the last question.

TANNER: No problem, because I'm sweating bullets, right?

ZIERLER: No, no, no. Not at all. So for hopefully your very long career ahead, what are the things that you're most excited about? What do you think are the things that will be unlocked that will have that major clinical or therapeutic value that answer this narrative point that's been

appearing throughout our discussion, which is your desire to create things that are useful, right?

What are you most excited about in terms of what your research will lead to?

TANNER: My goal is that by the time I'm done with my illustrious career that we would understand what defines how do cells colonize the brain to form brain metastases, and more importantly, how to stop it. That's really where I've decided to go with that.

ZIERLER: What's the connection between the two in terms of understanding how it starts and how to stop it?

TANNER: Brain metastasis remains one of the worst sites for cells to go to.

ZIERLER: You mean in terms of mortality.

TANNER: Mortality and quality of life and access to treatment. Trying to merge what my PhD was focused on in trying to understand normal brain homeostasis. Like how does the brain even operate? For me, what I'd like to be able to do is the brain is such a protected organ. How do cells go in there? How do cells survive?

ZIERLER: By protected, you mean like the blood-brain barrier?

TANNER: Blood-brain barrier. It's an immune sanctuary, so it's such a protected organ. And yet tumor cells can get in there.

ZIERLER: So these are really fundamental questions that remain unanswered.

TANNER: These are fundamental questions that remain unanswered.

ZIERLER: And one of the things that you're saying is it's possible to answer these questions in your career.

TANNER: Well, that's my goal.

ZIERLER: Okay. Dr. Tanner, thank you so much. This has been a great pleasure, and you did a terrific job.

TANNER: Sure. Please, please feel free to edit, and put in some Beyoncé in there. I can't sing, but you could always--

ZIERLER: [Laughs] We'll ask her if she wants to join in.

TANNER: Exactly! You can edit it.

ZIERLER: Thank you very much.

TANNER: No problem.

[End of recording]