**Interviews of the Margaret MacVicar Memorial AMITA Oral History Project, MC 356**
Massachusetts Institute of Technology, Institute Archives and Special Collections

**Lydia Villa-Komaroff** – class of 1975

Interviewed by Nafisa Syed, class of 2019

June 20, 2018

**Margaret MacVicar Memorial AMITA Oral History Project**

Lydia Villa-Komaroff (PhD Biology, 1975) was interviewed by Nafisa Syed (SB Physical Biology, 2019) at her home in Chestnut Hill, Massachusetts on June 20, 2018.

Dr. Villa-Komaroff is a molecular biologist, biotech executive and diversity advocate. She grew up in Santa Fe, New Mexico, and earned her bachelor's degree in Biology from Goucher College in 1968. Villa-Komaroff co-founded the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) in 1973, while doing her graduate work in biology at MIT. When she earned her PhD in Cell Biology from the Institute in 1975, Villa-Komaroff was one of the first few Mexican American women to receive a doctorate in the sciences. During her postdoctoral work at Harvard University with Walter Gilbert, she was part of a team doing landmark research that resulted in the discovery of a method of generating insulin from bacterial cells.

Villa-Komaroff has been on the faculty of University of Massachusetts Medical Center, Children's Hospital, Boston, and Harvard Medical School. She has also served as the Vice President of Research at Northwestern University as well as Vice President for Research and Chief Operating Officer of the Whitehead Institute at MIT. She is a member of the MIT Corporation's Visiting Committee on Biology.

SYED: This is Nafisa Syed. I'm here with Lydia Villa-Komaroff, and the date is June 20, 2018.

I'd like to begin by asking you a bit about your childhood. I understand that you grew up in Santa Fe, New Mexico, and that your family was very encouraging of your interest in science.

VILLA-KOMAROFF: They were.

SYED: Could you tell me more about that?

VILLA-KOMAROFF: Yes. I'm the eldest of six. I have a really big family. My father is one of 12 sibs. He's about in the middle. There were 15 altogether, I think, and he was the first in his family to go to college.

SYED: That's very cool.

VILLA-KOMAROFF: My mother has one older half-sister and one younger brother, and she was the first to go to college in her family. So her family's not as big. Total, I have over 100 first cousins.

SYED: Wow!

VILLA-KOMAROFF: We're a big family…

My mother was someone who had rheumatic fever as a kid, so she lost some school, but she nevertheless skipped ahead a grade. She never quite caught up with math because of that, but she did go get a master's degree.

When I was 13, she went back to school to get a master's, and it required statistics. She did OK. As she said, she didn't get the lowest grade in the class!

We sort of took it for granted that we would go to college, which was not true of all of my family members, cousins. And my grandmother was also a very independent woman. Her father sent his daughters to the equivalent of high school, to normal school, but not his sons because they were going to run the ranch. They just had to know how to add and subtract, and sign their names to contracts, and read well enough to read contracts—but he sent his daughters to school. So my grandmother and her sister taught school in one-room schoolhouse in New Mexico.

SYED: Oh, that's very cool.

VILLA-KOMAROFF: And her sister was probably one of the first bilingual teachers. It's just that the kids grew up knowing Spanish and she spoke both, so she would teach them in both languages.

So it was a family that encouraged learning, and they sort of let us go wherever our interests led. My grandmother had a book. It was a natural history book. It had watercolors of animals. And she was very interested in the garden—new herbs and stuff. So I think all of that-- My father's mother was a *curandera* [traditional Native healer]. She knew the medicines to take care of stuff, so I think all of that played into my own interests.

That, plus, it seemed to me that being a scientist, which I wasn't entirely clear on, but I thought maybe it involved quiet rooms with lots of space, which is, of course, completely wrong. And we moved to Santa Fe when I

was in the third grade. First and second grade were in different towns in New Mexico. And so I was there until I left for college at 17 or 18.

SYED: Can you tell me a little bit about your interest in science as a child?

VILLA-KOMAROFF: Well, I was one of those kids who liked to take things apart. And Dad worked on the car, so I would watch that, too. Back in those days, we dissected frogs in high school, and I found that really interesting. And I read a lot of science fiction at the time, that and Star Trek. We didn't get a television until I was 13. But Star Trek was on, and I think that crew was really critical to me because the crew was such a diverse crew, with women, and anybody could be anything in there. So I think that sort of had a big impact on me.

But I decided very early I wanted to be a scientist. It was about the time I was in the third grade. I don't know. I sort of mushed together chemistry and astrophysics and all of that kind of stuff.

SYED: I think in some of your interviews you mentioned that your uncle was a chemist?

VILLA-KOMAROFF: Yes. He [Ishamael Ortega] was a master's degree chemist. He got his PhD, too, but after I did. He showed me a paper [“Nitration and Bromination of m-Phenoxyanisole” J. Organic Chemistry, 1952, *17* (11), pp 1475–1483] when I was a kid that he'd written, which I looked up later. I found it when I was writing something. I wrote a little piece [“On the Inside Looking In: The Roots of a Life in Science,” in “Paths to Discovery: Autobiographies from chincana with careers in science, mathematics, and engineering,” Norma E. Cantu, editor, 2008] for a book called-- what is it called? I'll show it to you. I looked up the paper, and it was a synthesis paper of some sort. And he said, “This paper was easier to write than an English paper.” And since writing is something that comes slowly to me—it takes work—that impressed me a lot. So I think that has something to do with it, too. He and his wife, my mother's older sister, they had two boys when I was born, my two older cousins, so I was the first girl in the family. And since Mom and Dad were both in school, and they all lived in Las Vegas, I spent a lot of time with that uncle and aunt.

SYED: That's very cool.

VILLA-KOMAROFF: Yeah.

SYED: Could you tell me a little bit about your college experience at University of Washington?

VILLA-KOMAROFF: When I was ready to go to college, I really wanted to get out of New Mexico. I don't think I could have said why that was the case, but I wanted to do that. I think, looking back, I sensed at some level that if I didn't leave home to go to college, I wasn't going to leave. My dad, for some reason, he got it in his head when I was a junior in high school that I would be going off to college, and somehow, that would mean the family wouldn't get back together again, so he decided we should all go on a trip together. So all six of us kids, my parents, grandmother, and the family dog—piled into a blue station wagon and went to Seattle, to the World's Fair, which was a great trip. We had a lot of fun. And Dad had a brother there that we stayed with, one of his younger brothers. And that was where the University of Washington was. So I decided, "OK, that's a good place." And that's really the only school I applied to. I didn't know any better. We didn't go on college trips. We didn't check anything out. And I didn't see the university. I just decided, "OK, I have an uncle here. There's a school here. It's not in New Mexico."

SYED: Checks all the boxes.

VILLA-KOMAROFF: So that's where I applied. I took the bus, and I didn't have any money. I worked as a waitress during high school and did babysitting and all the usual stuff. But Mom and Dad were not good at handling money. They both worked, and I think-- I mean, they did have six kids, which is not nothing, and they were both helping out their parents. But still, I suspect that they didn't really have a good handle on money management. Anyway, there was always stuff to be paid for, so most of my salary and all my tips went to Dad.

I got a letter from the University of Washington telling me that tuition was going to go up by $25, and I was, of course, paying out-of-state, which then still wasn't so much as it is now. It would be very hard now. So I went to him, and I said I was offered a scholarship at the University of New Mexico, which was in Albuquerque, 60 miles down the road. So I said maybe I should stick around and go there. So he stopped and he said, "How much money do you have for college now?" I said, "I don't have any." He goes, "Well, so what difference is $25 going to make if you don't have any?" So I said, "Yeah, well, there's a point there." So at that point, I found out about student loans, and the church gave me a small scholarship, and one of my teachers in high school arranged a gift from one of her friends who had a

lot of money. It was like $300, but it got me there. And once I got there, then I applied for work study and got a job, so I was OK.

I worked all through college—and I wasn't a very good student. I was a good student in high school. And I was pretty socially inept in high school. I didn't have boyfriends. I wasn't very social. I was a good student. I had a small circle of friends, and we were all kind of the nerdy types. So when I got to college, it was a whole different story, because all of a sudden, it was a whole new world. I was on my own for the first time, like many freshmen. And I got to know a lot of the foreign students. And of course, if I kept my mouth shut, I could be Mexican. I could be Puerto Rican. I could be Indian. I could be Pakistani. I could be whatever as long as I didn't say anything. So I made friends with all of these foreign students. And for a while, I kind of grooved on not being taken for American. It was the '60s and the war was going on, and it was another time when one questioned the works of the government in the Vietnam War and so forth.

So I was having a great time, which meant I wasn't going to class and I wasn't studying. So my first term grades were not terrific. First year, in fact. And in the second year-- I started as a chemistry major, because I had asked for advice. I had gone to a program just between high school and junior high that the National Science Foundation did. Summer Science Training Program, it was called. And what they did was they took high school kids and took them to a college campus and introduced them to a summer of doing research. It was very cool. Great program. I'm sorry they stopped it. And so there, I met kids from all over the southwest.

And it happened rather suddenly. I don't really have a clear memory of how I found out about it and how I got in or any of that stuff. But it was on a campus in Tyler, Texas, which was my first foray into the South. It was very interesting because we were a very diverse group of students. There were some Hispanics. There were some white kids. There were some black kids. And we got along great. We had a great time. But we couldn't go places together. That was the first time I had run across that. And I remember one sign—I think it was on the bus as we went to Texas, or it was on some field trip out of Texas, further south—that said, "Blackest land. Whiteist people." And we couldn't go to church together on Sunday because there was no church where all three races could go.

I went on a weekend with one of my classmates. She was from west Texas, and her family had a ranch. We had a great time. I learned how to ride a horse with her. But her parents, at dinner, they were asking us questions

about living with students who were black. They wanted to know what they ate. They wanted to know if they smelled different. It was really--

SYED: That's very odd.

VILLA-KOMAROFF: Odd, and really an extremely-- I mean, that was eye-opening. I think that solidified or made clear something that I just hadn't known about the country or about the way people could be.

But what I did there in science was I had gotten-- they bought me a book called Calciphylaxis. There was a person named Hans Selye [Hungarian-Canadian endocrinologist, 1907–1982] who was one of the first physiologists [and] who studied the stress response in humans and in animals. So what I got to do that summer was to try to reproduce some of his work using rats. We did an adrenalectomy to see the effects of the lack of glucocorticoids on the rat system and response to stress. I didn't get any clear-cut results, I have to say, but they let me take the rats home. I smuggled them onto the bus, wrapped them in brown paper and stuck them under my seat so it was like part of my luggage. When I got home, I was going to continue doing stuff, but one the rats bit me one day. I had the cage open, and I went like that to throw him off my finger, and all the rats got away. And for years afterwards, you could see hybrids. The white rats bred with the brown rats, and every now and then, you'd see a hybrid rat running around the neighborhood.

But I had always been interested in biology, and that ticked up my interest. I thought I wanted to be a physiologist like Hans Selye. So I had asked people at the University of Washington what I should be, what I should major in, and they said chemistry. So I began as a chemistry major. And chemistry, in those days, was, first of all, not very welcoming to women. Secondly, it was a knockout set of courses. Unless you were a major, the purpose of chemistry was to narrow the number of people who would be able to get into medical school.

SYED: Oh, I see. Oh, no. Not this again.

VILLA-KOMAROFF: So when I took organic chemistry, that was the course. On the first day of the course, the professor who was teaching it did that classic thing. "Look at the person on your right. Look at the person on your left. Only one of you will be here next year."

SYED: Well, that's very stressful.

VILLA-KOMAROFF: So that didn't help. And I did. I got a D in chemistry, organic, the first time around. By the next year, I had decided that, if I wanted to go to graduate school, I had better clean up my act. So I took it again and aced it, which was a good feeling. And also, I changed majors. I had gone to see a professor after a particularly onerous exam. It was a 100-point exam, and the highest score in the class was 8. So I went to go see my adviser, saying that I was having trouble in chemistry, in the major, and he said, "Well, of course you're having trouble. Women don't belong in chemistry." So I said, "Oh, OK," and I went and changed my major to biology. But biology then was a really sort of classic 'memorize, look at slides of developing chicks'—boring. It was very boring, so I didn't last there very long. Changed my major a couple of other times. I went through history. I really liked history of science. But the big history class was not something I grooved on.

And then the biology department hired a bunch of young faculty, and I went back to biology. And then it was a very dynamic, interesting place. They had great courses of animal behavior, and particularly animal development.

SYED: That's very cool.

VILLA-KOMAROFF: Developmental biology. So that solidified my desire to do biology. And I also cleaned up my act in terms of grades. Buckled down and actually did a little studying. I also met Tony [Anthony Komaroff, M.D., University of Washington; built a renowned academic general medicine unit at Boston's Brigham & Women's Hospital while Director of the Division of General Medicine and Primary Care, now Senior Physician at the hospital; Distinguished Simcox-Clifford-Higby Professor of Medicine at Harvard Medical School], my husband, who was a medical student at the time.

One of my jobs was in the medical school library. So all of that came together to get me back on track academically. And so when Tony graduated—he was a fourth-year medical student when I was a sophomore—he was going to come east to do his internship. So I figured I had to transfer because nothing was going to happen if we were at opposite ends of the country. So my professor [Robert Cahn] at Seattle told me, "Well, you should go to Johns Hopkins." But Hopkins was an all-male school at the time. They didn't accept women.

SYED: Oh, really?

VILLA-KOMAROFF: Yeah. It was quite a while ago. And so instead, I applied to Goucher College, which was the sister college. It was an all-girls school, completely different from the University of Washington. The University of Washington is huge, 37,000 students, beautiful campus. Goucher had, at most, 1,000, and usually something under that.

SYED: Oh, it's very small.

VILLA-KOMAROFF: Tiny little school. Beautiful campus in Towson, which is outside of Baltimore. Initially, when I applied, I was told that there was no more room in the dorms, and everybody had to live on the dorms. So that was that. But I had also written to one of the professors there, Dr. Moment [Gairdner B. Moment, Professor of Biological Sciences, Goucher College], and he was very encouraging. He said I could get work in his lab, and he was sure that arrangements could be made. So I sent that to the admissions department and got on a plane, basically, to come and see Tony, who was in Washington at NIH at the time. And I met there Ms. Flowers, the Director of Admissions, a very imposing, tall, New England woman with a hat. She always wore a hat. And she put me through a very grueling interview. It was like three hours!

SYED: Oh, my goodness.

VILLA-KOMAROFF: And then she let me in. She came to our wedding, and she said, I always knew you had the IQ, but I needed to know if you had the "I do." And that was a good transition for me because that was a very supportive place. The faculty—since it was so small, we all got individual attention. And there were no guys. It's now a coed school, but at that time, it was all women. I had a fabulous professor of philosophy who really taught me a lot about writing. Whenever I did an essay, it would come back with as much red ink as the original ink that I had written. Also, the faculty there got me a summer job at NIH.

And the person there, Loretta Leive, who was a microbiologist, taught me the basics—e.g., how you handle a pipette. And she was really the one responsible for my going to MIT, because I knew that Tony was coming here to do work after he finished in Washington.

We got married the day after I graduated. My mom and dad and most of my brothers and sisters came. It was a small wedding. I could invite the whole family, but they couldn't come. But it was a good strategy.

So I applied to every school in Boston except MIT. And Loretta, when I gave her the things for letters of recommendation, she said, “Where is MIT?” And I said, “I didn't apply to MIT. I don't think that's a good place for me.” She goes, “Why not?” And I said, “Well, math's not really my thing.” That was my view of MIT: guys running around with slide rules, lots of math.

SYED: What's really funny is I almost didn't apply to MIT for the same reason.

VILLA-KOMAROFF: Really? Some things don't change. But she said, “You know, you said you wanted to do molecular biology. MIT has the best department in the country, and maybe in the world. And if you're serious about wanting to do that field, you have to apply to MIT.” So I did, and it was a good thing, because that was the only place that accepted me.

In retrospect, I'm sure that partly that was because Loretta Leive knew Boris Magasanik [microbiologist and biochemist, Jacques Monod Professor MIT Emeritus of Microbiology]. It was Boris Magasanik, Gene Brown [MIT Professor Emeritus of Biochemistry] and Salvador Luria [Nobel Laureate in Physiology/Medicine, former MIT Chair of Microbiology] at the time who kind of ran the department. And I'm sure that she put in-- She knew them, and she must have given me a quite glowing letter. And for all I know, she called Boris. But anyway, they let me in. And that was great, because MIT is a fabulous place to go to graduate school. (I think it's hard to be an undergraduate there unless you really know what you want to do.) So that was great.

We moved to Boston, lived in Baker House for the first few months because Tony had to start his internship, and we didn't have a house yet or an apartment. We found the apartment—or maybe we had the apartment and we couldn't move into it; I can't remember. It was on Park Drive, near this old Sears building, near the Landmark [movie theater] in the medical school area, a fifth-floor walk-up. And graduate school was great. In college, I was still pretty active. In high school, I think I was a member of every club there was. That was a lot of fun. I did music and chess club and Future Teachers of America and a whole bunch of stuff. And so in college, I was on Young Democrats and the biology club. Not as many things as high school, but a few.

And then in graduate school, of course, it was really just paying attention to getting work done. And it's still a remarkable experience. The department treated the students there as junior colleagues. We ate lunch

with the faculty most of the time. We had a lot to learn, clearly, but they considered us their junior colleagues, and that was really pretty cool.

And then I worked for David Baltimore [1975 Nobel Laureate in Physiology/Medicine; former MIT Professor of Microbiology; former president of both the California Institute of Technology and The Rockefeller University; did postdoctoral research at MIT and was a member of the MIT faculty for nearly 30 years] and Harvey Lodish [molecular and cell biologist, MIT Professor of Microbiology], and that was a remarkable experience. They were both young faculty at the time and very demanding.

But one of the fortunate things that happened is that those are two people who, though they were very demanding, they didn't make assumptions about what could or couldn't be done by an individual based on who we were. So the fact that I was a woman and a Hispanic, I'm not sure it even registered with them. And that was probably incredibly critical for me because I think there were people. We were a small group, my graduate class—there were only 16 of us, and it boiled down to 12 very quickly—who in the department we should stay away from because either they didn't treat their students with respect or they didn't like women. There was one faculty who left fairly soon after I got there who was quite eminent. But when a woman in another class, who is now a world-class immunologist, wanted to be in his lab, he said, I don't take women from those women's colleges. Where'd you go to school? Well, she'd gone to Radcliffe.

SYED: Oh, dear.

VILLA-KOMAROFF: So she said Harvard, and then decided she didn't want to be in his lab anyway because that wasn't going to work. So we knew. And I think that, if I had been in a lab which was both very demanding and where the underlying assumption was that I couldn't do the work, that would have been not healthy. So working for David and Harvey was really a pleasure. High pressure as it was, it turns out I like pressure. That doesn't bother me at all. So those were great years. We had a very tight-knit group of students because we were a small class, and the faculty were incredibly responsive to us.

We decided we didn't like the way that the first prelim was set up. We knew we had to do one part, which was a test, and everybody had to do that. That was fine. But we decided, for the next part, we didn't want to do what they wanted us to do, and I forget even what it was.

SYED: Was it an oral exam? Because I know they had those in--

VILLA-KOMAROFF: Yeah, it was partly oral. So instead, we proposed that we go up to-- MIT owns, or owned (I don't know if it still does) a place up in New Hampshire, in the woods. So we proposed we go up there for a week, and we would give each other seminars on a topic that we'd chosen, and we'd cook. And they said yes. So we did have to write a paper. And the first part of the prelim was a combination oral and written. I think we had to answer questions about papers and stuff. It was a great group. It was a lot of fun. Learned a lot. And it was very productive. I got several good papers out of my thesis research, which set me up for the postdoc.

And for that, Tony was here, so I figured this is a good city. It's got a lot of places. And people come through, giving seminars. And one of the people who came through was a guy named Fotis Kafatos [Harvard Professor of Cellular and Developmental Biology], who at the time was doing developmental biology using the silk moth as a model system. Antheraea Polyphemus is a silk moth that's native to this country. It's a big, big moth, and it lays eggs. And the eggs in the ovary are a time course, a natural time course. Each egg is connected to the one in front and in back of it by a little string of protein and they get bigger as they mature. And the egg shells are a very complicated protein structure. And so the synthesis of each of the different proteins, you have this time course you can dissect out and follow.

So I went to go see Fotis, and we arranged that I would come to Harvard to be his postdoc and study the RNAs that made those proteins. And I didn't really consult with either David or Harvey in making those arrangements. What I had done in their labs was to do protein synthesis of the poliovirus RNA. Harvey was an expert in protein synthesis, particularly in red blood cells, reticulocytes. And David had done a lot of work on poliovirus. In fact, his thesis was the discovery of the enzyme that makes RNA into RNA. Short thesis, very important work.

So we combined them, because polio is one long RNA. It has the coding for all of the proteins on that one long RNA. And so the question was, is there a single protein synthesis start site? Or do the ribosomes start internally? We knew that the RNA didn't break down because you could find the whole long RNA with ribosomes in the cells. So that was where they were synthesized. And at that point, we sort of knew that, in most eukaryotic,

RNA start at one site. My job was to figure out that question. And so we showed that there was a single initiation site for the polio RNA protein.

I was the first graduate student to have two advisors. I noticed that, when I was at the retreat this year, that it's actually pretty common. A lot of the folks who gave talks had two advisors.

SYED: A lot of my friends that are graduate students now have two.

VILLA-KOMAROFF: I don't know how often it happened at other places, but at MIT, it hadn't been the practice in the past. And that happened because when I went to David—I went to David first—and asked to be in his lab, he said he didn't have any room, really. He had a big lab already with a lot of postdocs. So then I went to Harvey and said, "What about this idea? And I could be in both of your labs." And Harvey thought it was great. So then I went back to David and said Harvey says yes. So it worked out.

And then I went to Fotis's lab. Tom Maniatis [a microbiologist who has had appointments at the Cold Spring Harbor Laboratory, Columbia University, the California Institute of Technology and Harvard University and Arg [Argiris] Efstradiatis [molecular biologist and pioneer in breast cancer research] had just shown that you could copy RNA into DNA using reverse transcriptase, which was what David Baltimore--

SYED: Oh, very exciting.

VILLA-KOMAROFF: --won the [Nobel] prize for. And so Fotis thought we could use that to clone the polyphemus eggshell proteins. Well, that didn't work. The eggs became quite viscous when we broke them to isolate RNA because of the yolk, so it was hard to get any RNA out of them at all, one. So then we thought, "Well, we'll try to clone the chromosomal DNA and find the eggshell proteins using hybridization. We can use that as a way." Well, that didn't work very well, either. And that was my job. At the time, you couldn't do recombinant DNA work in Cambridge. The city hall had made it against the law. That was a time when they were all worried. There was this worry about recombinant DNA that it would unleash some terrible new disease upon the world. It was a big political thing, a little bit like the GMO issues now. But very intense in Cambridge, in particular. Some faculty at MIT came out against recombinant DNA. Some faculty at Harvard did, as well. The mayor had a hearing.

I wasn't here at the time. I was at Cold Spring Harbor [Laboratory, on Long Island, in New York] because, since I couldn't do that work here, I went to Cold Spring Harbor with Tom Maniatis, and he set up a temporary lab at Cold Spring Harbor. So I spent a year at Cold Spring Harbor trying to clone these eggshell genes and not getting anywhere. I would make plasmid DNA and double-stranded cDNA copies of the moth RNA and attach it to the plasmis DNA, then attempt to put the DNA into bacterial cells (called transformation). But I got no colonies of bacteria. In other words, there was no successful transformation.

SYED: Oh, no! That's the worst.

VILLA-KOMAROFF: For a year. Very bad. Really awful. And so when I came back, I didn't have anything, and that meant I had to go back to Harvard without any results, which is not good for a postdoc. And then that led me to Walter Gilbert's lab because I did have some enzymes, and I had learned how to clone. So I joined the Gilbert lab by way of Arg Efstradiatis. He and I shared a bench in Fotis's lab. And that was great because that was very successful work and sort of opened the door for the rest of my career.

SYED: Thank you. Could you tell me a little bit more about your time at MIT? Were there any professors other than Lodish and Baltimore that impacted you?

VILLA-KOMAROFF: Luria was really very important in our lives. He was the graduate officer. And he was just a wonderful person. He was brilliant, first of all. He was the one who conceived of the idea of a cancer center for MIT. He was the one who hired Baltimore and Lodish and all the young people to make it a hot seat of molecular biology, so he was really quite remarkable. And then two other people whose impact really I felt later was Lisa Steiner [MiT Professor of Biology] and Mary-Lou Pardue [MIT Professor Emeritus of Biology] because they were the only women in the lab in the whole department.

SYED: Yeah. Lisa Steiner is really cool. I got to meet her.

VILLA-KOMAROFF: Yeah. Lisa Steiner is a very cool person, turns out. She seemed rather aloof. But as graduate students, we wanted more women in the department, and so we went to go see Luria and [Gene] Brown to make that case. I think that was the first time I had a sense of-- Because I'd worked for Loretta Lieve, and I'd been at Goucher, where the faculty were primarily women in the biology department, it didn't occur to me that there might be

difficulties on the gender side, never mind the minority side. And I think that made it clear in the department.

Boris Magasanik was the most elegant lecturer you can possibly imagine. He would come into a class with no notes, no slides, and he was just so clear. We would go, as graduate students, to the undergraduate course because it was just such an elegant show.

SYED: Which course was it?

VILLA-KOMAROFF: He taught beginning microbiology for a very long time.

SYED: Oh, very cool.

VILLA-KOMAROFF: Yeah. And he also taught an advanced course which I did not take, but we all went to his undergraduate lectures. They were so good. And Gene Brown [MIT Professor Emeritus of Biochemistry], who taught biochemistry for a gazillion years, taught me. And I'm sure taught it the same way. He would start at the top of one blackboard-- we were in a lecture that had the usual three moveable blackboards. He'd start here at the top, and he'd go to the bottom, go to the top, go to the bottom. And by the end of the hour, he was finished, at the bottom of the last blackboard. Very clear. And all of his exams were open book, but if you depended on the book, you were lost.

SYED: That's how open book exams go.

VILLA-KOMAROFF: You couldn't do it. So I think that the whole department was quite a revelation in terms of the intellectual excitement and the partnerships that the faculty showed each other and the respect they had for each other. Everybody teaches in biology. And it was even more so then because it was a smaller place. There was no Whitehead. There was no Koch. There was no Cancer Center. It was just everybody was, at the time, in building six--

SYED: Was it still 68?

VILLA-KOMAROFF: Yeah, building 60-- No, it wasn't built yet. It was where physics is now. Was it 7? It connects directly into the physics hallway. It comes across and connects to the new building. I can't remember which number it is.

SYED: Maybe it's 26, but I'm not sure.

VILLA-KOMAROFF: It could be. I could see on a map, but-- It was a much smaller department. So we got an introduction to everything. And the best course was one of the-- We would take a paper apart and put it back together. It was really a remarkably exciting place to be. And we didn't do rotations. Everybody took courses first so that we all were in the same place, and then we heard faculty lecture for a month in January. Then we chose our labs. Now they do rotations.

SYED: I understand that you helped found the Society for the Advancement of Chicanos and Native Americas in Science while you were a student at MIT. Could you tell me more about that?

VILLA-KOMAROFF: I did. And that happened sort of by accident, in a way. When I was towards the end of my graduate work, Harvey said that if I went and presented my work on the poliovirus translation at the federation meetings—it was a great, big, many thousands of people meeting in Atlantic City—then I could go to Squaw Valley for the ski meeting. No-brainer. I said sure. So when I got the materials for that meeting, in the program there was a notice that said that a group of people was going to get together to talk about Mexican-Americans and Native Americans in science. And I said, I have to meet these people. I didn't know there were any others.

At the time—it's a little hazy; no one can quite put their finger on the number—there were under 20 Native American or Mexican-American PhD hard scientists in the country at that time, in 1973. They had all gotten together at some meeting in New Mexico, where a lot of them had met each other for the first time. And they said, this is silly. Why is this? And so they thought, well, let's meet in Atlantic City at the federation meetings, because all of us will be there, and plan something. And so that's the meeting that was in this program. I went to that meeting, and we decided there that what we should do is have an annual meeting, where we would get students from the southwest, primarily Mexican-American and Native American. It was originally focused at Mexican-Americans and Native Americans—though I must say, from the very first, other Hispanics and other folks started coming pretty quickly—to introduce them to us and to point out that science is a viable career path. And so we started the meetings and planning the meetings and getting the money.

At that very first meeting, there was a guy named David Lopez from NSF and a guy named J.V. Martinez, who was at DoE [the Department of Energy], both of them Mexican-Americans, both of them PhDs, and who had been on the east coast for a long time, although they both-- I don't

know where David was from, but J.V. is Arizona. So anyway, they got initial funding. And then we wrote bylaws and constituted ourselves as a not-for-profit group. All of that took a long time. So we weren't formally a not-for-profit group until the last decade. And we didn't get an executive director until the '80s.

VILLA-KOMAROFF: So the groundwork was we would do the meeting. We would plan it, who would talk. Initially, it was us talking to students. I remember one meeting, there were nine faculty, six students in the basement of a Holiday Inn in Albuquerque. And we learned. There was one year when we were in Arizona, and we would pay for the students to come to the meetings. We'd bus or fly them to the meeting.

And we gave them their round-trip ticket, and half the students took off for Las Vegas. So after that, we learned that students are not born knowing how to be a scientist. And so we began to incorporate discipline. You can do whatever you want at night, but you will be at the first session. You don't get your plane ticket back until you return in this-- We would give them a sheet, and they had to go talk to the sponsors and the exhibitors, and they had to get signatures of the speakers to show that they were there and so forth. So we began to build a sense of how you act professionally, which, if you don't grow up in that milieu, you just don't know.

That worked. The students were impressed that we could-- I remember, once, another young faculty, Maria Elena Zavala [biologist, PhD University of California, Berkeley] and I were registering students at the meeting, and one of the young women came up, and her name was Oaxaca, which is spelled O-A-X, et cetera. And she turned to her friend and said, “Wow, they even know how to say her name here.” It was amazing.

So now, from that tiny group, it's become much more professional. It's held mostly still in the western part of the country, but it's been here in Washington and in Seattle. It's more broadly held. And there's between 4,000 and 5,000 people who come. And there's 26,000 people affiliated and--

SYED: That's amazing.

VILLA-KOMAROFF: --a dozen members or something. So that's been a good feeling to see that.

SYED: Yeah, it's great.

VILLA-KOMAROFF: It's become the number one minority-oriented society. And it impacts-- there are people now that I met as undergraduates, when they first came in. And now the current president, Lino Gonzalez—I met him as an undergrad—he's now the president of SACNAS. And he's also the Head of Proteomics at 23andMe.

SYED: That's awesome.

VILLA-KOMAROFF: So we know that it's made a difference. And now Hawaiians have joined, because they're an indigenous people, as well (the 2019 SACNAS meeting will be held in Hawaii}. The name has been formally changed to Chicanos/Hispanics. From the very beginning, there was the discussion as to who are we for. And in the end, I think you don't help diversity if you are not inclusive yourself.

SYED: Of course.

VILLA-KOMAROFF: And a lot of the universities, when they started sending booths, a lot of the folks who were worried about diversity in institutions around the country were black. So a lot of the exhibitors were the black members of this community, and they became fans. So I'd say 10% to 20% of the membership is also African-American. So it's truly the most diverse society I think there is. It's really fun. It and ABRCMS are kind of the only national action for undergrads. So that's been great.

And I was very heavily involved for the first 10, 15 years, and then life comes along. You get busy with your career. And the meetings-- Cell biology always was the conflict with the meeting or something else. And then it was neuroscience. And then it was cell therapy and ASH, the Hematology Society, which I had to go to when I was with the company. But now that I don't have a day job and just have my little consulting company, I've become more involved. Now I'm on the Nominations Committee and on a committee called the Committee of Senior Advisors. So it's some of us who have been around from the beginning who are there for advice if the powers that be within the society want to ask.

SYED: That's very cool.

VILLA-KOMAROFF: It's not so hard to start something, it turns out, particularly if you have a group of people who are willing to put in the time to make it happen. We tried to do an early chapter here in Boston, and that didn't work too well.

But now chapters are where a lot of the action is. A lot of institutions now have local chapters, and that's now able to be supported better by the central office. And so that's, I think, where a lot of the action is because the society meeting has gotten to sort of an inflection point. It's hard for it to get bigger without having fewer sessions where the whole group gets together. So it'll be interesting to see how it goes.

SYED: That's very cool that it's grown.

VILLA-KOMAROFF: Yeah, it's growing.

SYED: So we need to go back a little bit to your life at MIT. I was just curious to know what your social life was like.

VILLA-KOMAROFF: Well, I was married at the time, and I was there as a PhD candidate. But as a first-year graduate student, Tony was an intern. And in those days, interns were on 36 hours and off 12, so he was basically not around. And once I started working in the lab, then that was pretty full-time, too. And besides that, we were always studying. So my social life at the time was really limited to working with my fellow students on the courses. We had an office. We were all together. We had a pet rabbit because some benighted person thought that MIT would be a good place for an animal--she had a rabbit. She took this rabbit to the biology department. I don't know what she was thinking.

SYED: Rabbits are quite a lot of work.

VILLA-KOMAROFF: That faculty still doesn't know how to deal with live animals except their mice and rabbits for making antibodies. So we had this rabbit who would be in our room. We'd take turns taking care of the rabbit. And we'd walk the rabbit on a leash. For a very long time, there were guards who would remember me when I'd show up on campus because, oh, you're the one who had the rabbit on the leash, because we'd go walk the rabbit.

And then, when I got into Harvey's lab, a group of us would go skiing every Wednesday.

There was a postdoc who said we should go skiing, and it's better to go in the middle of the week because it's not so crowded. And Harvey objected once. He said, where were you guys? What do you mean going skiing in the middle of the week? And we said, Harvey, does anybody leave before you

do? No. Are we here when you come in on the weekends? Yes. So what's your beef? So that was great.

And then we would take vacations with this group, as well. So there were a group of us. There was a place in British Columbia where it's a 40-mile circuit of rivers and lakes, so we did a backpacking community trip together.

SYED: That's very cool.

VILLA-KOMAROFF: So life was pretty much revolved around either MIT or the medical community, where Tony was involved. And otherwise, it was pretty limited.

SYED: Did you have a lot of classmates who were women? Or was it proportionate?

VILLA-KOMAROFF: There were four of us out of the 12. It was me and Barb Baumstark [MIT Biochemistry PhD 1976] and Eva Aufreiter and a fourth woman, whose name I can't remember. The department, biology had a good ratio of women to men pretty much all along in the students, but not in the faculty. Now it's really nice to see. The young faculty are great. So there was less gender stuff there. It was quite different than, say, chemistry at the time or some of the engineering classes, where it still can be a little bit tough. And geology is really tough. Geology and physics are fields where it's still nowhere near where it needs to be. And there were people we knew we had to avoid, but for the most, part, we were pretty happy with it.

SYED: That's good.

VILLA-KOMAROFF: We had a reunion for David Baltimore's 80th birthday in March. One of his former postdocs, I think, had drawn a tree with the name of each of his trainees. There was the MIT branch and the Rockefeller branch and the Salk branch and the Caltech branch. It was pretty cool. And people came because it was such a great time. So there wasn't that sense in that department, except that we were aware that there was a real problem in the faculty. And it took a long time. I mean, after I graduated from MIT—I think it was a year or two later, maybe when I got my first faculty job—I was on the visiting committee. And my job there, I felt, was to ask about women and ask about minority students, because at the undergraduate level, the biology department and MIT generally has done pretty well, which isn't to say great, but at least as well as anybody else in the country, and better than some. And it's gotten better.

So I would ask, and the faculty, all of whom I knew and admired and respected, would say, well, we're so good that the good people will come to us. And they didn't really think they had to do anything. And then when NIH said you have to have more than lip service for diversity or you're not going to get a training grant, that's when the department responded, and it was true nationwide. So that's when they started thinking about it, started the summer program, brought in Mandana [Mandana Sassanfar, Director of Diversity and Science Outreach, MIT Biology and Brain and Cognitive Sciences], who was in the department. She runs the summer programs and other stuff.

SYED: Yeah, I did the biology IAP crash course with her. She's great.

VILLA-KOMAROFF: She's terrific. And that's made a big difference because, I think, that through that program, the faculty has realized that there's a segment of talented people that they wouldn't see if they don't make it clear that those people can be successful here. And now, one of the faculty was a student in that summer program. Eliezer Calo, happens to be Puerto Rican, and is a dynamite scientist. So MIT has come a long way. Women generally have done better than minority folk all over the country. The curve of increase is at a faster rate than the curve for minorities in the country. But MIT is in a pretty good place. And it was really fun to see the spirit and the diversity within the department at this retreat. It was great. So that was really fun. And now I'm on the visiting committee again, and it's a pleasure.

SYED: To kind of go back to right after you had worked at Cold Spring Harbor and done your postdoc, could you tell me a little bit more about your research path after that?

VILLA-KOMAROFF: After my postdoc-- In my postdoc, when I went into Wally's lab, that was one of the most exciting-- In many ways, it was the most exciting because everything worked, which just never happens. So Arg Efstradiatis had spent a long time figuring out how to isolate RNA from pancreas, which that's where ribonuclease is made. So you break the pancreas and you destroy RNA.

John Chirgwin in California had shown that guanidine thiocyanate was a potent inhibitor of ribonuclease. So we were competing to buy this guanidine thiocyanate. So Arg also had-- They learned about Bill Chick at the Joslin Clinic, and he had done a quite amazing thing. There's this technique where you join two rats' bloodstreams together, called parabiosis. So he had irradiated a rat lethally, and then he connected it to a

healthy rat and waited. And the lethally irradiated rat lived because of the healthy rat being connected to him and developed an insulinoma. And that was passagable. So by taking the tumor and injecting it into other rats, you could make large amounts of the tumor that was making lots of insulin. So while the folks in California were dissecting pancreases out by the ton and using pounds of thiocyanate to get RNA, we had the tumor. And Arg had made RNA. I knew how to use reverse transcriptase. Arg would do the reverse transcriptase and make it double-stranded, and then he'd give it to me, and I would clone it.

And so we were doing that, and we got the insulin clone. That we also got a clone that was making insulin was pure luck. That was a wonderful day because one control that I always did was the plasma that we put the insulin in had two drug resistances. And if you got an insert in ampicillin, that was our cloning site any clone with an insert would be ampicillin resistant and tetracycline sensitive. So I always would double plate (i.e., duplicate plate each colony on both amp and tet plates), even if I knew there was an insert, just because. And one day, I went in and one of the colonies which should've been amp sensitive wasn't. It had an insert, and it was not amp sensitive. And given the site, I interpreted that to mean there had to be read-through, and we were making a hybrid protein, a beta lactamase insulin hybrid. So I got all excited. And the first thing I did was go to Bob Weinberg, because he's a very good friend—he's Tony's best friend, in fact—and said, “I have the most wonderful news.” And he said, “You're pregnant!”

SYED: No.

VILLA-KOMAROFF: So I went down the hall to tell David, and he got it right away. And then I went back to tell Arg, and he said, “Oh my god, don't even tell the priest.” And then we told Wally. Stephanie Broome, in the lab, had developed a test that would allow us to see if it was making the hybrid protein, and it was. So then we started writing. And then I started looking for a job shortly after that. There was a big hoopla because Wally called us up one day from Chicago. We were trying to get a prettier picture for one of the figures. And he called us up and said he had promised one of the reporters at The [Boston] Globe that he would let him know what we were going to make this public. He said, “I'm going to give a seminar, so I called him up and he's going to come see you tomorrow.” And it started a mad rush because he gave the seminar. It made national news. It was in the Wall Street Journal, The New York Times, everywhere.

SYED: That's so exciting.

VILLA-KOMAROFF: We had people calling, and I was showing them labs, and Arg was talking-- it was really a crazy and fun time. So it was in that vein I was looking for a job, and I got an offer at the University of Massachusetts Medical School, where several of the people who had been postdocs were now on the faculty there at MIT. They were postdocs at MIT, and they'd gone to there. So I took a job there. And initially, I took a leave so that we could go to England to try to clone the human insulin, which there's a book called Invisible Frontiers [by Stephan S. Hall] which describes all that. And it was another bust because we had contaminated the cDNA with the rat clone. So we recloned the rat in our mix. We've never known whether it was me or Arg who did the contamination. A colleague, Nadia Rosenthal, who's now the Head of Research at the Jackson labs, called it transtubation because the reverse transcriptase is so sensitive that if you get something on your fingers, it's easy to contaminate. So we never really knew where the contamination came from. But it certainly wrecked that trip.

SYED: Oh, no.

VILLA-KOMAROFF: So I came back and set up my lab. And there I made what's a classic mistake, which is that-- OK. It's not that I was the only woman in the department. It was a department of 10. There were five men and five women. All of us were married. Yes, everybody was married. All the men had kids. None of the women had kids. Interesting observation one. And two, as the only minority woman, I was asked to be on all the committees. And I do that-- Organizational things I'm good at. And I hadn't learned how to say no. This is something you need to learn, like, now!

So I was on a ton of thesis committees, and I was on lots of university committees and lots of departmental committees, and I was off giving talks, as well because the insulin stuff still was generating invitations. So that meant that the lab work suffered. And I didn't have as many papers as I needed. So when I came up for tenure there six years later, ah, it was not a slam dunk, to put it mildly.

Fortunately, one of the people on my committee was Susan Leeman [endocrinologist; then-Professor at UMass Medical School; at other times, Professor at Harvard Medical School and Boston University]. She's the woman who discovered Substance P, and had also gone to Goucher, it turns out, so we had this bond. So she was on my committee, and she was the one who kept me sane. She'd peel me off the ceiling and had lots of

Kleenex when I broke down and all that jazz. It's never easy anyway going through tenure process, but if you're a weak case, it's much worse. So that was tough. I did get tenure in the end and decided, well, this is obviously something I have to pay attention to. I need to go where I know I can get work done. So I left UMass and went back to Harvard to a non-tenured position and set up a lab there. And that was a good move for the wrong reason.

Good science doesn't depend on where you are. It depends on what you do and what you think about and who you bring in to work with you and so forth. But for me, it focused my mind to be back in that environment. And I had a great time. There what we did was we-- I had taken as my role model, really, Wally Gilbert. The way he ran his lab was people came in with interesting ideas, and he followed them up. He'd let people follow them up. Of course, he also generated lots of interesting ideas. I think what I didn't fully appreciate was that that was becoming an increasingly untenable way to run a lab in the funding environment that was developing at that time. And I did it for eight years. At the Children's Hospital, we continued to do work on insulin production. So there was some cell biology we did, where we were interested in-- Insulin is one of those proteins that's secreted—processed and secreted. We did some work showing that if you mucked around with the c-peptide that you would interfere with the secretion of the molecule.

And that group continued. He was a visiting graduate student in my lab, a visiting postdoc in the Joslin Center. And so they continued that work there and did some very nice work on the secretion of insulin. We did some work on IGFs, which are insulin-like growth factors, for example, production in the developing oocyte because a guy came to my lab, and he's an obstetrician, and he was interested in early, early, early development. IGFs were known to have something to do with that. They're very abundant in the early embryo and egg. So we showed that IGFs were there. It was one of the early demonstrations of how early IGF is present. He became the chair of obstetrics and gynecology at Beth Israel, and now he's at Mass General.

There was a guy in the department who was interested in vision. In cats, there's a critical period. Cats are a favorite model for studying the development of vision. And so we wanted to bring molecular biology to that and looked at the expression of what was then called immediate early genes. They were transcription factors, we now know. And we showed that those were developmentally regulated and important in the development

of the visual system during the critical period. And we did some work on beta amyloid and Alzheimer's disease. And a neurologist who hadn't had lab experience up to then came and wanted to do that. So we looked at beta amyloid. What we did was we cloned it and put it into PC12 cells, which you can differentiate them in culture into neuron-like cells. And we showed that the expression of the beta amyloid peptide—the thing that you see in Alzheimer's brains—killed the cells. So it was the first direct evidence that beta amyloid had a detrimental effect on neurons. And Bruce Yankner is now a full professor at Harvard in the Department of Neurology and continues to do really nice stuff.

And there was some other stuff, but it was kind of a hodgepodge, which is a lot of fun for someone like me. I have broad interests. But if you don't have a thing that's your thing, then it becomes harder and harder to maintain a lab when you have to bring in the grants to support the work in the lab. So after eight years-- I was at Children's, as well, involved in the administrative life of the institution. I was a little bit better at saying no, but not a lot. So I worked on the graduate programs at the medical school and was one of the people who helped build a system for getting Harvard faculty nominated for important prizes, helped build the Enders building. I learned a lot during those years, and it was great scientifically. It was really fun.

It took a long time for me to look back at those papers and appreciate them. I don't know what that says about me, but everyone knows me for the insulin work. That's something that stands out in my career. The other stuff, they're not as important as that finding or as public, but they're good, solid stuff. And then I decided maybe it was time to do something different and began looking around, thinking I would go back to the lab and concentrate—you know, do the thing you needed to do as a scientist. But I ended up going to Northwestern instead to be the vice president for research there, which was great. I loved that job.

SYED: What was that job like?

VILLA-KOMAROFF: That job really gave me a chance to really use the skills for organizations that I had developed. I started as the associate VP. And the job, when it's done right, is what the job of the administration generally should be-- to make the institution a place where scientists and researchers in all fields can do their best work most easily, so that the bureaucracy doesn't get in the way. It's helpful instead of getting in the way. And Northwestern was at a place where it was sort of a B-ish place. Lots of good things, but it hadn't

really cracked the top. It had a lot of work that needed to be done on the infrastructure. It had fixed its financial problems, and it had a new president who was a dynamite fundraiser. It's a great place to be an administrator because you can say yes more often than you say no.

And so I went in to work for a guy, Bill Kern, who was the vice president for research when I first went there. And he turned out to be as important a mentor in how you run an institution as David had been or Harvey had been in science itself. He was a theoretical chemist. So after two years, they did a nationwide search when Bill retired, and I became VPR. And that job was really fixing the infrastructure so that it was simpler to take care of all the regulatory things that a faculty member has to worry about. We did things like provide money for graduate students in the social sciences and in things like-- There was a faculty member who was studying ancient Buddhist caves in China. She had a vision of taking three-dimensional photographs of these so that they would be more accessible to the world. And so we bought her a plane ticket and a camera—a fancy camera, but a camera. And that set her off and running. It was a wonderful project, the Dunhuang caves. So sending people to meetings, encouraging people to use their creative selves, often all it took was just saying to somebody, you can do this. I also liked helping recruit faculty that are really good.

Also, there were hard things to do. I had to close some of the research centers that were there, and we opened a couple of others. But altogether, it's really a job of not being the person who's doing the work, but part of the infrastructure that makes the work possible and also creating an environment where faculty could be entrepreneurial. They hadn't figured that out yet. So the very first company at Northwestern that went public was one that I helped the faculty member get going, and that was fun.

SYED: So speaking a little bit about entrepreneurship, I noticed that you've been involved with a lot of biotechnology companies. Could you tell me about that?

VILLA-KOMAROFF: The first one was really Biogen, indirectly, because we didn't know it, but Wally Gilbert was talking to people about founding one of the early companies, Biogen. And Biogen was founded based on the premise that it would make insulin. But it never made insulin. When I left his lab, he offered me a job at Biogen, and I didn't take it. I wanted to see what I could do by myself. But he made me an advisor to the company and gave me a grant for my lab, which was extraordinarily generous and important. And that meant that I got to see up close the development of Biogen from us in

his lab to Biogen. And that meant that I saw what it took and how a biotech company can grow and what some of the pitfalls are. It was incredibly instructive.

But most of my classmates were involved in companies much sooner than I was. When I started at MIT in graduate school, the attitude was that if you went into business at any level, you were a failure as a scientist, that you had to do that because you couldn't do science. By the time I left MIT, every single one of the faculty had involvement with a company, either as a scientific advisor, or they had founded something, or they were trying to found something. Even the people who'd been against recombinant DNA were involved in companies. So it was quite a change in attitude.

It was an interest that I had, but I didn't do anything about it until I got to Northwestern and could help people get going. And I also took-- There's executive education type stuff—all business schools have them—programs where rising executives can come and learn stuff. So at Kellogg, which is the business school at Northwestern, there's basically business school in a box. It's one month, residential, 24/7, everything you need to know for business, and it's mostly for people who are mid-level executives who the company sees as stars that can grow up to be CEOs and business leaders. And the dean of the business school got me into that program, the Advanced Executive Program. He invited me to take that program without paying the tuition, which tuition at that one-month course was probably $30,000. (In 2019, the tuition will be about $45,000 and the name has changed slightly from the one on my certificate.)

SYED: Wow.

VILLA-KOMAROFF: And companies usually pay it. So they waived it. I just paid for my books. And it taught me a lot of important things formally about business-- HR and most importantly the financial aspects of it, which when I came back to Boston, stood me in good stead. So now I had the formal things I needed. So I became a member of a board of a company called TKT, which was a for-profit company making enzymes for rare diseases. And Wally was on that board. And the guy who was CEO, Michael Astrue, had been a young lawyer at Biogen in the early days, so we had known each other then. So this was a great opportunity to learn stuff. It's a seven-person board. I was the only woman, and the youngest, and the least experienced in business.

And through happenstance, I became the chair of that board at a time when Shire Pharmaceuticals wanted to buy it. That was a very interesting

period of time. It was incredibly pressured and hard work. I was, at the time, at the Whitehead, working as the VPR and COO. But Susan Lindquist [MIT Professor; molecular biologist; first woman to lead the Whitehead Institute; recipient of the National Medal of Science] had decided to go back to the Hughes, and so things were kind of in limbo, so I had the time to do this good thing. And in the end, Shire did buy TKT, and it became Shire Genetics and worked out fine. So that gave me a taste for things.

And after things sort of sorted out at the Whitehead and I decided to leave there, I joined a company that Wally's son, John Gilbert, had started. Wally said, you did well in TKT. John could use your help. He's having trouble with his board. And it turned out John didn't need me on his board. He needed me in the company because, like many entrepreneurs, he's a brilliant guy. He had a great idea. He wasn't so good on the management part.

SYED: What was the company?

VILLA-KOMAROFF: The company is called Cytonome. Still around. And it builds cell sorters. His vision in 2002 was that, if you had a cell sorter that sorted cells gently, rapidly, sterilely, and in very large numbers, you could use those cells for therapeutics. And he was thinking about bone marrow transplants; separating out the bad T cells that attacked the patient, or enriching Tregs, cells that inhibit the attacking cells. And he had the basics of a microfluidic chip that could be very high speed and sterile, so you could separate the optics from the fluidics. Great idea. Little ahead of its time. And we all underestimated the difficulty of the basic engineering of putting all the pieces together.

So I joined the company. I said I'd go for a year to help them get the management part right. I think it was five or so months in we decided-- A few months in, we decided to flip. I would be the CEO and he would be the chief technical officer, because that would play to both of our strengths. And then he decided that wasn't really working. He had a hard time, as he should. It was his baby. He was the one who developed this idea. He hired some really talented people. It just wasn't working. So he decided he would just go found another company, which is what he's good at. He's now, I think, on his fourth company startup. He's really good at that.

I took over the company. I also had to find money for the company. That was in 2007, just as the economy started crashing. So I spent the next three years trying to find money to fund the company. Wally and I and an angel funder kept it going for those three years. I found a partner, not a VC. I

talked to a lot of people, over 200, and finally found a guy who was interested in the technology who knew nothing about the medical or biotech world. He's a guy whose vision was that since you have to replace a milk cow every three years, it would be ideal to be able to separate female sperm and male sperm, because you don't want males when you're making milk cows. You want females.

He had bought all these old cell sorters—they're called MoFlos—that people didn't want. And he cobbled them together and he put them in a big building. He had like 60 of them. And he was sorting sperm. He'd had a crew of people who had developed ways to separate the sperm based on the DNA content. There's a 4% difference because of the X and Y DNA difference. And there's a dye that binds stoichiometrically, so you can separate the sperm based on whether they have a male or a female chromosome. And this could be a big thing, except that keeping MoFlos, especially used ones working—because he was tight for money, he didn't want to buy new ones—was really limiting his company. So he was interested in any technology that might help that.

He visited us because he saw us online, brought with him a really brilliant young engineer who had been one of the people that developed the MoFlo. And so he came in with the money, rescued us, so to speak. John Sharp came in, and he was a perfect person to be the CEO, and I stepped back to chief scientific officer. And John Sharpe came up with a machine for Juan Moreno—that's his name—that would do nothing but sort bull sperm.

MoFlo's a complicated machine. You need a PhD to operate that thing. They're kept in facilities in the universities, and you sign up for it, and people watch you, and it's hard to set up and hard to use. Our machine is easy. You roll it out of the shipping crate. It's big, but it's very robust, and it's very easy to use, and it only does one thing. It just sorts sperm. So now we've got a couple hundred of those out in the world, sorting sperm for Juan, and his business is gangbusters.

In the meantime, John's dream machine was putzing along. We were now a whole new company. We were an LLC instead of an Inc. And I left management of the company in '14. I'm on the board. And now, the dream machine has reached a point where it's in a facility in Japan. Sumitomo is a drug company that has built a cell therapy development lab in Osaka. And our machine is there, being used to sort iPS cells that have been differentiated into neurons for an unspecified neurological disease. They're

going to be doing a clinical trial sometime in the next year or so. (Update: the machine has sorted cells that will be used in a clinical trial to be started later this year—2019.)

So far, the machine has performed for them fine. They came here to make sure of that, and then we built one under GMP procedures so it can be used in a clinical trial for them. If it works, then they'll write a paper, and that will go a long way to making the company successful.

The other thing that's happened is that the company's also developed a desktop sorter. It's not much bigger than a large toster oven. And it'll fit in a biohood, which means a droplet sorter can be used for sterile sorting without having a whole sterile room. What the company's hallmark is that we build cell sorters that free you from having to have a specialist run it. We want to make the cell sorter equivalent to a PCR machine. It's a desktop tool. And that machine—we called it the Viva—is going to be distributed by Thermo Fisher, and they're releasing it now to just a few labs on the west coast, and then it'll wrap up next year, if everything goes well. (Update: Thermo has released the machine as the iSORT on the West Coast.)

SYED: I hope it goes well.

VILLA-KOMAROFF: Yeah, me too. So right now, things look quite promising. It looks like the company will make it. So that was my foray into running a company.

SYED: That's awesome. So I just wanted to ask, in general, how your experience at MIT kind of impacted the trajectory of your life as a scientist and as a person. You'd spoken a little bit to the various experiences you've had there.

VILLA-KOMAROFF: Yeah, I think it really was formative and transformative because it took what was kind of an amorphous dream—I want to be a scientist—and helped me to understand what a good scientist is. It was at MIT that I learned rigor of thinking, self-questioning, humility, i.e., "don't be too confident," because the key thing to ask is, “Well, OK, this is a great idea, but how could it be wrong?” Which doesn't come naturally. It taught me self-confidence. I was someone-- In the Mexican culture, or at least the Mexican-American culture, asking questions is not something that's viewed as polite. So it's hard to overcome that. And those guys really made it a point to say, this is part of what you have to do. And just the back and forth in a group meeting was really instructive and an important component of

speaking up. So all of that was key. I mean, it really made possible my career in a way that I don't think would have happened had I gone somewhere else.

I wouldn't have had the exposure to these people. Because when you come from MIT, when you've got MIT on your CV, that means that people make certain assumptions about you, which are positive.

SYED: Yes.

VILLA-KOMAROFF: So it really makes a huge difference to have MIT in your background. That's why I tell students, you really must aim very high and go to the best place you can go to because it just makes life easier later. It's not that you can't overcome a slow start or that good scientists who have gone to other places. It's just that it's easier. So if you can, you should. It's like getting good grades in the beginning. Do it. It's just really much easier than trying to explain why you failed organic. I think it was really key.

I'm eternally grateful to MIT, really, and that's why I stay involved, both with the institute-- I've been on several committees for it. That's why I do the visiting committee. That's why I stay in touch with people in the department. It's because it was so transformative. So I've talked to the students at all levels—undergraduates, graduates, postdocs—and will continue to do that, because it's a good place.

SYED: That's really great.

VILLA-KOMAROFF: Yeah.

SYED: Do you have any advice for women at MIT or women in science in general?

VILLA-KOMAROFF: I think probably the most important thing is to recognize is that there is this gender bias that often is not conscious, that a lot of the bias against women is something that's deeply rooted in how human minds work. And really what I'm doing now is trying to get this message out.

This happened because I was on a committee at the National Academies of Science, Engineering, and Medicine. It was a committee that was called the Committee of Women in Science, Engineering, and Medicine. It's a committee that looks at issues for women scientists across the board.

And we did a workshop. We decided to do a workshop on minority women in academia. So I was asked to chair this workshop. And I said, “Ugh, we've done this so many times.” And so I said, “OK, I have to have a cochair.” And Florence Bonner was the Vice President of Research at Howard. So I said, let's do this together because we need to do something different. And she is a social scientist. And she pointed out to me very gently saying in essence, the thing about trying to get diversity in STEM or anywhere else is that you guys, meaning physicist, chemists, biologists, engineers, get together, and you discuss the problem, and you agree that there's a problem, and you agree that something should be done about the problem, and you try to think about methods to do this without really knowing or understanding what it is that we know about human behavior and how people behave as they do.

We did a workshop where we looked at some of that information. We had experts in that come in to talk to us. And that, for me, was another one of those, ‘ah ha’ moments. I read Kahneman's book *Thinking, Fast and Slow* and Mahzarin Banaji's book *Blind Spot* on implicit bias and Claude Steele's book, *Whistling Vivaldi*, on stereotype threat, and *Lean In* by Sheryl Sandberg, just a whole bunch of stuff. And then I started reading the papers, which are much harder than the books because, like all technical papers, they use the language of the field, which is opaque until you’ve learned it.

But what it told me was that people make decisions without realizing that they're being informed by a cultural climate which they are not in control of. And you can overcome these implicit biases, but first you have to know they're there. And you have to invoke the part of your brain which is rational in order to not make bad decisions. My job right now is to provide the data that says that people do this to my skeptical colleagues and to also provide the data that says that there are steps that can be taken which are relatively simple, because faculty don't want to hear about something complicated that they have to do on top of the things they're already doing, that can really make a difference. And so I've been going around the country giving a lecture on implicit bias—sometimes it focuses more on women. Sometimes it's women and minorities. Sometimes it's mostly minorities. And it varies in length, depending on what the talk's supposed to be, who I'm talking to, all that stuff. And I find that interesting and satisfying.

If women need to understand this, understand what the biases are that tend to be there, they need to understand how they can undermine

themselves, sometimes through processes which are kind of the result of internal implicit bias, because if a society has an implicit bias against women or blacks or Hispanics, everyone in that society shares that bias, including the women, the blacks, and the Hispanics. And so we need to be able to develop mechanisms to protect ourselves from turning that on ourselves in a negative way. So that's one piece of advice.

A thick skin, can be part of that, really. I think that's what helped me. I just didn't notice. So you can develop a thick skin. You can develop a core of friends and colleagues and advisors who can give you feedback about when somebody really is acting inappropriately or when you really need to shore up one thing or another in your own behavior or work.

I think a lot of women who are very talented and could be successful are sensitive to criticism because they view it as an attack and can't separate criticism which is truly negative and not fruitful from criticism which is really helping you be your best you. That's certainly not easy to do, but you have to at least know that that's part of the issue before you can do something about it. So I think that's the main thing.

The most important thing is probably-- It's very much a cliche, but there isn't anything that's not hard in some respect or another, so you need to pick something that gives you a lot of satisfaction in ways that you want to be satisfied and that suits the life that you want to live because there's going to be aspects to it that are going to just be hard. You need pleasure in there as part of the basics. That would be my advice.

SYED: Thank you very much. Is there anything else that you would like to add?

VILLA-KOMAROFF: I think I've shot my mouth off a lot!

SYED: It was wonderful to talk to you.

VILLA-KOMAROFF: It was good to talk to you.

SYED: Thank you so much for your time.