Interviews of the Margaret MacVicar Memorial AMITA Oral History Project, MC 356

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Lenore Blum – PhD class of 1968, Course XVIII, Mathematics

Interviewed by Madeleine Kline, class of 2020

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Margaret MacVicar Memorial AMITA Oral History Project

Lenore Blum (PhD Mathematics, 1968) was interviewed by Madeleine Kline (SB Biology and Chemistry, 2020) at the Cambridge Hyatt hotel on June 2, 2018.

Professor Blum is a prominent mathematician known for her leading-edge research in aspects of both mathematics and computing, including model theory and complexity theory. She began her higher education at Carnegie Tech (now Carnegie Mellon University) before transferring to Simmons College, where she took a mathematics course at MIT. She earned her PhD in mathematics from the Institute in 1968, with a thesis in generalized algebraic model theory.

Professor Blum was a postdoctoral fellow and lecturer at the University of California, Berkeley and then taught mathematics at Mills College, where she founded and headed the Mathematics and Computer Science Department. She spent a year at IBM, co-developed the Blum-Blum-Shub random number generator and spent two years in Hong Kong, where she co-wrote *Complexity and Real Computation.*

In 1999, Blum joined the faculty of the School of Computer Science at Carnegie Mellon University (CMU), where she, her husband Manuel and their son, Avrim Blum, have all been professors. During her time at CMU, she has greatly improved access to computer science for female students which now has gender parity in its undergraduate major. She co-directed the NSF-seeded ALADDIN (ALgorthim ADaptation Disseminiation and INtegration) Center, founded Project Olympus, CMU's startup incubator, and was faculty director of the university's Swartz Center for Entrepreneurship.

Professor Blum has also played a significant role in encouraging women's participation in mathematics. She was a founding member and third president of the Association for Women in Mathematics; founded the Expanding Your Horizons conferences, which encourage young women in middle and high school to excel in STEM subjects; and founded the Summer Math Institute at Mills College. At Carnegie Mellon, she founded Women@SCS, which addresses issues faced by women in computer science. She has served as the deputy director of the Mathematics Sciences Research Institute (MRSI), received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring in 2005, and is a fellow of the American Association for the Advancement of Science, the American Mathematical Society, and the Association for Women in Mathematics.

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1 Early Life and Childhood

KLINE: I'm interested in your early life and childhood; I think it sheds so much light on people's careers and development. Maybe you can start with what your parents did and what your siblings were like.

BLUM: My mother was a child of an immigrant family. She had three sisters and a brother. Her parents lived, at least first, on the Lower East Side of New York, which was a teaming immigrant place. They ran a small grocery store. They had few means but they made sure that each child had an education. My mother and her three sisters became teachers and lawyers, and their brother, the oldest sibling, became a doctor.

Education was really key. I think that's a common thing in Jewish families, and particularly in immigrant families, where education is viewed as the way to move up in the world. So here are these fairly poor people with little education themselves, and then their five children all became professionals, which I think is quite remarkable.

My mother's eldest brother, the doctor, died very young. My mother was studying to be a doctor, also. When her brother died of leukemia, it was a great tragedy for the family. He had been handling radioactive materials that in those years, no one knew were dangerous. My grandmother was sure that was the cause of his death. So she wouldn't let my mother continue in medicine, and so my mother became a science teacher. It was the family tragedy and not because she was a woman that they didn't want her to become a doctor.

I grew up in New York City, though I don't remember the first couple years of my life. My dad was in the Navy. He was drafted a little after I was born. I know that my parents took me to Maine for us to be near his training camp. We went back to New York after my dad's training when he was sent to the South Pacific.

I lived in New York City, in Queens, in a very Jewish area. I didn't know anyone who wasn't Jewish, not at school or in the neighborhood, except for one family. We lived in an apartment building, which is typical in New York, and one family on the first floor was Irish Catholic. They had a daughter Maureen who was a year or so older than me.

Ever since I can remember, my mother was working. After my father was drafted, they didn't have much money. I think they got $25 a month stipend from the Navy, or maybe it was $25 a week. My mother was teaching, and my

aunt Lottie who was living with us was also teaching. My grandmother, my mother's mother, also lived with us.

I suppose they thought my grandmother was my babysitter, but since she was elderly, I became the one taking care of her during the day. I am very grateful for that experience because my grandmother taught me many things, including how to speak and read Yiddish. Because we were very close, I was her only grandchild who understood Yiddish. She taught me how to sew, how to knit, how to bake strudel, all these things. Even though I had to take her outside every day to sit with the other elderly people --which you might think I would have resented-- I didn't. I really appreciated that. There was a kind of Jewishness that I felt a part of. Although she was religious, I was not. I would help her on Saturdays tying things, [tying some knots are forbidden on the Sabbath by religious Jews], turning the stove on. I was totally non-religious.

I had a very close-knit family. Another of my mother's sisters lived just a couple of blocks away, and my two cousins, who were about my and my sister's ages, spent a lot of time together. They were our best friends.

Because my mother was a science teacher, and my aunt, who was living with us, taught in a program for special needs children, I always had a lot of pure creative things to play with at home. My mother would have access to a lot of basic science equipment and science materials, which she'd bring home to show me. And my aunt, because of the program that she was teaching in, had a lot of art material, colored paper and pens and colored pencils, and she'd also bring home some of those things for me.

So, I used to have this raw material—art material and science material—even though we couldn't afford to buy science kits or art kits for me. I actually had better stuff, the raw material, than store bought material. For example, I would have a huge piece of red construction paper to work with and good pastel colors. So I was always doing projects from an early age on my own. Even when they were working during the day -- even before I went to school, I was always doing projects. In fact, from an early age, I did a lot of things on my own.

KLINE: And you had siblings?

BLUM: I had a sister. My sister died a few years ago. My sister was two years younger than me.

KLINE: I'm sorry.

BLUM: One thing that was really important for me in my childhood was, we spent every summer at the beach. In those years, we didn't have air conditioning, and New York summers were brutal, so we would go to the beach --my mother, my sister, my grandmother --and our two cousins would often come along. New York has quite nice beaches, really, right in the city. Rockaway Beach (which was devastated during one of the recent floods) was a lower-middle class enclave where you could rent a bungalow for the whole summer. It actually had a quite gorgeous white beach. And there would be these little bungalows, one after another after another after another, crammed with families. But it was so much fun because all us kids could just walk out and we'd have lots of friends and we'd always play together. And always there were projects to work on, such as magically turning cigar boxes into jewelry boxes by pasting our collection of shells artistically on the outside. Those were wonderful summers.

Every day, I'd have to take my grandma and her folding chair to the beach, and seat her under the boardwalk so she could be in the shade. But again, I don't think I ever resented that. All the other kids would run ahead and I would walk slowly behind because she had a hard time walking. I don't know. I just felt fine doing that. I think I became a kind of a grown up very early on. Independent, very early.

About my dad. He had been a social worker before the war; afterwards he became a businessman. He was in partnership with my uncle. They had an import/export business out of New York. I often asked him why he changed to be a businessman and didn't stay a social worker. There were probably many reasons, but he said after coming back from World War II, he just could not do the work he had done before. The war changed him a lot, that's what he told me, and he didn't have the stomach to go back to what he had done before. That's what he said. But business was not in his nature in any way. When he started a business and it was going really well, he would give his workers part of the business. I guess it was sort of like his still being social worker, making sure everybody else was taken care of. But that's not the way to run a business. Eventually, his workers took over.

KLINE: Was he from an immigrant family as well?

BLUM: Yes. My father's family came from Russia, and my mother's family came from north Poland. My father's family-- my grandfather was very intellectual --they weren't rabbis because they were agnostic, but they were very intellectual, not business people at all. Not at all.

We moved to Venezuela because of the import/export business. When did we go? I think we went in 1952. My dad had gone a little before that. I think it was because of the political times also. This was the McCarthy era. I don't know if you know about that. And I think because he had been a social worker and my mother had been a teacher in the New York City school system they were disillusioned, maybe afraid-- There was a lot of paranoia in New York at the time.

In fact, we had a television set early on in New York. Very few people had televisions in the early '50s, late '40s. And I remember my dad watching the McCarthy hearings on television. It was the first time I remember my dad ever paying attention to television. I think that was an element of why we left for South America. My parents had friends who were-- I don't know if you know what the Abraham Lincoln Brigade was?

KLINE: No.

BLUM: That was a brigade of Americans—Hemingway might have been a part of that, too—that went to Spain to fight the fascists in the Spanish Civil War. I remember when I was just nine and we were going to Venezuela, and my mother had these letters from her friends. In those years, apartment buildings had incinerators, and she decided to throw them down the incinerator. And even though I was just nine, I was really upset, because I thought this was history. You don't want to throw away these letters. But you could imagine at that time that my mother wouldn't want to have these letters from her friends in the Abraham Lincoln Brigade, because everybody was being called a communist. But I remember vividly realizing that was part of history.

KLINE: That's really interesting.

2 Moving to Venezuela

BLUM: In 1952, we moved to Venezuela.

KLINE: You went to Venezuela because your parents knew people there, or why?

BLUM: Well, as I said, my father was in the import/export business, so he was going to be in Venezuela as the import part of the place where they were exporting to. My dad would be importing hardware for building supplies and things like that. Venezuela today is in terrible shape for a lot of reasons. Even though Venezuela had lots of resources—oil was the big one, but also, iron ore, gold-- they never

developed local industries because of the oil. The government was able to survive on the oil revenue. So they had to import much of what they needed. My dad also had a sister who was living in Venezuela. Her husband was a Cuban engineer who had been developing engineering projects throughout South America and they ended up in Venezuela. So, I think that also was a reason my dad went there, because his sister was there. So, there were some connections to Venezuela.

When we got to Venezuela—at first, my father had gotten us some rooms in a private house in the Jewish section of Caracas, San Bernardino-- there was a very large Jewish community then in Caracas. The Jewish community consisted of two parts. One was the Sephardic Jews, who had come very early to South America. Then there was the other wave of Jews who had come because of the war-- the Sephardim had in large part sponsored these Jews to come to Venezuela when other countries, including the US, were closed to them. My father thought the Jewish section would be a good place for us to live. In that community, there was a small school, a Venezuelan school, that my parents thought would be good for my sister and me, because we'd learn Spanish faster.

KLINE: And had your aunt and grandmother come with you?

BLUM: No, they did not. And in those years, there was no internet. Mail from the US took a month to come. I think it was a big thing for my mom to lose this close-knit family of hers -- she always thought we'd go back to New York. We actually did every summer. Every summer, we would spend three months in New York with the family at the beach as we had before. [LAUGHS] So my spending every summer at the beach continues. It was also a little sad because my mother would then be the sibling to visit with all her aging relatives. But we'd also go to the beach, which was fun, with my cousins. That was a big thing to look forward to.

3 School and Dropping Out for a Year

Getting back to school – When I was in New York, public schools were very progressive. I don't think we had grades when I went to school in New York. As I remember it seemed very informal. But this Venezuelan school was very formal and rigid. We had these special things called *cuadernos*, notebooks—and the teacher would write something on the board, and you had to copy it into the notebooks. And we had to draw these beautiful pictures, which I loved to do, but they had to be perfect. And then because we were Americans, the principal of the school thought it was an opportunity to teach us Spanish formally. And I

remember being in his office and his teaching us the subjunctive verb. I remember that so strikingly. I had never learned grammar in New York and subjunctive was like—I didn't even know what subjunctive was in English. No fun. And also, I was put back a grade because the system was different. I didn't like that either.

KLINE: But you were taught in Spanish?

BLUM: In Spanish. And then the kids, particularly the boys, would be taunting us because they'd learned some words in English from the movies. "I love you," ….. That was very annoying. So one day, I told my mother I was not going back to school. I was there for about four weeks. "I'm not going back."

KLINE: And your mom was teaching in Venezuela or not?

BLUM:

Not then. My parents agreed I didn't have to go to school, which I think was kind of interesting. For a whole year, I was out of school. A whole year. I wasn't homeschooled, which I found really strange. I never asked my mother why. What did we do every day? -- My mother was an explorer, so we would explore the city and countryside every day. She discovered that if we would go to El Silencio in the center of Caracas and take any bus, we could stay on it until it came back. The next day you could take another bus and see a different part of the city. And every day, we'd go to the center, take another bus, and come back. And then we'd end up at the end of the day in a café in this Jewish community. Actually, the Jewish hospital had a café where they made American style ice cream sodas. [LAUGHS]

Most of the women who my mom would meet at the café were European, and it was like a café culture from Europe. I remember having so much fun exploring the city then going back to this café with all these people who were part of a café society, which I'd never seen before. So, for me, it was really a wonderful year. I loved it. It was very exotic in lots of ways.

During my first year in Venezuela, a revolution was under foot. I don't think it was successful. What I remember most were the nails scattered on the roads to slow traffic. And cars had bush-like Christmas trees tied to their front fenders to sweep away the nails. I don't know if the nails were scattered by the government or the revolutionaries.

KLINE: And your sister, as well? Was she out of school?

BLUM: Yeah, they took her out, too. That was a great year for me; but it was a terrible year for her.

4 Back to School: Becoming an American in Venezuela

At the end of the year, my parents decided that we had to go to school. There was an American school in Caracas, Campo Alegre, run by the oil companies for the children of the families who had come to Venezuela to work in these companies. (At the time, there were about 70,000 Americans in Venezuela, mostly with the oil companies.) The tuition at the school was very, very high if you weren't part of the system. My mother got a job teaching junior high science there, so I guess we were given lower tuition, and were able to attend the school. We were the only Jewish kids in the whole school that we knew. Most everybody was from Oklahoma, Texas, California, it was a very WASP culture. There were also a few well-to-do Venezuelans.

It was in Venezuela that I first heard the American pop music of the 50's, doo-wap, rock 'n roll, Elvis Presley. Every summer when we'd go back to New York, I'd tell my cousins, about the music, about the bop. Even fashion-- I remember one year, the fashion was pink and black. And my cousins were, of course, in New York, the center of fashion, but it was the American school where I found out. It's where I became an American.

But that time was also critical for my going into mathematics. This is what I remember so distinctly. I guess I was 10 then, 10 and a half when I started school again. I'd been out for a whole year. American schools are so wasteful in that every year they repeat what you've done before going on to new things. The first day I started school, they were doing something like Euclidean algorithm, long division.

I hadn't seen this before and I caught on-- I was so excited to be back at school, and I caught on immediately, quicker than everybody else. And all of the sudden, "Wow, I love this mathematics." I hadn't noticed that I was good at math before. And everybody was like, "How did she become better than all of us?" So one advice to parents is that that's the perfect year, nine years old, to take your kid out of school. When they go back, they won't be bored to tears. Anyway, that's when I knew I loved mathematics and I was good at it.

On the other hand, for my sister, it [being out of school for a year] wasn't a very good thing because she was seven, and that year she forgot how to read, so going back to school was a struggle. And I don't understand why my mom didn't

actually notice that or if she did -- I don't know. I never talked to her about that. It was harder for my sister. Whatever I saw as beautiful in Caracas, like I remember in our house-- I remember going out to the backyard, and it was just so—it was like going from New York, which was like black and white, to technicolor. There was a parrot there. It was beautiful with such bright colors. And my sister remembered seeing that parrot and was scared to death because of the squawking. Her interpretation of everything was very different than mine. I loved growing up in Venezuela. I liked being in an American school. On the one hand, it was bad because I didn't learn Spanish fluently. But on the other hand, I really enjoyed school, and I skipped two years and was able to move ahead.

So that was when I really started to excel. And what was really interesting-- I don't think anybody put me down for being a girl and being the best in class. And I sort of thought this might be a reason, but it might be a story I'm making up. They may have attributed it to my being Jewish, like, “She's smart, but because she's Jewish, she can't help herself.” It was a little like that. I never [felt] put down for being Jewish, and I was never put down for being a girl [doing well in math and science], but it's sort of like maybe because I all the sudden got so much better than everybody else, it took the pressure away from them to compete. And I had lots of friends.

Another thing I have thought about my growing up in Venezuela was that when you're “other,” you get lots of freedom. I wasn't Latina, Venezuelan. When I went to an American school, I was Jewish, I wasn't like everybody else. I was so “other” in so many ways and I found that that really does give you a kind of freedom --- when you're outside the norm. You don't have to totally conform. I think that was a big thing that kept me going.

Campo Alegre, which as I said, was the American school that was run by the oil companies, went only through ninth grade. After that, many of those kids were sent back to the U.S. to boarding school. It was not in my parents' culture to send me to boarding school, so I went to a missionary high school in Caracas, Colegio Americano, which was an international school. Classes were in English, too, but it was different—run by missionaries.

My math teacher was great. He was a missionary. He was a great teacher. But I remember when I was applying to colleges, I told him I wanted to major in mathematics. He said to me, “Why would you want to go into mathematics? All the best stuff was done 2,000 years ago.” He was only teaching geometry, so his knowledge of math was mainly geometry; like it went up to Euclid, probably. And I was thinking to myself, “Oh, gosh, I didn't want to go into a dead field.” Caracas at that time was really beautiful in terms of architecture. It had these

great buildings, and I loved art from my early days. So I thought, “OK, I'm going to go into architecture. It combines math and art. So that's what I decided I'd study. And I wanted to come to MIT. So I applied.

5 Meeting Manuel

KLINE: And at this point, you'd already met your husband?

BLUM: Yes, that's a parallel story. When we first moved to Venezuela, I was nine and a half. As I mentioned, we were living in the Jewish community of Caracas, San Bernardino, and we started to meet people in the Jewish community. One day, we went to visit some people who my mom knew. I don't know how she knew them. They had four boys. I guess they were all sent to boarding school in the US. It was Christmastime and Manuel [Manuel Blum, SB and SM Electrical Engineering and Computer Science ’61, and PhD Mathematics ’64; Bruce Nelson University Professor of Computer Science, Carnegie Mellon University] the oldest, had come back for vacation. He and his brothers were sent to military school, which is utterly unfathomable -- if you meet my husband-- [LAUGHS]. But anyway, he came back to Caracas for Christmas. He tells the story very differently, which totally embarrasses me, but I met him at his parents' house.

Manuel's four years older than me. I was about 10. He was 14. But we had a lot of interests in common, then and later. We both liked music, even though I was totally un-musical. He played piano, violin. When you're in fourth or fifth or sixth grade, those years make a big difference. But he was always in the back of my mind all those years… until I was in high school. He was sort of like the guy on the white horse. And I'd meet his mom from time to time, and she'd always encourage me to write him.

6 Manuel and Applying to MIT

I started writing him my senior year of high school. That was, I think, around his senior year at MIT. And we just kept writing back and forth. His aspirations were very much like mine, and then he came down to Caracas for my high school graduation. And from then on, we were always together. I remember one of the first things we did. We went to the American bookstore and we bought a philosophy book. So this is, like, my dream. I couldn't imagine any kids in my high school buying a philosophy book. We had a lot going for us!

I applied to MIT. He didn't push me to, and I wasn't accepted. I got a letter saying whatever they put in a rejection letter. But this particular rejection letter

was interesting. It said that all MIT freshmen have to live on campus, and MIT only had 20 beds for women [which I believe were in Boston, not exactly on campus], and they just didn't have enough room. I don't know if they said that to everybody or what, so I ended up going to study architecture at Carnegie Tech. Back then it was Carnegie Tech.

7 Carnegie Tech and Alan Perlis

KLINE: Which preceded Carnegie Mellon?

BLUM: Yes. I think it became Carnegie Mellon about 50 years ago. But when I was there, it was Carnegie Tech --Carnegie Institute of Technology, like Massachusetts Institute of Technology. After the first year, I realized that architecture was not the right thing for me because it didn't have the art I liked. Drawing was mechanical drawing --really rigid. And the math was not the math I liked. I wanted to understand why, and architects couldn't care less.

They just wanted the formulas—how do you use them-- so it wasn't very satisfying to me in any way at all. I remember even in high school seeing a math proof and thinking, "Wow, this is beautiful." I had this idea of math being beautiful. Also, it wasn't dependent on your opinion or somebody else's. That was something that I really was drawn to. But none of the architecture classes had any of that appeal.

I tried to switch majors; I had to make a decision to go into art or math. And I thought, "Well, art I could do on my own. I don't need to have instruction," which is not true, but that's what I thought. But I thought with math I needed to study. I tried to switch to mathematics. Architecture was in the Fine Arts school, and math was in the Engineering school. And at Carnegie Tech then, and even today at Carnegie Mellon, it's very hard to go from one school to another because you're accepted into the school rather than into the whole university. I talked to the deans, but nobody would let me transfer over. In fact, I remember one dean saying that I should get psychological counseling then --so I don't know how I came across.

I finally knocked on one math professor's door and asked if I could come into his class, and he said, "Absolutely. I'm doing this experimental course using the new computer [an IBM 650] in basement of the business school. The computer can correct all your old homework and I'd love to have you in the class." So that's how I switched to mathematics because this professor said I could join his class.

And it was a fantastic course. It was really a problem-solving course using computers. It was the early days of computers and we used punch cards.

KLINE: And the name of the professor?

BLUM: It's Alan Perlis, who was the first Turing Award winner [1949 SM Mathematics, 1950 PhD Mathematics; President of the Association for Computing Machinery; Turing Award recipient in 1966 for his contributions to computer programming]. He later became the first head of the computer science department at Carnegie Mellon, which was before there was computer science here at MIT. And then he would become head of the computer science at Yale. I have often found that men who are confident in themselves, also visionary, have been more accepting of women in the field.

Years later I found an article Perlis wrote saying computers are going to be used in every field and he talked about his experimental undergraduate class. "You have to teach everybody how to think computationally." This was way back. This must have been … my class was 1960, the one that I took. It was probably the first real [undergraduate] computer science course given at Carnegie or anywhere on the planet for that matter.

8 Getting Married, Moving to Boston, Simmons

Anyway, Manuel was here in Boston. I was there in Pittsburgh. He would drive down to see me. And somehow, we decided very young that we were going to get married, so we did at the end of my sophomore year. I didn't even apply to MIT again for a transfer, but went to Simmons for my last two years [of college]. There was one very good teacher there, whom I will talk about tomorrow [at an event at Simmons College], Marion Walter [mathematician who taught at Cornell, helped create the mathematics major at Simmons College, taught at the University of Oregon; known for Marion Walter's Theorem].

9 MIT and Is Singer

I went through all their [Simmons] math courses in one year, and did very well. It was my junior year, and I had nothing [in math] left to take in senior year, so Marion arranged for me to take courses at MIT, and that was just perfect. I took this class. It was an undergraduate algebra and linear algebra course, but done in a very abstract way. And at a very high-level. And the guy who was teaching was Isadore Singer [Institute Professor in the Department of Mathematics at MIT; co-founder of the Mathematical Sciences Research Institute; member of

the National Academy of Sciences and the American Academy of Arts and Sciences; Fellow of the American Mathematical Society; recipient of the National Medal of Science among numerous awards], who was a University Professor. I don't know if you've heard about him.

KLINE: Professor Singer?

BLUM: He's very famous. And that course was exactly what I imagined a math class to be. It was absolutely perfect. The guy knew his stuff. He was not teaching from a text; he was teaching from his research. It was very deep. It was very abstract, which I loved. The pace was really good. He covered a lot of things. It was perfect. I loved it. It was just what I'd been looking for. It was a two-semester course. That was my senior year. So, I applied to MIT for graduate school. It seemed natural. I was getting A's. I was one of the best students in the class. And in those years, the class was huge. It was like 100 or more. Maybe that's small today, but that was impressive. But I was on top and I was doing really well, so I applied to MIT.

I came to the math department, Building 2 for an interview. The top floor was where the administration was then, or the second floor—I can't remember. They moved around. I go in and I talk to the chairman of the math department, and he says to me, "You know, MIT is not a place for women." He had prepared for me a whole list of schools to apply to. He said, "If I had a daughter, I would advise her to go to one of these schools." I was completely devastated because this was really what-- I've always wanted to go here, and I had taken this course, which was fabulous. And then they're telling me no. So that was so disheartening.

Then something really crazy happened. [LAUGHS] I got accepted one week later, and I'll tell you how that happened. That weekend, there was a math department party. And somehow at that party, they were discussing this girl --I was 19 or just 20. I was really young to go even to graduate school. This girl, who is applying to the math department, the graduate program? I don't know if they were joking about me or why I would even come up. And Singer was there, and he asked, "Who are you talking about?" And then they said my name. "Wow, she's the best student in my class." Others have told me he did say that. I'd say, well, I was one of the best. But anyway, the next day, I got accepted. So having taken that course, and that party, and their talking about me, and having Singer there, well-- otherwise, I'm pretty sure I wouldn't have been accepted into the program. That's how I got into MIT.

10 MIT and Women in Math

But there was a bad aspect about that “lucky break” and I think this often happened to women of my generation: I was totally grateful that they let me in, which I shouldn’t have been. I should've said, “Yeah, they did the right thing accepting me. I'm smart.” But I was totally grateful. And as a consequence, I was going to show them all, and Singer, as well, that they didn’t make a mistake. So I started graduate school taking eight graduate courses.

Imagine taking eight graduate math courses all at once! It was completely nuts! Manuel was a graduate student, and he'd only take two courses each semester. I signed up for eight, and nobody told me no. But of course, I couldn't do it. I had to drop one by one until I ended up with three or so. But that was very discouraging to me because I set my goals and I couldn't meet them. So rather than thinking, “Well, you were just trying to figure out which courses to take and then of course you were going to drop a few,” like everybody else does -- I thought it was just me. There was no women's movement at the time, and no understanding that we internalized all these things as “it’s just me, it’s my fault.” There was no acknowledgement that you needed to have mentors and you needed to have community.

And there was a lot of the sexism that was subtle or not so subtle. Like, for example, I remember going to some math department parties. There was this common joke that they would always tell, and I didn't even realize that it wasn't funny, so I did internalize a lot of feelings about why women really aren't good enough. The joke was, “There were only two women in mathematics. One wasn't a woman, and the other wasn't a mathematician.”

That “joke” was about some of the most famous women in mathematics, Emmy Noether [Amalie Emmy Noether; worked at Göttingen until she was forced to leave Germany during World War II; taught at Bryn Mawr College], who was kind of masculine and not feminine. So she wasn't the woman, they'd say. And Sofia Kovalevskaya [19th century Russian mathematician and the first woman to obtain a doctorate and then a full professorship in mathematics], who got a lot of awards, very attractive woman, and they said that she wasn't a mathematician. She must've gotten the awards because of her attractiveness.

So I had internalized so much, I didn't even realize they shouldn't be saying that, the head of my department. I think they were just saying it to break the ice and say something that might be relevant that I would find interesting. They didn't even realize, and I didn't realize it until years later, these are two of the most famous women of mathematics until that time. So that kind of thing you kept on

internalizing, and you'd flip around. You either think that you're great or you're terrible. And either they put you on a pedestal or they drop you off. And there weren't too many other women around, students or professors.

But an interesting thing about women and the women's movement is that things change. I would notice, every four years, things would change. In my generation, women had to get married. So I got married, check that off, and then I could go ahead. That was a freeing thing. And then there was a lot of pressure to have children. You had to satisfy everybody. But then, if you have a kid, well, you dropped out. We had a kid while I was in graduate school, and I didn't drop out.

Years later, women weren't getting married. They were just living with their boyfriends. And then they weren't having kids. But then later, they realized they had to have kids, time was running out.

Women went through a lot in the past 50 years. There's been so many different phases as we get to realize different things. I think there has been a huge evolution.

What was interesting is—you asked about being Jewish—there were two other women who came into the graduate program with me, Julie Conger [SM Mathematics '68] and Joan Lukas [PhD Mathematics '67]. Julie was half Jewish and Joan was Jewish. They'd both gone to women's colleges. One went to Smith and one went to Barnard. Although it wasn't intentional, I had gone to a women's college. We were all married when we entered graduate school and we all had babies [boys!] while we were in graduate school. And we all came from New York originally. Now, was that a coincidence or what? But I think when you look at that, it's not just a coincidence. We were addressing our needs, society's needs, our families' needs and all these things all at once, and the Jewish drive. [LAUGHS] And we all studied logic! So that's something that's interesting.

I didn't particularly feel direct discrimination. But I did notice the following: Julie Conger, who went to Smith, she was a student leader, president of her class, I believe. She was absolutely beautiful. Long, blonde hair, tall, feminine, really gorgeous, very outspoken.

And I remember being in a topology class with her and she would raise her hand and answer a question or ask, and I was always thinking, "Wow, what a great question. I wish I had thought of that." And the moment I thought that, she would be put down by the professor and he would call on somebody else, a guy

who actually was my officemate. He graduated from MIT in three years but I didn't think he was that great, quite frankly. [Later, Julie told me that this topology professor suggested that she should transfer out of MIT to a Teachers' College where her abilities would be better employed.] And I could see that-- -- with Julie, the view was that, well, here's this beautiful, blonde woman who speaks out a lot so couldn't be that smart--- was probably the gut reaction to her. She was not treated well at MIT. I actually think she was put down for being very smart --and attractive. It was something I noticed. Julie didn't get her PhD at MIT. She only got her master's. But she went on to get a law degree at Berkeley where she was editor of the law review and became a well known judge.

During those years, we were also priding ourselves on not being the typical woman. And in fact, when MIT would send me letters addressed to Mr. Blum, I would say, "Oh, finally I'm accepted." I wasn't angry about that, so I was not what you'd call a feminist. I possibly was an anti-feminist at that time. So that's the early part of my MIT story.

So we'll have to fast-forward.

11 MIT and My Thesis

KLINE: And your thesis?

BLUM: That's a more difficult thing to talk about.

First of all, I had two thesis advisors. I was interested in algebra because of that first class with Singer, and particularly in algebraic number theory. So my first advisor was a very famous algebraic number theorist whose name was Kenkichi Iwasawa [MIT Professor from 1952-1967; known for his contributions to number theory; born and educated in Japan; received numerous awards including the Cole Prize from the American Mathematical Society in 1962, among numerous other awards]. He was Japanese. I worked with Iwasawa for about a year or two on a topic in group representations and did my quals with him. (They used to have oral qualifying exams for the PhD.. I don't know if they still do.)

KLINE: Yes.

BLUM: After my orals, Iwasawa took a position at Princeton. All of his other students could follow him because they were male – but at the time, Princeton didn't

allow women in their math department. So even if I wanted to, I couldn't go there. I was married and probably wouldn't have done it anyway. But even if I wanted to—Remember, there was no internet then, talking by telephone “long distance” was costly and not very satisfactory, traveling back and forth to Princeton was not easy. So it just didn’t work out.

At the time, I was a TA for a graduate course taught by Professor Hartley Rogers in an area called model theory, which is a branch of logic. There were some new results coming out, particularly from people at Cornell, combining model theory with algebra. I was getting really interested in that because I knew a lot about algebra and number theory, and I was learning model theory as a TA for the class. And I was sort of thinking about how I could combine these areas myself. I didn't have an advisor.

There was a young post doc Al Manaster from Cornell at MIT, and he had the papers of these guys at Cornell, Simon Kochen [Professor of Mathematics at Princeton University, won the Cole Prize with James Ax for a series of papers in number theory] and Jim Ax [James Ax, mathematics professor at Cornell University and later Stony Brook University]. He gave me copies of their papers. I was really fascinated by what I was learning in model theory, how model theory could be applied to algebra and these very wonderful saturated structures called ultraproducts, ultrapowers. It's really kind of beautiful. And there's something local/global. In number theory, local/global is a major concept. From local information, you get global information. And that was happening with these new model theory tools. I was seeing lots of similarities. So I started reading their papers. I got really excited -- it really grabbed me. There were these two areas of mathematics that I knew and I could put them together, and I could see how to do that. So I started to really study them and give talks on them.

Some months later, Gerald Sacks [Professor Gerald Sacks, Emeritus Professor of Mathematical Logic, died October 4, 2019] took a position at MIT. He also came from Cornell. And he was a person who was famous because of work he did in recursive function theory, which is another branch of logic, and in degrees of unsolvability, where you're looking at how unsolvable problems are, but had not done anything in model theory or algebra before. But he was very aware of the work that had been done at Cornell because it was getting a lot of attention. So when he came to MIT, he had heard that I was studying it and asked me to be his student. And it was a really nice relationship because I would be there almost every day, going through those papers with him, teaching him this stuff, which was a lot of fun for me. At one national math meeting in New York, he introduced me to another mathematician from Cornell, Anil Nerode, who I told

what I was doing, and he said to me, “Do you know this paper of Michael Morley [Cornell Mathematics Professor Emeritus], which is more abstract, but you might want to look at it.”

I got the paper. And all of the sudden, I saw-- It was kind of interesting. I was trying to develop a generalized algebraic model theory using saturated structures that would explain all the things that we knew and even more, and Morley’s tools (spaces) were exactly what I needed to delve even further.

And then another mathematician visited MIT from Yale, Abraham Robinson, and I told him what I was doing. I was combining Morley's work with algebra, developing this abstract theory in a new way, much more modern.
It was really based on a lot of modern mathematics, where the older stuff had been based on 19th century. This was like, 20th century.

He said, “Oh, well, I think your work is interesting, but I have a case where it won’t apply, differential fields [e.g., differential fields don’t have closures like algebraic closures, differentially closed field don’t have simple axioms like algebraically closed fields]”—that's what he told me and pointed me to a paper in the Israeli Journal where he had said that—which really upset me because I thought, well, I have a beautiful theory here, and if it only explains what we already know and no more, what good is it? So I learned all I could about what he told me. And I found that he was totally wrong. It absolutely did apply and I was able to discover things he said were not possible. That was really great. So I was able to pull all this together and put it in my thesis. And I remember when I defended my thesis, Morley came and Robinson came and lots of people came to hear it because it was really like a new way of thinking. That was great. I really did a great thesis. [Generalized algebraic theories : a model theorectic approach (1968), https://dspace.mit.edu/handle/1721.1/12515]

And it was very much on my own. The role that Gerry played for me was listening to everything I was doing and cheering me on, and I really appreciated it. I think graduate students rarely get that kind of attention.

But I also realized he was using me in some way. When he came to MIT from Cornell, I would say, he was in the doldrums, not knowing where he was going to go mathematically, and he saw my work as a way to change what he was doing and get into something new.

I remember being at a math conference right after I got my degree in '68, which was 50 years ago, and Robinson was there, and he introduced me to this grand old guy in logic, Mostowski [Polish mathematician Andrzej Mostowski, best

known for the Mostowski collapse lemma]. They wanted to publish my thesis in the first issue of the Journal of Pure and Applied Logic, and I didn't do it. I was just so unsure of myself because, in fact, when Robinson had told me my stuff wouldn't work and then I discovered it could, even though I proved it, I still had this doubt that maybe I didn't totally believe that I had done it. I was very unsure of myself, so I didn't publish it. I just didn't have the confidence at the time—[possibly a kind of what is called today “imposter syndrome”.]

And what Gerry did was he started giving talks on my work and getting a lot of recognition for that, writing a book called Saturated Model Theory. This is the part that I really-- at first, I felt, wow, he's publicizing my stuff.

But then I realized it was just some of my theorems. That's nice. But he stole my thesis. That whole book is my thesis, that is my perspective, my point of view -- It wasn't just the few theorems that he chose. He gives me credit for this theorem, that theorem, but it was a whole new perspective. And I should've been at least a coauthor of that. And he became very famous. He actually got a position at Harvard for that work. It was my work. And I thought that everybody would realize--

I was like, everybody would realize, how could this guy who's really known in recursive function theory that had nothing to do with this perspective on model theory, all of the sudden do this? At the time, I wasn't so aware of how damaging that would be for me. And as the years went by, he became more and more famous, and he had no re-- he didn't want to look back and say, hey, that was Lenore's work, too. I mean, he just bought his own whole story. That, I believe, is true. That's my perspective.

KLINE: Did you ever talk to him about it?

BLUM: I did not. I told other people. They didn't want to-- they'd rather just—they didn’t want to deal with that. But I did write him at his retirement from Harvard. They were making a book for him, and everybody assumed that I would write something. So I wrote a letter to him, which is very, very subtle. Maybe I'll find it later and show it to you. It's so subtle. He got it, but nobody else did, I'm sure, because I showed it to someone else and they go, “Lenore's, that's so subtle. No one will ever notice.”

I don't think I had recourse in the early years. No one would have-- this was 50 years ago.

And the irony is, when I went to Berkeley in 1968, they weren't so interested in my work because they saw my work as applied logic. And in those years, mathematicians put down applied math and the logicians at Berkeley put down applied logic.

The added irony is the area I was working on in the 60's is the hottest area today, modern model theory and differential algebra and how they inform each other. It really became very hot, even at Berkeley, but I'm not part of it. Unless you stay in the field there is little incentive for anyone to acknowledge your work or remember you.

12 MIT and Avrim

KLINE: So at this point, you and your husband had a son?

BLUM: Right. That's a whole other MIT story. Our son was born while I was a graduate student at MIT. On the last day of classes in May 1966, I was in Hartley Rogers' office, and we were grading papers for model theory, recall I was the TA, and I'm counting my contractions. And Manuel and I go right from MIT to Beth Israel Hospital. And there's Julie Conger, my friend, on her motor scooter, following us to the hospital. We're driving over the Mass Avenue Bridge. She's following us. An MIT experience.

Since our son was born here, when he came back as a student, it was like he was coming home. I think for the first-year students, coming to MIT is often a daunting experience. But for him, he grew up amongst our friends, and he was here for his first two years. So it was like home for him. That was a huge advantage for our son Avrim [Avrim Blum, SB Physics '87; SB Mathematics with Computer Science '87; SM Electrical Engineering & Computer Science '89; PhD Electrical Engineering & Computer Science '91; currently Chief Academic Officer and Professor at Toyota Technical Institute in Chicago].

At the time, Manuel was working in the neurophysiology lab at MIT with Warren McCulloch [neurobiologist and cybernetician who worked at MIT with Norbert Weiner; famous for his work with Walter Pitts in which they modeled a neuron using logical principles, and for his work on neural network modeling] and Walter Pitts. Those are very famous people in terms of what's happening today in neuroscience. Manuel had an office in the basement of Building 26 right next door to Warren's office. Every time I come back to MIT, I always take Manuel's students, for example, Mike Sipser [theoretical computer scientist; MIT

Professor of Applied Mathematics, former Chair of the Department and Dean of Science], to visit Warren's office. Warren McCulloch was a fabulous person.

Since there was no daycare, and getting childcare was really hard, we would bring Avrim, in his little bassinet, which was the early versions of a car seat, to Manuel's office in the basement of building 26. Avrim spent the first six months of his life down there.

And everybody would take care of him while we were in class. Later, when I was doing my thesis, I would take him to the Margaret Cheney Room [a meeting place in Building 3 set aside for women students] for a little while, but they didn't like to have kids there. I remember one day in the middle of winter, Manuel took him to the Boston Commons for an outing. And I get this knock on the door of the Cheney Room. And there's my husband, Manuel with Avrim, who was sopping wet. He had fallen into the pond in the Commons. So they allowed them to come in and we dried Avrim up.

13 MIT and Professional Rivalry

But there was another aspect of rivalry going on there—professional rivalry—the people who were supporting Manuel, didn't know much about what I was doing. And the people like Gerry Sacks, who were supporting me, did not like Manuel's work at all. In fact, Manuel was starting to develop what is today called computational complexity theory, which is looking at problems *that you can solve*—it's become the most important area in theoretical computer science—and trying to understand which ones you actually can solve, and it turns out some are very hard. Whereas Gerry Sacks was looking at the ones you couldn't solve and looking at that hierarchy, and he was putting down anybody who was looking at so called solvable problems. And he said, "You should divorce that guy."

KLINE: Oh no!

BLUM: Things like that. Yeah, yeah. He was suggesting that my career would be destroyed, but… My career was destroyed—not destroyed, but went in different directions … . So there was that kind of like professional rivalry. And it was like the places that wanted me -- like I got the first assistant professorship in any top math department in the country, tenure track position at Yale that Abraham Robinson gave me-- but they didn't really want my husband. And at Berkeley, they really wanted Manuel, not me. So it's like they're playing us against each

other. And there was no place where people were saying, ”Hey, this is an opportunity to have these two people.”

KLINE: So then how did you decide to go to Berkeley instead of Yale?

BLUM: Because I, in truth, thought I could survive in lots of places. And I felt Manuel needed to be in a place where he was really wanted. I didn't think he could really do well if he went to a place tagging along with me.

So my thesis advisor was totally wrong. [Manuel] became a Turing Award winner, as have three of his students, two of whom are MIT faculty. Shafi and Silvio were my husband's students.

KLINE: Who?

BLUM: Shafi Goldwasser [Israeli-American computer scientist and Turing Award recipient; MIT professor of electrical engineering and computer science] and Silvio Micali [Italian computer scientist at MIT’s Computer Science and Artificial Intelligence Laboratory and Professor in the Department of Electrical Engineering and Computer Science]. And Mike Sipser [who was head of the MIT Math Department for many years, now Dean of Science] was my husband's student. Also, Ronitt Rubenfeld, who's a professor in the MIT computer science department, was his student. So he and his students, and the whole area of computational complexity theory, which was being put down by the logicians, became really important, key even to logic.

There’s certainly a kind of arrogance of what's important in science. That affected me because I couldn't be around people who didn’t respect my husband's work -- isn't that ironic that the work that my husband was doing that they didn't respect is the one that's gotten the biggest awards, and it’s so relevant to so many different areas of computer science. So those were the kinds of tensions that also came in, that affected my decision.

And I was totally naïve. I didn't have anyone saying “make sure you go to a place where they really want you, where there's a mentor there, where there are people who can advise you, who can write letters for you, who can do that.” I didn't know those things at all. I thought I could do it all on my own.

And I didn't realize my husband like most men in science had those things-- I thought that he just moved up on his own, I didn't realize he had so many mentors, like Warren McCulloch and Marvin Minsky [founder of the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL), and the MIT

Media Lab, highly influential in the field of artificial intelligence, 1969 Turing Award recipient], who was his advisor, and then the people at Berkeley, who wanted him there, -- all those people that made a difference. I didn't realize those were important things to have.

14 Berkeley and Women's Organizations

Actually, one of the reasons I decided to go to Berkeley was that there was a mathematician whose work was closest to mine. It was a woman, Julia Robinson [Julia Hall Bowman Robinson, mathematician known for her work on Hilbert's 10th Problem; first female mathematician elected to the National Academy of Sciences; recipient of a MacArthur Fellowship; first female president of the American Mathematical Society; fellow of the American Academy of Arts and Sciences], very famous. I had read all her papers which all gave her current address as Berkeley, California. So I thought, well, OK, I'll go to Berkeley and work with Julia. When I got to Berkeley, I found out she had never been a regular faculty member there. She just lived in Berkeley. Julia's husband Raphael was. For years there were nepotism rules –only one person in the family could have a regular position in the same department. And of course, it was usually, probably always, the husband who had the position. That was an a-ha moment for me.

KLINE: I'd be interested in hearing mostly about the women's organizations that you started and how you ended up at Mills and then more about your family and Carnegie Mellon. But yeah, as much as you want to say or don't want to say about that time--

BLUM: So when I got my PhD, I also got a postdoc from the AFOSR, the Air Force Office of Scientific Research, which allowed me to go anywhere I wanted to, and so I thought Berkeley would be the place. I thought I could do OK. Julia was there. Manuel was offered a good position, they wanted him. And also Berkeley sort of reminded me of Caracas -- I loved the tropical and revolutionary atmosphere. When I was in high school in Caracas, there was a Venezuelan revolution. It was, I believe the year after Castro took over Cuba. We had also had a dictator. And then there was a revolution. The dictator was out. It was interesting because a lot of my friends were at the university. They were patrolling the streets. The Boy Scouts were directing traffic. My friends would take me along with them. It was a kind of exciting thing. Berkeley sounded a little like -- it had these kind of revolutionary ideas anyway all along, so it sounded right.

So I went to Berkeley in '68 as a post doc, I started teaching in '69 (as a lecturer).

The math department was much more radical than the other math departments in the US. Mathematicians tend to be pretty liberal in general. They were running a seminar series on mathematics and social responsibility. This was, I think, the last year I was a lecturer, and they asked me if I would do a panel on women mathematics.

This was really a changing point in my life because up to that time, I'm not a feminist. I don't know many women. I told you that realizing Julia did not have a position at Berkeley was an a-ha moment for me, but not totally a-ha. And I didn't know anything about women in mathematics.

So what I did was I gathered together four women, one who was an amazing woman, Betty Scott [Elizabeth Scott, statistician who received her PhD from Berkeley in 1949 and joined Berkeley's mathematics faculty in 1951]. She was a statistician. She actually had been an astronomer, later became head of the statistics department at Berkeley. She was one of those people who couldn't get into the observatory because she was a woman. And she had done a study on the status of academic women on the Berkeley campus, which I had read and thought was fantastic because it had both statistics and stories, which rounded out the picture why that there had never been any women faculty in the math department, at least for 30 years or more,, except during the war time, when they needed women to teach. So I asked her to be on the panel. Then I found a woman, a historian, who had studied the history of women in mathematics, which I didn't know anything about. Then I found a woman who was a psychologist who actually had studied all the women in the U.S. who had gotten PhDs in mathematics in the '30s and '40s, and she was classifying those who went on to research and those who didn't. She was trying to look at the different personality types, so she was on my panel. And I probably had another person, but I can't remember.

It was really kind of fun because I learned a lot about the statistics from Betty Scott. I learned a lot about the history from the historian. I'd never heard about all these other people before-- I did know Emmy Noether, but I didn't know Kovalevskaya. And then about these personality types from the psychologist, don't know whether they're accurate or not. But this was from her study, which was interesting. It was in a big lecture hall, which was totally packed. Really packed. Standing room only.

15 Accidental Activist

After that, I became known as the expert on women in mathematics [LAUGHS], at least on the West Coast. And so all these women students came up to me, and I started making women friends in the math [world]—women students, graduate students, mostly, including my lifelong friend Judy Roitman. We formed a group in Berkeley.

And then I had found out that, on the East Coast—in Boston, particularly—they were starting a 'women in mathematics' group led by Alice Schafer [Alice T. Schafer; Professor of Mathematics at Wellesley College; founding member of the Association for Women in Mathematics and its second President], who was at Wellesley, and Mary Gray [founding member of the Association for Women in Mathematics and its first president; received the Presidential Award for Excellence in Science, Engineering, and Mathematics Mentoring] in Washington, D.C. I met them at math meetings. They started the Association for Women in Mathematics [AWM] on the East Coast, and I became the person leading it on the West Coast. And we joined forces. I became the third AWM president.

These women, somewhat more radical and out front than I was, became my "sisters," so to speak. The women graduate students at Berkeley started cheering me on and I became their role model. It happened almost overnight. And my realization that, hey, I was pretty good at this, too, and I wasn't afraid too much to say what I wanted to. I often call myself an accidental activist.

But also, in those early years, I had this huge advantage over other activists in the field. Because I had gone to MIT and I had done research that was very well-respected—many knew about my work—I was taken pretty seriously, more so than women who didn't have the same background and maybe weren't considered researchers. When I became president of the AWM, it became part of the wider math community. We became a member of the Conference Board for Mathematical Sciences. As I said, the other women were even more radical and more out front than I was. They were really fantastic. But I think my having the research credentials gave me a little bit more authority.

That's how I got involved in the women's movement. And that's when I starting becoming friends with women in my field. And that's when I started to realize that there were all these issues that we had all internalized. With community, we found out that, "Oh, your experiences are not unusual." That was big. And that's what happened while I was still at Berkeley.

16 Sabbatical

I was a lecturer at Berkeley for a couple of years after the post doc. And then I wasn't rehired, so I had to decide what to do. I had some offers but was not ready to make a decision. My husband took a sabbatical and we left Berkeley.

KLINE: What did you do during your husband's sabbatical?

BLUM: We traveled to Boston, to Cambridge, and there was another big shocker for me, because one day I walked into a Math meeting at MIT and there's Gerry Sacks talking about my work. I come in and sit in the back row, and he's giving this talk on my stuff. And later he writes it up for an article in one of the math journals. And then I find out that he had gone to France and given talks of my work, too.

Then we went to Italy. I started working with Manuel on something called inductive inference. I also wrote up some of my work, which got put into a compilation of articles, but not at all where it should've been.

KLINE: And that was work from your postdoc or from your thesis?

BLUM: It was derivative of my thesis that I wrote up.

17 Mills College

But then, when we got back to Berkeley, I don't remember whether I saw an advertisement, but Mills College [in Oakland, California] needed somebody to fill in for a year, so I thought I'd take that job. And I thought, “Well, OK, this will be my political work. I'll sort of teach these women great ideas in mathematics that they're not getting from anybody else.” So, I designed a course called Demystifying Mathematics, and in it, I would talk about all of these cool ideas. It might be Alexander's Horned Sphere or cryptology, cool ideas from different areas of mathematics. I thought I'd just teach the cream of math areas and really get an exciting course. But then they also had me teach a college algebra course, which most colleges had it those years. And I thought, “Oh, god.” I didn't want to do that at all.

So I get to Mills and I advertise the Demystifying Mathematics course, and I get six students who were really good, a very nice class. But the college algebra course had something like 30 students. I started looking at the syllabus for this course, and all I could see was that they were rehashing high school material

that either these students hadn't had, or hadn't done well in. It was high school all over again—9th, 10th grade algebra, 11th grade algebra. Well, these days probably 9th grade algebra.

You have to understand, in those years, four years of high school math wasn't required to go to college; in fact, only two years was. And so for women, they were mostly counseled out of taking four years of math. Their parents and their teachers and their counselors would say, “Why spoil a good high school record with maybe a B or a C in math?” Not the same for boys. “You can’t drop math. You need math for whatever you do.” And, in fact, there were studies showing that women were entering college without enough math to do calculus, and so they were cut out from many fields, even the traditional ones, that now needed math skills. Lucy Sells at UC Berkeley pointed to calculus as “the filter in the job market” for women

So here I'm teaching this algebra course, and one day, I said, “This is totally insane. This is ridiculous. We're just regurgitating old things. It's not leading you to calculus.” I added “OK, I'm going to start teaching calculus in this class. Forget about everything else.” What I realized is we could start getting into ideas of calculus right away.

So I designed a course where I promised, “Anyone can take this course, no matter what your background, and in one semester, you will be ready for calculus.”

And then I thought, “Well, gee. There is a math major at Mills, but no math department. There is also a computer science course. I could revamp this whole thing and we could have a Math/Computer Science department with a math major, computer science major, and have entry level courses that would get people into these subjects very quickly. You didn't need to have all the remedial courses that weren’t leading anywhere.”

So I wrote a white paper with these ideas. And two things happened. One is the woman in the advancement office called me up one day and says, “I've looked at your white paper and here it is.” It's on the floor. It's all cut up into little pieces. “And I'm going to write a proposal to the San Francisco Foundation for a grant for women in science.”

I was so horrified. There's this thing I wrote in lots of little pieces on the floor. She was obviously editing it, there was no computer to help you to cut and paste. “OK, fine, do whatever. That's good.” So they get $25,000 from the San Francisco Foundation for a women in science program. The next day, I get a

note from the dean saying I'm fired. [LAUGHS] Basically, she thinks I'm turning this women's liberal arts college into a technical school.

Two weeks later, a woman who was on our board of trustees, and her husband, who was a professor at Stanford, gave a million dollars to Mills College for a chair [the Letts-Villard chair] for me because they understood what I was trying to do. And the president of Mills named me head of the new Math/CS department. It was the first computer science department at any women's college on the planet. And I started sending out these brochures [Everything you wanted to know about math/cs but were afraid to ask] in the beginning of the year to every entering student with a self-correcting test, with answers on the back. The brochure said: Even if you get a few of the questions right, you're prepared to take my course. And so we had all these women taking math and then calculus. That changed things. At one point, there were more students enrolled in math courses at Mills than any other field.

18 The Math/Science Network

And then I connected with people in the Bay Area who were working at lots of levels to increase participation for girls in STEM. We didn't have the acronym STEM then. Nancy Kreinberg [Director of EQUALS, University of California, Berkeley], who was at the Lawrence Hall of Science, a science museum for teachers' training, was a visionary. Nancy pointed out that although the Hall sponsored many after-school classes for grade-school kids, none of the science classes had any girls in them. So she decided to started Math for Girls. Not to say that girls do math differently, but that math is an appropriate endeavor for girls, like ballet. Math for Girls had Berkeley undergraduate women in math and engineering as teachers. They were role models. The course was geared to problem solving, promoting both collaboration and competition.

We formed the Math Science Network, which included everybody in the Bay Area who was interested in increasing the participation of girls in STEM. In addition to Mills and the Lawrence Hall of Science, there were people from the Lawrence Berkeley Labs, Lawrence Livermore Labs, Chevron Corporation, at the university [UC Berkeley], at San Francisco State, and we would meet once a month.

And we decided to have these conferences for middle school and high school girls called Expanding Your Horizons in Math and Science. I don't know if you've ever heard of Expanding Your Horizons (EYH), but they're all over the country now. I think over a million girls have attended them.

EYH is like a regular conference. You have to register. You come in. You get your packets. In the morning, you have a panel discussion of women talking about their careers. And then hands-on workshops and career workshops, and you can meet people. And then we end with some kind of general session. And each conference had like 400 girls. Every state in the country, actually-- maybe you don't need it here, but like in Utah, they hold the EYH conference at the university, and girls come from all across the state to attend. So that was a big thing.

Nancy and I became the first co-Directors of the Math Science Network. We got a major grant from the Carnegie Corporation of New York which supported both K-12 and college level work.

And then I was asked to be on a lot of government panels, programs and policy committees, in particular at the NSF. One such was the NSF Committee for Equal Opportunity in Science and Technology (CEOST). One program we developed in CEOST was the Visiting Professorships for Women (VPW) awards that were meant for women who were at smaller colleges who didn't have much opportunity to do research. The awards would enable them to spend a year at a more research focused institution.

19 Back to Research: Complexity and Real Computation

One day, I got a phone call from one of my colleagues in New York, Mike Shub [fellow of the American Mathematical Society, known for the Blum Blum Shub random number generator and the Blum Shub Smale machine]. He says, "You know, Lenore, I saw this announcement for a new NSF program, Visiting Professors for Women, and I think it's perfect for you. You could take a year off from Mills, come to New York." Mike was at the Graduate Center [at the City University of New York] and I think also at IBM at the time. "You can work with me." We started talking about lots of things that we would be working on. And then I said, "I can't apply for that. It's a program I helped design!" It never occurred to me that I could be a candidate for the VPW program until Mike called me up. I applied, and I got this grant to spend a whole year in New York. I split my year into two half-years which worked better for my family who stayed in Berkeley during that time.

That's when I started doing research again and got into this area of developing, with Mike and Steve Smale [Professor of Mathematics at the University of California, Berkeley; known for the Smale Horseshoe, Smale's problems and the

Blum-Shub-Smale machine] a model for computation when your underlying space is continuous. The classic theory of computation, which goes back to Alan Turing (which you may know about), assumes that you're dealing with discrete objects, 0's, 1's, bits, graphs. But many mathematicians, most mathematicians, work in the continuous realm. Calculus, applied mathematics, numerical analysis, algebraic geometry. You're also have algorithms in these fields. But the Turing theory doesn't really apply unless you sort of stretch it in funny ways that aren't appropriate. So we started developing a basic theory of computation over the real numbers, or complex numbers, or general domains, which became a parallel theory to the Turing theory and became adopted by many people in applied math. It's the key underlying theory. We also developed a complexity theory for algorithms in these domains. So that's how I got back into research—through that grant, which I helped design.

At Mills, the funds in my chair were for research or whatever I wanted to do; previously, I had used the funds mostly for developing programs. People at Mills who weren't there when the chair was awarded, were not too thrilled I was now spending more time on research. They said, “This money is for educational programs. … What good are you now that you're doing research? You're not so involved in our programs.” At that point, I decided that wasn't the place for me to be. And even though I'd had a tenured job, I gave it up and took a position at the International Computer Science Institute, which is a research institute at Berkeley. That is where most of my research happened. At the same time, I also became deputy director of the Math Science Research Institute, also in Berkeley.

20 Hong Kong and the Book

And then in the mid '90s, my colleague Steve Smale, retired from Berkeley and went to Hong Kong.

KLINE: I was going to ask you--

BLUM: He invited me and Mike and Felipe Cucker to join him. So we joined him at CityU of Hong Kong, and that's where we wrote our book on complexity and real computation [*Complexity and Real Computation* by Lenore Blum, Felipe Cucker, Michael Shub and Steve Smale]. I was in Hong Kong for two years. And while we were in Hong Kong, Manuel and I started getting emails from Carnegie Mellon [CMU], where our son meantime had become a full professor --and our grandkids were there. Raj Reddy, dean of the CMU School of Computer Science

and Jim Morris, CS department head asked us to come—they'd invited us years before, but it wasn't the right time then. Maybe now.

21 Carnegie Mellon

Well, I loved living in Berkeley, that's true. But when I was in Hong Kong, I had developed a lot of new interests and new friends. Berkeley didn't seem as exciting to me anymore. It was like, been there, done that. OK, maybe we'll go to Carnegie Mellon. And of course, it would be interesting professionally because the three of us would be professors in the same university, the same school, same department, same group, same building, turning everything on its head.

So that was really nice. Carnegie Mellon was a great place, our family was there, so we decided to take the positions. So that's when we went Carnegie Mellon. I actually went in 1999; Manuel in 2000. We've been at Carnegie Mellon all these years. [As of fall 2019, all three Blums have left Carnegie Mellon.]

22 Women@SCS

Now, at Carnegie Mellon, I guess I can't get the women in STEM out of my system. When I got there, a study had just been completed on undergraduate students at Carnegie Mellon, looking at gender differences in computer science. And what this study found was that there were big gender differences. Whereas the men liked to code, the women like the applications. The writers were a sociologist who had worked with—this woman at Harvard, who was a gender sociologist—and one of the associate deans, a guy. And they wrote this book that became very popular.

Based on their study, they advised that Carnegie Mellon change its computer science curriculum to become female friendly, have more applications. When I got there I was furious. I was like, "What do you mean, female friendly? We have to make sure that the environment is right for women, women need role models. They need community. And of course, in your study, there were only 8% women in the program, those women, they were really miserable, and their view of computer science was affected by that." That study was totally biased by such a small sample of women in a relatively hostile environment.

But it reverberated or resonated with so many people who had bought into stereotypes about women. Oh yeah, women like this and men like that. And the feminists sort of thought that, too. And I was really angry. So I said, "No way.

We're not changing the curriculum. What we have to do is form a professional society for our undergraduate students and our graduate students, where there would mentors, where there would be community, where there would be opportunities for leadership." And that's when we formed the Women@SCS (School of Computer Science) organization. We did that when I went to Carnegie Mellon in 1999.

I was able to get funds from our president and some from the department to do this work. And I hired Carol Frieze [Carnegie Mellon Professor of Computer Science; author of "Kicking Butt in Computer Science: Women in Computing at Carnegie Mellon University"] to help me out; her background was in cultural studies and my ideas fit into what she knew. So I said, "Now that we're changing the environment, let's redo these studies." And so Carol became my PhD student. (Carol hadn't finished her PhD in cultural studies which I think was very typical of faculty wives her age --to do all but dissertation (ABD)—which made it difficult to have a real career .)

So we started doing the research again on our students, as we were changing the environment and as we were getting more women students. Over the years we're finding no gender differences. In fact, one of our first papers was titled, "In a balanced undergraduate computer science program, similarity is the difference". That's what we found when we had more women students and leveled the professional playing field by providing these professional advantages that were implicit for the majority in the community.

The earlier studies reflected a very unbalanced program. For example, if you were a student of computer science in the '90s at Carnegie Mellon, you were typically male. Your room-mate would probably also be in computer science. If you had problems with your homework, you'd work together.

If you were female, your room-mate would most certainly not be in computer science. It would be very awkward in the middle of the night to call up somebody in your class (most certainly male) and say, "Help me with my homework," or whatever. You didn't do that. And you didn't have access to the fraternities that collected old homework to check out, so you could look at old exams, so you could study from that. This was before the internet. If you were female, you didn't have fraternity brothers, who could let you know about summer jobs, internships. You didn't have access to all that.

So Women@SCS provides those kinds of things. And guess what? Everybody wants that, so absolutely all the programs at Women@SCS are open to the whole undergraduate community. For example, we have an advising session for

students who have to choose next semester courses. Upper division students give advice to the lower division students, and the advisors, they're women. But all the guys, they want to have that kind of explicit information too. Who are the good teachers; … ? So they come too!

At Carnegie Mellon, 50% of our undergraduate computer science majors for the past few years have been female, so we have a pretty good record.

And as we do the research, what we're finding is similar spectra. We find that yeah, some guys really love to code—but some women love to code. And some women love applications, but guess what? Some guys like applications, too. And everyone likes some of each --and of course everyone wants to have impact, so the spectrum is similar.

In fact, what's really interesting, MIT Press published the original study, but they wouldn't publish Carol's new book because there's a lot of controversy. They think what we're doing is so controversial. No! It's just common sense. I think Oxford University Press is publishing her book. So that's interesting.

OK, so that's how I got into that. And then there's a whole other phase of my life which has to do with entrepreneurship.

KLINE: Can I just ask you a few questions first?

BLUM: Sure.

23 Shaping the Field

KLINE: You talked about the results of the efforts in supporting women at Carnegie Mellon. How do you see your actions as having shaped the field of math and computer science from when you started to now?

BLUM: I think it's still distressing to me to see at many conferences, math and computer science, that there are so few women. Really, I can go to a conference and look: I get noticed. There might be one or two token women speakers. I think universities have been treated with kid gloves from day one. And the tenure system has helped the poor representation of women.

I remember, in the '70s, one of the motions we put through American Math Society was that, in terms of conferences or inviting speakers that they should be looking widely for women, have a broad net. Then, I think in '80s sometime,

it turned out I was head of the committee that was picking speakers for the next annual meeting. Everybody else on the committee was male. I was chair, and the committee decided who the speakers would be. So I start out by giving them the guidelines, which include the motions we passed in the '70s. All the suggestions we get are men, then more debates, more suggestions all men. Oh wow, I'm kind of just watching this happen. Then I remind them of this guideline. They say, "Well." And what I say to them is, "You're just asking your friends. Why don't you just open up to more fields, and ask your friends to open up to more fields? And maybe if you widen where you're looking, you might find some really great other people." And that's when we started to have women speakers.

But still today ….At Carnegie Mellon, I'm pretty central to the entrepreneurial things happening there. And there's a course on entrepreneurship where they invite speakers to tell their stories. This year I've been on sabbatical. So my dean, who is really good, sends me the list and asks for other suggestions. I looked and I say, "You know, there are no women on this list." He says, "Oh, I didn't notice."

Then I went back to the folks who were designing this course, these two guys. I said, "Well, you're just asking your friends. Why don't you open up-- there's so many women who could tell great stories." So still today … 2018, I'm saying the same things that we said in the 1970!

So some things have changed, some things not at all. I do think that there aren't enough women up there, in leadership roles. And I think because of that, and that the turnover in universities is not that great… there are still few women. People have to retire from their positions. It's not like companies that can really hire new people all the time.

Not sure how things are in the math department here at MIT. I know computer science is better.

KLINE: Yeah, I'm not sure about mathematics.

24 Independence vs Internalization

I wonder-- I'm sort of struck by your-- when you talk about your childhood and your independence and self-motivation. And then you talked about in graduate school, there's a lot of internalization of-- you just internalize your failures. And I

wonder what you think it is that allows some women to really excel, like yourself,what you think that it has to do with.

BLUM: Well, I think I wasn't prepared for the real world. I had the self-confidence, especially through high school, but I wasn't totally prepared for a world out there saying that you can't do it. You know once you got a letter from MIT saying," That's it," or "There's not enough room for you," or the guy telling you that it's not a place for women. And then I start to wonder, and the self-doubts begin.

But at the same time I was sort of oblivious to that. I didn't see it until its impact was not getting a real job. When I received my PhD there were no women in regular faculty positions at the top places. Nowhere, nowhere at that time, and that put me in the strange position. Am I going to be first? Am I good enough to be first?

And then there's this thing – everybody thought I was so great when I was here (at MIT), and then all of a sudden, you're no so great? I mean, how did that happen, I am the same person, right? So I think the reality of the world, I was not prepared for. I had a good foundation that's for sure. I'm independent, but the reality of the institutional structure, and not having the support structure -- and also the implicit bias.

I'm sure all these guys, who were my professors, many of their wives weren't working, although many were very well-educated. And certainly, at Berkeley, -- I can see the situation that Julia Robinson was in -- because most of the faculty wives weren't working.

So if they have this woman who's their friend, and she becomes their colleague, it changes the balance of things. They couldn't see Julia or even me as a peer, because that would change their own personal balance.

So I didn't have the community, but I think the moment I did, I gravitated to that community in lots of ways. But it did take me away from the research because I became so involved and started so many programs—maybe that was my way of dealing with it, actually trying to be constructive. But it wasn't a way that was totally constructive for me because constructive would have been just staying there with my research.

And I was really good at the other stuff too. And as I said, because I had those credentials, I was able to do things probably easier than others. Also, I felt, I was

right. I felt that a lot of the feminists -- most weren't in the sciences-- really had lower aspirations for women.

They probably didn't even believe themselves that women could do science, and that I was always countering that. I was always getting in arguments. At Carnegie Mellon, I got into arguments about this book that claimed you had to change the curriculum to attract and retain women in computer science. The book became very popular, in part I think because it went along with people's stereotypes. In fact, we did not change the curriculum. What we did was change the environment. But even today, people think that Carnegie Mellon is successful in attracting women because we have a female-friendly curriculum. I got a call this summer at Berkeley to talk in a conference. The organizer called me up, and we started talking, and she says, "Oh I'm so glad that this Margolis Fisher book keeps on having influence at Carnegie Mellon, and you still have these students." I said, "Absolutely not, we did the opposite." And she said, "Well, I don't think you should be at my conference, because I've been teaching this all these years."

Even in the early years, when I was saying that women could quickly get into mathematics, calculus, there was a big movement coming from social scientists saying women are really anxious about mathematics, so we have to have a psychological approach. "What was the first time you felt bad about mathematics?" No, the way you get out of this is to provide women the tools one needs to move ahead quickly, not remedial math, but the real stuff. So my approach has always been that… it seems so common sense to me, but it was also so outside the feminist mainstream.

I was able to change things. It took up a lot of my life but I think I had impact.

The really interesting thing is that my ideas worked at every single institution I started them in. Mills was a women's college. Carnegie Mellon is like the top technical place. Same ideas. Those are both private institutions, but at Berkeley, which is a public university I did the same thing. Everybody said, "Oh, she's just, you know, at the women's college you can do that." "Oh, you're at Carnegie-Mellon, oh, there must be a a lot of support for you." You know? There always was an excuse--

KLINE: People attribute your success to external factors?

BLUM: Right. But let me tell you about this year, because it's really interesting.

KLINE: Yes, great.

25 A New Research Direction: A Theory of Consciousness from a TCS Perspective

BLUM:

Manuel and I have been on sabbatical this year at Berkeley at the Simons Institute for the Theory of Computing [venue at Berkeley for collaborative research in theoretical computer science], which is somewhat like MSRI [the Mathematical Sciences Research Institute] where I was deputy director, except I'm not leading it. I'm one of the researchers in it.

They have several different topical programs. And one of the programs this semester was Brain and Computation, and Manuel and I both were part of it. I told you that Manuel early on worked in a neurophysiology lab, and he's always been interested in the brain since he was very young. He's done different things motivated by that. And he's been thinking about things like consciousness since he's very young. Partly because I think his mother was told that he's pretty dumb, and they'd be surprised if he graduates from high school. He wanted to get smarter, so he wanted to learn about the brain. He's been thinking about these things for a long time.

He's been wanting to work on consciousness for many years. But you know, it's been a taboo subject, because it's an old subject, it's not something that, you know, respected scientists have put their mind to too much.

So about a year ago when we're about to go on sabbatical, I go, “Well, why don't you start working on this again? You don’t have to teach. And this is what you really wanted to do.” So he started that. And because we were on sabbatical together, I had been talking to him a lot about it. I started working with him. It was the first time in a long time we started working together.

So what we're doing now is developing what we call a conscious AI … a conscious Turing machine. The idea is that we're constructing a mathematical model which is based on the studies and developments of cognitive neuroscience during the past 10, 20 years, where people have been able to look at the brain using fMRI technology to really see what's going on. Some really good theories are starting to gel from the cognitive neuroscience point of view.

So influenced by their findings, we're developing a mathematical model, a very simple model, like a Turing machine, which has an architecture that's very influenced, inspired by their work. And we're claiming that as we develop this, it will have properties of consciousness.

A Turing machine, is a very simple mathematical model of computation. You can think of the Turing machine as a little box with a state diagram in it. And there's a long tape with zeroes and ones on it. Just zeroes or ones, and they change, flick back and forth, depending on the instructions of the state diagram. Totally simple. But you can prove that whatever a big computer can compute, that simple machine can compute too. So if you want to prove theorems about what a super computer can potentially compute or what it can't, you need only look at this very simple machine. That's what mathematicians often do: abstract to the essence. Because once you have all of the things that make the computer faster, the bells and whistles, all that, it's almost too complicated to understand. We always go back to the simplest model.

That's what we're doing now—developing a Turing-like model, what we call a conscious Turing machine—which has this new architecture that's called the global workspace architecture. It was developed by cognitive neuroscientist Bernie Baars [neurobiologist who developed the global workspace theory; taught at the Neurosciences Institute in La Jolla, founded several organizations for the study of consciousness]. It's the first time, well maybe not the first, that we've been working on something that's really exciting for both of us—bringing some of my background in developing models, and his real interest in consciousness, and his knowledge about neuroscience. It goes way back. I remember he told me he told Walter Pitts and Warren McCulloch, way back in the '50s, that he wanted to work on consciousness, and they said, "No, no, you can't do that. No one can do that now."

So that's been what we're working on. It's controversial in a lot of ways, our work that is, because, you know, the neuroscientists [using fMRI technologies] have been able to map out the brain, and find out what the connections are, what different parts will do—and we're not doing that. We're not looking at the details or the connections, we're just looking at the overall structure and dynamics: What part is conscious? What's the unconscious? What's the role of each? We're abstracting and simplifying. So it's a little controversial.

The other big controversy, of course, is with the AI. Everybody's concerned that AI is going to be doing bad things in lots of ways—taking jobs away.

And the idea of working on an AI or a robot that may have its own consciousness or its own free will—totally a no-no, even to contemplate doing that. So, you know, we are mindful of all those things.

And of course we are very aware that with any disruptive technology, there are positives and negatives. You always have to be aware of that and deal with that too.

But you just can't stop doing research. I think people are interested, but a little skeptical – and I think at our stage, we're fine about it. I'm learning a lot and having fun. So that's my new area.

26 Back to Carnegie Mellon

KLINE: So you going back to Carnegie Mellon?

BLUM: Yes, we're going mid-July. We team-teach courses, too, Manuel and I. Actually, when we team teach, we get better reviews than when we do it separately, because, I don't know.. We're both very different. I mean, I'm more formal, he's less formal. He's very interactive, I'm less interactive. But the last time we taught together, we got the best reviews we ever got. And students said, "When we think of our time at Carnegie-Mellon, this is the course that we'll remember."

KLINE: Wow!

BLUM: And then they said something like, "Oh, and besides, they're so cute together." It was really funny. Undergraduate complexity theory is what we were teaching, it's the theory course, it's complexity theory. But now we're also going to bring in some of the research we've been working on into it.

KLINE: And are you going to continue with your work?

BLUM: I hope so.

KLINE: So you and Manuel worked together in Hong Kong—

BLUM: No. In Hong Kong, I was in the math department where I worked on my book, on complexity and real computation. Manuel was in computer science there. Actually, that's where he started this work that you probably know about. You know those squiggly characters the CAPTCHAs, that you have to read these characters to get into websites? That's coming from him. And he had started working what he called human computation when we were in Hong Kong.

KLINE: Have you worked together before?

BLUM: We did. We did this work early on. We did two things together [inductive inference and pseudo-randomness], but I don't think it's like what we're doing now. We have a couple of papers together. We don't have one with our son though—but we could, because he works in a similar area, in machine learning.

KLINE: Do you think your son's path was influenced by you and your husband?

BLUM: When he was growing up, when we were in Berkeley, people would say, "This is terrible. Your son, you know, how is he going to live up to you guys?" We'd say, "Oh, we'll be known as Avrim Blum's parents!" That's true, we are known as his parents.

He just left Carnegie Mellon this year, and he heads an institute at the University of Chicago, which is a machine learning institute -- he's one of the top people in machine learning. I think on the job market, he could get a job anywhere he wanted. I don't think that's true of us.

27 Entrepreneurship

KLINE: And your work on entrepreneurship?

BLUM: So quickly, about entrepreneurship, which is probably what I'm best known for in Pittsburgh. When I got to Pittsburgh, I was a little surprised that we didn't have a high-tech infrastructure around our university. Even at MIT, it has Kendall Square, and they had Route 128 and all that. And when I started teaching, I saw why, because you know, our students don't come from the area, Carnegie Mellon computer science students, even though our department is small, they're the biggest hires in all the tech and startup companies.

Google, Microsoft, all these companies, more than MIT—well, probably Stanford, because they're close by—compete with us. So if everybody's leaving, nobody's going to stay around and develop companies in Pittsburgh. It wasn't something I was particularly interested in, but I became interested later because I co-directed a research center called ALADDIN funded by the National Science Foundation. ALADDIN is an acronym: algorithm adaptation, dissemination, and integration-- All the algorithms people at Carnegie Mellon were part of this. They were interested in the synergy between theory and practice, which is very much a Carnegie Mellon thing. We also were the experts in proving correctness of algorithms, the complexity of algorithms, what algorithms can do, what they can't do.

People are often developing specialized algorithms in different areas, and don't even understand whether their algorithms work or not. We were looking at how a common algorithm can be applied to many different areas. We had about 15 different projects in lots of different areas, and we had gotten the largest grant for a theory group in the country at that time ($5million). And this was a program that we started under Clinton and Gore called Information Technology Research (ITR).

So one year, the PI and I —I was the co- PI-- were invited to Washington to showcase what we'd done, along with maybe 500 other people across the country who are showcasing what they'd done under ITR, which was great and very exciting. It was neat to see what everybody else was doing. And then the guy who heads the program says, “I have an announcement to make.” And we're sort of thinking, “Oh, great.” He says, “I'm sorry to say, but we're disbanding the program because there is a downturn in funding.” You may have heard that funding every so often gets cut by the government. And they're going back to individual grants to people. So our center whch was funding something like 15 graduate students, 15 faculty, and now everybody had to go back individually to NSF for funds and compete with each other. I thought to myself, “You know, each of our projects has an application. Why don't we commercialize that and bring money back to research? This was very naive.”

This was a scientist thinking about entrepreneurship, not a person who wants to make money. Not realizing that it’s going to be a long-term process to bring funds back to research. But I started this incubation thing anyway to go to the next stage, look at what we were doing, and see how we might commercialize some of these things.

So that turned out to be a genesis of a lot of startups actually coming out of Carnegie Mellon. I started a center called Project Olympus in 2007, and that's where a lot of things happened. It was like I didn't even know what I was doing, and then I hired people to help me out who knew more than I did. Yeah, I know a lot about this now, but not everything!

So that grew, and it also took over my life (again). I organized lots of popular Show and Tells for the community and my work in entrepreneurship became very well known. In fact Olympus became pretty instrumental in Pittsburgh becoming a startup hub. And that's when a lot of politics came in. I was in computer science, and the business school probably had been wanting to do this for many years. They said, “Who's this new kid on the block? She knows nothing about business. But how is she getting into every newspaper and why is

Olympus getting lots of attention?" That grew into a big thing, which has been a lot of my current life.

KLINE: That's interesting, talking about your dad and his foray into business. He was not really a businessman.

BLUM: Yeah, but I think I'm much more entrepreneurial than my dad was, but I still have this thing - I don't know if you know what angel funders are. They're very early stage funding. And we claim, my group, that we're the true angels, because we give, and we never take back!

So I never invested in any of the companies we helped create, and some are really big. Yeah, I'm my dad in that way, in that I helped develop this huge thing, but I'm still just getting a professor's salary.

So this entrepreneurial foray has been another big part of my life. You know, each time you do these things, if you want to do it really well, you've got to do it and think about it 24/7. I started going to every meeting of businesspeople in the city. I was the only faculty coming from an academic (rather than business school) point of view who was doing this. They were very grateful and I learned a lot, but it took over my life.

So that's why this year has been really good, because I was able to go back to research. Not completely, but for that I'm grateful. We'll see what is next.

28 Lifetime Achievement Award

And then I got a call about a month or two ago from Simmons, saying they were giving me this lifetime achievement award. That's why I'm in Boston now. I was actually quite surprised. I will have to give a speech. But that will be nice. And what I'm going to do is say that, because I have this award, that's inspired me to think about the many women who have encouraged and inspired me along the way. And so I'll talk about my mom, and her sisters.

But I'll also talk about Marion Walter who was my math teacher at Simmons, and who saw that I needed to have more. And then I'll talk about time in Berkeley and the women who cheered me on.

But you know, I've been a student and faculty both at women's colleges and "integrated" universities, so I've had a chance to look at the value of both.

One thing I've noticed, for a lot of women, women's colleges give them the confidence and the tools to do much more than they would have felt able to do. But, the same time, partly because there's generally no graduate program, there's often a truncation of aspirations. And unless you have the technical skills and the research experience—at least in tech areas, STEM areas—you're not going to be able to compete, either technically or professionally.

So it's really important that women's colleges align themselves with some research institutions.

For example, at Carnegie Mellon, in our PhD program, we only look at applications of students who've already done research. And if a woman is coming from a women's college and she hasn't done research, there's no way they're going to look at her application. So that is the challenge for women's colleges: avenues for research have to be built into their programs.

And also, being in a supportive environment, even for my own women students, is great at the time. But is it preparing them for the real world? Specifically, if they're going out to Silicon Valley, which can be a hostile environment, are they prepared? I don't know.

So related to your earlier question about me, yes I had the confidence. But I wasn't prepared when I went out (into the real world) because there were things I had to deal with that I didn't know how to deal with. I didn't even know there were things I would have to deal with. I think having that kind of awareness is really important. Those are the kinds of things I think I'll say.

One of the reasons I'm going to Simmons now [after this conversation] is the meeting with the president of the college. Actually, Simmons is becoming a university in September. Not sure if they will have graduate programs in STEM areas, but in other areas they will. And I think that's very good. That's very good.

KLINE: I didn't know that.

BLUM: I don't know if it's been announced yet. But it will be. That's one of the reasons she [Simmons president] asked me to be part of the small group.

KLINE: Well, congratulations!

BLUM: The other thing I should say is, it turns out that the end of this week, which I'm not staying for, is my 50th anniversary of PhD [at MIT].

KLINE: Why aren’t you going to your reunion?

BLUM: For two reasons. One is I never went to my own graduation -- it was the sixties. But the other is, really, ‘68 is when I got my PhD, and it's not like you have a class. You know? Some of the people I knew got their PhD the year before me, some two years after. They wouldn't be here.

It's not like I would know anybody, so it's not like the class I would come back to. And you know, there would be a lot of old people (like me, laugh). So I prefer being with my young people-- I teach students, I don't know how old you are, but I teach students now [2018] that were born in 2000. Oh my god! So that's a little bit of my life story.

KLINE: Well, thank you for sharing it with us.

BLUM: You’re welcome.