Evelyn Lamb: 00:14 Welcome to the Lathisms podcast. I'm your host Evelyn Lamb. In each episode we invite a Hispanic or Latinx mathematician to share their journey in mathematics. Today I have the pleasure of talking to Tony Varilly Alvarado. Hi, how are you today?

Tony Varilly Alvarado: 00:28 I'm doing great. Evelyn, how are you?

Evelyn Lamb: 00:31 Just fine. So can you tell us a little bit about yourself?

Tony Varilly Alvarado: 00:35 Sure. I'm a mathematician. I work at the intersection of algebraic geometry and number theory. I'm originally from Costa Rica. I grew up there. I lived there until I was 19. Then I came to the States and have stuck around essentially since. In fact today, September 9th is ... marks the 20th anniversary of my move from Costa Rica to the US so it's a good day for me.

Evelyn Lamb: 01:01 Yeah, happy anniversary.

Tony Varilly Alvarado: 01:03 Thank you.

Evelyn Lamb: 01:05 So do you remember if you were interested in math as a child? Did you have experiences with math when you were a kid?

Tony Varilly Alvarado: 01:13 Yeah. So not so much when I was a kid. I think, I used to get sometimes birthday presents from my dad that included sort of puzzle books. But not sort of advanced or sophisticated mathematics. It was more as a teenager that the interest in math began. I guess at the time I participated in Math Olympiads essentially by accident, but that really got me very interested in the subject. And even though the Olympiads is something I look back fondly on. But I think there's a whole lot more to math than that. But that is sort of how I got my start.

Evelyn Lamb: 01:54 And you say it was a somewhat accidental, so how do you accidentally start competing in Math Olympiads?

Tony Varilly Alvarado: 02:03 Yeah. So I was in ninth grade and my math teacher showed up in the morning in homeroom and she pulled me out of the class and said, "Well, there's this math competition." And there were supposed to be this team of five 10th graders who were supposed to go, but one person hadn't shown up. And so they needed a ringer basically. And so he asked me if I wanted to go spend the day in this math competition. And that sounded like fun to me. And so I just sort of said, "Yes." And within an hour I was sort of sitting in a room doing one of these Olympiad style, multiple choice exams and that was really not what I had thought I'd be doing that day. I mean the questions were like

nothing I'd ever seen before. So it was pretty cool but it was really difficult for me at the time and I was just very intrigued. I had never seen math like that before.

Evelyn Lamb: 03:06 And did the Olympiads ... were they sort of the impetus for you to continue studying math as you went to college?

Tony Varilly Alvarado: 03:14 In some sense? Yes. I think I first learned about the idea of a proof in Olympiads and that was a very eye opening experience. It was no longer this sort of mechanical, very methodical way of doing problems, but it felt more open ended and there was a certainty in the sense when you finis the proof and you know it was correct. That was quite appealing and yeah, so that really sort of continued when I went to college. I should say even after Olympiads, I still thought that maybe what I should be doing something "useful," quote unquote. It would be, be an engineer or something like this. And so for awhile actually thought about doing civil engineering, but then I would do Stewart's calculus book and all the interesting bits seem to be the proof's in a sense.

Tony Varilly Alvarado: 04:12 And so eventually I just decided maybe I should just stick to math. But I did spend a semester at the University of Costa Rica in 1999 because the way the academic calendars work in the US and Costa Rica, it's different. Even though Costa Rica is in the Northern hemisphere, we use a Southern hemisphere calendar and the academic year runs from February to November. So I had a few months to kill before starting college and I actually went and studied biology in Costa Rica for a semester. I figured that that was ... Costa Rica is a great place to study biology and so why not?

Evelyn Lamb: 04:51 Yeah. Did you consider doing biology after that semester of studying it?

Tony Varilly Alvarado: 05:00 That's a good question. In some sense, no. I really enjoyed that semester quite a bit, but I'd had interest when ... especially when I was smaller, I had really loved astronomy and the idea of physics. And so I was sort of more drawn towards that quantitative field and yeah. And if you dissect enough bats, that will also take your mind off biology.

Evelyn Lamb: 05:30 Oh, wow. So you came to the US for college and what was it like the transition between Costa Rica and the US?

Tony Varilly Alvarado: 05:43 Yeah. I mean it was very, very different. I mean in the US, I had never been to this the lecture format and I guess this is new for

most people anyway, but that 50 minute drink out of a fire hydrant lecture style was definitely sort of a new experience. And I was always used to understanding everything that was happening in real time and then all of a sudden, it was much harder. Culturally, it's extremely different. I actually found the language was pretty hard. I grew up speaking English at home as a second language with my dad, but a lot of my education had been in English, but it was one thing to go to school and have your teachers talk to you in English. And it was a different thing to actually be immersed in an environment where English was the primary language and everyone spoke really fast. So yeah, it was sort of difficult at first to get used to it. But I really liked it.

Evelyn Lamb: 06:48 Did you immediately know you wanted to do algebraic geometry or did you start looking at other fields of math first?

Tony Varilly Alvarado: 06:56 So I was an undergrad at Harvard and in the very late '90s and early 2000s. That really meant you were doing mostly algebraic subjects. And I think in the undergraduate pamphlet at the time, I think the first sentence said something like, "Modern mathematics is written in the language of algebra." And so it was in some sense a lopsided department at the time. I think they're much more balanced nowadays. But that sort of really got me going in the sort of more algebraic side of things.

Tony Varilly Alvarado: 07:28 And when in between freshman and sophomore year, I was a counselor at one of these summer camps, Promise, at Boston University that did sort of inquiry based in a sense program in elementary number theory. And I really liked that. And so then I started sort of looking more and more into number theory and algebraic number theory. But it wasn't really until I got to graduate school that algebraic geometry was sort of on the radar. And it just happened my first year in graduate school when I took a class in the subject that I just ... I really liked it. And so decided to go in that direction.

Evelyn Lamb: 08:12 And what are some of the questions you work on now?

Tony Varilly Alvarado: 08:14 Right. So I've been working a lot on K3 surfaces, which is a ... it's a particular type of surface. And let me just say that the type of questions that I like to study are number theoretic in flavor, in the sense that I want to study Diophantine equations whose geometric avatars are surfaces and K3 surfaces are what one might call surfaces of intermediate type. So if you sort of classify all surfaces, then there are sort of a larger spectrum of them. And at one end of the spectrum, there are surfaces that we really understand quite well, both geometrically and in terms of

their number theory. And so, for example, anything that looks like the projective plane is usually reasonably understood. And at the other end of the spectrum, there's this whole area of surfaces of general type, which comprise most of the surfaces out there. But they're very, very difficult to understand.

Tony Varilly Alvarado: 09:19 Even the geometry is not really worked out very well. And so, somewhere in between those two ends of the spectrum, there's K3 surfaces. And I think there's a lot of really interesting questions about do they carry rational points, meaning do they even have one point where every coordinate is say a rational number. And then if you have one point, then you ask for more, are there infinitely many points and how are they distributed on the surface. and do they sort of cover the surface in a suitable sentence or do they sort of accumulate in different parts of the surface. And so I focused a lot on more sort of the existence of points and understanding what prevents a surface from ever having one of these rational points. And so I've been working on conjectures that try to come up with sort of a reasonable explanation for why these surfaces might lack points.

Evelyn Lamb: 10:22 Moving away from the research a little bit. I know that aside from research you do obviously teaching because you're a professor at a university. But I also see your name all over the place as organizing various conferences and being involved in the American Mathematical Society and things like that. So do you want to talk a little bit about what I guess would appear on your CV as service to the profession?

Tony Varilly Alvarado: 10:51 Yeah, sure. Yeah. No, I think service to the profession is an extremely important part of my job. At the end of the day, I mean you already see this in the research side of things, which is that to do mathematics is to be in a community. And you know when we talk, when people will say like, "Oh that is an interesting problem." Usually what they mean is that it fits into a much bigger program and that there's sort of good reasons to attack that problem and try to crack it. But those sorts of statements depend on the existence of a community of other people who might also think that such a thing as interesting.

Tony Varilly Alvarado: 11:28 And so I see sort of service to the profession as part of sort of that community building. So I think it's very important to be involved in the AMS, which is the ... a leading organization for research mathematicians and also a part of what they do is they interact with government for example. Mathematics is an activity that it's hard to explain sometimes why one should spend taxpayer money on. But I think it's very important to try

because I think people have the right to ask. And I'm a big fan of talking to people in government and explaining why it is we should keep doing this. It's paid off incredible dividends sort of both at the industrial scale and things like that. But also just culturally as well.

Evelyn Lamb: 12:28 And I've really enjoyed talking with people on this podcast series about mentorship and the way that has played a role in their careers. Who were some of your mentors when you were starting your career?

Tony Varilly Alvarado: 12:44 Yeah, that's a great question. I think two people really stand out. In some sense, they are the obvious people, but they really changed my life in fundamental ways. One was my PhD advisor, Bjorn Poonen. He really sort of helped me understand a lot of really hard mathematics, but also this idea that you need to be working in a community. And Brendan Hassett, who was my postdoctoral mentor at Rice, and he was just fantastic. I mean, he was just a fountain of wisdom basically at every turn. And he really sort of helped me understand what it meant to be a professional mathematician, not just sort of in the research side of things, but just sort of how to be part of that community and move sort of the conversation or a field in a particular direction by sort of for example, having students and having postdocs, and helping them sort of develop in a sense their own tastes or mathematics.

Tony Varilly Alvarado: 13:57 But of course it's also the style of math that you like to do. So, Brendan was a fantastic mentor. So that was a life changing experience. I came to Rice, I mean, I knew of Brendan well before I came to Rice. And he was the only algebraic geometer at Rice at the time. And so, I didn't know. It was a little sort of concerned that maybe I wouldn't have many people to talk to. And I remember being in a bar in Atlanta with Danny Krashen for a completely unrelated reason. And I told him what I was trying to decide between places and he just looked at me, he was like, "Well, clearly there's no better mentor for you than Brendan Hassett." And I can't remember what else he said, but it just the moment he said that, it was like, oh yes, that is absolutely right. And I'm glad I followed Danny's advice and I came to Houston. It was life changing.

Evelyn Lamb: 15:02 And now you're at the point in your career where you're probably doing a lot of mentoring as well. How do you approach that?

Tony Varilly Alvarado: 15:10 So I'm reminded now that we were just speaking about Brendan Hassett and I asked him, "When you have graduate students, what should want to do?" And he told me like, "Well, remember what your advisor did with you?" And I said, "Yeah, sure." And it's like, "Okay, don't do that." And I thought it was actually really good advice and what he was getting at is every person is different. And so as best as I can, I try to understand people's strengths and try to sort of leverage those strengths to help them produce a thesis that everybody can be proud of. That's sort of at the graduate level and at the postdoc level, it's a bit through more hands off where you're sort of there as more a support mechanism and happy to talk math. But you're sort of helping people sort of start that career without necessarily sort of having sort of meetings every week and things like this. It's sort of a bit more hands off or at least that's my personal style.

Evelyn Lamb: 16:22 And I also want to know what kinds of challenges you've faced in your research or broader career, and how you've handled those, how you've overcome those.

Tony Varilly Alvarado: 16:38 Right. Yeah, the challenges certainly abound. I think for me personally, the biggest challenge is time management. I'm sort of involved in a lot of things and it's sort of easy for things to fall through the cracks. And it's taken me a long time to sort of work out a system where I can keep all the balls in the air, or as much as I can. And I have trouble saying no. And I think that university administrators have caught onto that and so that it makes for an interesting career here at Rice. I like to be very involved. I think that it's good to be involved at the university level, for example, and also at the professional level. But I think one of the biggest challenges is being sort of juggling it all and keeping an active research program.

Tony Varilly Alvarado: 17:38 So I have found about myself that I work better in blocks of time. And by blocks I don't just mean sort of a four hour block here or a four block there. I mean that this summer I really threw myself at research and I spent it mostly in Europe and it was great. I really just did mostly research in a sense. And when I teach to classes, I really focus on a lot of energy on my teaching because I think it's a very important part of what I do. And to some extent when you're teaching to classes, I let sort of the research take a little bit backstage knowing that I'll sort of fire up and go back to it again as the semester winds down.

Evelyn Lamb: 18:31 But maybe managing that and managing your own expectations about what you'll get done is important.

Tony Varilly Alvarado:	18:38	Absolutely. I've sort of come to peace with the idea that there's only 24 hours in the day. And there's only so much you can do in one day. And that mental health is extremely important and in fact I am sort of much happier and more productive when I don't try to overdo it.
Evelyn Lamb:	18:59	Well thanks a lot for taking the time to talk with me.
Tony Varilly Alvarado:	19:02	Thank you, Evelyn.
Evelyn Lamb:	19:06	Thank you for listening to the Lathisms podcast. It's produced by me, Evelyn Lamb, and made possible by a Tensor-SUMMA grant from the Mathematical Association of America. Our music is [foreign language 00:19:17] by La Floresta. Lathisms is an initiative to celebrate the accomplishments of Hispanic and Latinx mathematicians. It was founded in 2016 by Alexander Diaz-Lopez, Pamela Harris, Alicia Prieto Langarica, and Gabriel Sosa. You can find more information about the project at lathisms.org. That's L-A-T-H-I-S-M-S.org. Join us next time to hear from another inspiring mathematician.