Colin Adams Interview

Colin Adams is Thomas T. Read Professor of Mathematics at Williams College. He is the author or co-author of many research articles, eight books, and the mathematical humor column "Mathematically Bent," which appears in the *Mathematical Intelligencer*. He is also known for his humorous math plays and for starring in "The Great Pi/e Debate" and "Derivative vs. Integral: The Final Smackdown" together with his colleague Tom Garrity.

Diaz-Lopez: When did you know you wanted to be a mathematician?

Adams: Unlike most people, I found out relatively late in life. When I was a kid I wanted to be a writer, but I ended up getting into MIT and Oberlin, which are very different schools, and my father essentially said, "I'll pay for MIT but I won't pay for Oberlin." So I went to MIT and started out as a philosophy major. But I just couldn't get into philosophy because I would disagree with the professor, and if you disagree with the professor you don't get As. In math there is no such thing as disagreeing with the professor. You are right or you are wrong. I ended up really liking math, but it wasn't until graduate school, when I solved a problem nobody had solved before, that I really fell in love with mathematics. That was the moment when I said, "OK, this is what I am doing for the rest of my life."

Diaz-Lopez: Who encouraged or inspired you?

Adams: It's interesting because it's related to what I just said. I was taking a graduate seminar at the University of Wisconsin and I was trying to decide if I wanted to work with Jim Cannon (who later became my advisor) or a different faculty member. One day in the seminar Cannon said, "I will give five dollars to the first person who finds the hyperbolic volume of the 5_2 knot." At the time the hyperbolic volume of only one knot was known (the figure 8 knot) and the 5_2 knot was the next knot in the table. I was a starving graduate student so I said, "Ok, I'm going to get those five dollars." I spent the next month trying to solve this problem, and I couldn't solve it. After a month I started to think, "Okay, five dollars is not worth it anymore," but I kept working at it. There was a postdoc who was in the seminar, Dennis Stowe, who actually solved the problem. I was crushed when I heard he had solved it, but when he presented his proof I realized what I had been doing wrong. The interesting thing is that his method only worked on that one knot, but I fixed my method and it worked on all the rest of the knots in the table. So he got the five dollars but I got a PhD, so I thought that was a pretty good deal.

Diaz-Lopez: How would you describe your research to a graduate student?

Adams: I work in two areas and the intersection between the two, namely I work in knot theory and hyperbolic 3-manifolds. Knot theory is very tangible and very easy to describe in terms of knotted circles sitting in space, how

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on the ground floor of hyperbolic 3-manifolds, right after Bill Thurston invented the field. There were many problems to work on, and to this day it is still a really exciting field. Thurston conjectured (and Perelman later proved) that 3-manifolds can be cut up into pieces that come in eight varieties. One of those varieties is hyperbolic. All manifolds in the other seven classes have been classified. So all the excitement is in the eighth category, hyperbolic manifolds. That made it a really great area to be in.

Diaz-Lopez: *What theorem are you most proud of and what was the most important idea that led to this breakthrough?*

Adams: Let me tell you about the theorem I didn't get, which would have been my favorite if I would have gotten it. It was conjectured for many years that the figure 8 knot has the smallest hyperbolic volume among all knots, in fact among all cusped hyperbolic 3-manifolds. I really wanted to prove that theorem, and I spent fifteen years working on it. Eventually somebody else got it, Robert Meyerhoff and Chun Cao [Inventiones, 2001]. That was difficult, but a lot of the ideas and things I learned in the process of trying to prove that theorem allowed me to prove many other theorems; so in the end it actually worked out fine.

Colin with students in the knot theory group of SMALL, 2013, now all in graduate school (Michigan, Georgia Tech, Brown, Princeton, MIT, Duke, and Stanford).

they are related to each other, and the different ways to tell them apart. Hyperbolic 3-manifolds is an area where you have 3-dimensional manifolds with a metric of constant curvature -1 . It turns out when a manifold has such constant curvature there is a theorem called the Mostow rigidity theorem, which says that there is only one possible metric on the manifold. Therefore, you can associate a volume to the manifold and make calculations. I was very lucky to come into the intersection of both topics, and since then I've worked in both areas. It has been a really exciting time because I came in

And they used some ideas that I had come up with in order to prove the result.

Diaz-Lopez: *All mathematicians feel discouraged occasionally. How do you deal with discouragement?*

Adams: As long as you are excited about the problems you are working on, even when you feel you are not making any forward progress, you can't help but

think about the problem. Eventually the results come. It's hard to come to that realization in the beginning of your career because you haven't yet had enough times when that has happened. But as you go on and it happens to you more and more, you become more confident in the fact that it will happen, even if it's not happening now. Eventually you may not solve the problem you set out to solve, but you will solve some other problem instead that is related to the problem you set out to solve.

Which brings up another important point. Don't assume you pick a problem and you solve that problem. More often what happens is you pick a problem and you try to solve that problem and it doesn't work, but then you think of all these related things and you solve those instead.

Diaz-Lopez: *You have won several honors and awards. Which one has been the most meaningful and why?*

Adams: One I was really pleased by is the Robert Foster Cherry Teaching Award, because that's an award that's not just for math; it's a general award for someone in academics in the English-speaking world. It was an honor to have people beyond the mathematical community saying, "Wow this is interesting stuff that this person is doing." It was very nice.

Diaz-Lopez: *Apart from your mathematics you are well known for your humorous plays and articles. How did you get involved in such things?*

Adams: That actually goes all the way back to what I said before about wanting to be a writer when I was a kid. I didn't want to be a mathematician, but as I mentioned before, math won out. But then, when I came to Williams I started writing again, and I actually published my first story in the Williams Literary Review. I had so much fun doing it. So, I started to think, "What can I write about humorous mathematics?" It turns out that math humor is a niche market. There isn't a lot of competition. I could not succeed in the humor market but in the math humor market I had a shot. So I started writing math humor, and I got

Adams' "cousin," Sir Randolph Bacon III, gives a talk, "Blown Away: What Knot To Do When Sailing."

always have some mathematical project to think about

I started putting on productions. It has really been fun. For me this is my hobby. I work all day on math, and then I come home and I get to work on the expository fun stuff, so it's a good way to break up the day.

Diaz-Lopez: *You have given over 300 presentations, published over fifty papers, refereed for numerous journals, published eight books, and run a research program every summer. Given your many commitments, what techniques do you use to manage your time?*

Adams: Rule number one for me is that I don't watch TV, so when I go home at night the things you mentioned are what I do for fun. And it works for me because I enjoy them. I can get my teaching, research, and administrative commitments done during the day, and then I have time to do the fun stuff in the evenings. And that's the reason I do so many different things. For me it's fun to do different things; if I had to do just one thing I would burn out and be frustrated. Being able to switch gears a lot has helped to be more productive.

Diaz-Lopez: *If you could recommend one book to graduate students, what would it be?*

Adams: For people interested in knot theory, there is a book for graduate students that to me was really transformative: *Knots and Links* by Dale Rolfsen. It has been around a while now but it's still an amazing book, and it has been a resource for me for many years.

Diaz-Lopez: *What advice do you have for graduate students?*

Adams: When I was near the end of my grad career, I went to my first research conference and met Joel Hass. He had graduated a couple of years ahead of me (from a different school), and one of the things he said to me that was really useful was, "Don't worry if you go to talks and you don't understand much of anything. Don't worry about it, it's okay. Many of the people in the room don't understand what's going on. Just let it wash over you, and

very lucky. I met Ina Mette, who was one of the editors at Springer at the time (and is now at the AMS), and I asked her, "Could I publish a book on this?" She said, "Why don't you start a math humor column in the *Mathematical Intelligencer*?" I started doing that, and then I started turning those columns into scripts, and then

Because the complement of the 5_2 knot has a hyperbolic structure, maximal neighborhoods of the knot correspond to infinitely many tangent horoballs in hyperbolic space. In general, horoball diagrams can expose information about the symmetries, volumes, and other typical features of knots.

after you let it wash over you enough times, eventually it starts to make sense." My advice is: don't feel like you are the only one in the room who doesn't understand what's going on. You are not. There are many people in the room who don't follow what is going on. You get the impression everyone does, because the ones who speak up and ask questions all do. But they are the experts in the area. If you see the speaker speak enough times, eventually it will make sense. So don't be intimidated by the fact that you don't grasp it all at the beginning.

Second, always have some mathematical project to think about. The most fruitful place for me to think about math is when I am at a conference in a talk that I don't understand. At some point I might give up on the talk, but I can't leave, so I think about mathematics.

Credits

Photos of Colin Adams and Colin Adams with students are courtesy of Alexa Adams.

Photo of Colin Adams as Sir Randolph Bacon III is courtesy of Frank Morgan.

Horoball diagram was created by Jeffrey Weeks using SnapPea.

Alexander Diaz-Lopez, having earned his PhD at the University of Notre Dame, is now visiting assistant professor at Swarthmore College. Diaz-Lopez was the first graduate student member of the *Notices* Editorial Board.