A Few Firsts in the Epsilon Years of My Career

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Synopsis

In this essay, I describe the unexpected ways I achieved some milestones in the early years of my career.

I arrive at work on a beautiful Tuesday morning in October 2017. Coffee in hand, I open my work email and see the daily arXiv Number Theory email, chock full of titles and abstracts.[1] In my endless scrolling, I see a paper with "Hasse-Witt Matrices" in the title [1]. I wonder if this is related to a wonderful result of Manin's [3] that I used in my thesis work and the papers that I published from it. It's a lovely result that connects arithmetic and analytic properties of curves – a unification of mathematics, if you will [2, Section 2.12]. I click the link that brings me to the article on the arXiv website. I open the PDF and do that thing I always do when articles seem like they could be related to my research: I scroll to the end of the article without reading it, look at the list of references, and see if they've referenced my papers.[2]

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[1] Are you familiar with the Tuesday arXiv email? Let me tell you about it. Wednesday, Thursday, and Friday's arXiv emails contain the articles that were submitted on the previous day before 5 pm (as well as articles two days prior that were submitted after 5 pm). Monday's is similar, except it goes back to Friday before 5 pm since there are no arXiv emails on Saturday and Sunday. But Tuesday is different. Tuesday's arXiv email contains all the articles submitted between 5 pm on Friday and 5 pm on Monday. That's a whole 72 hours of submissions. And so on Tuesday morning a behemoth of an email arrives in your inbox. You then engage in a seemingly endless scrolling through all the journal articles that everyone but you is writing.

[2] Perhaps this is overly honest, but I'm sure I'm not the only early career mathematician who does this.

Lo and behold, it's the day that every girl dreams of her whole life: the first time when not one, but two of her papers are cited in a research article.

But wait, what's this paper about? Did I see the word "warning" in the title? I go back to the abstract for a more careful, less self-serving, investigation. Oh. There's been a potentially huge mistake in using Manin's result on Hasse-Witt matrices. For years, people have been conflating these matrices with Cartier-Manin matrices. Over 90 research articles are possibly affected (including the two of mine that are cited, and potentially one more that I had just submitted).

The blood drains from my face. I close the browser tab. I look at the clock and realize that it's time to head to class (I get to teach Abstract Algebra for the next few hours, which I normally love but how will I be able to focus?). I wonder if my work is a sham, my thesis false. Will I have to leave academia?

This was an overreaction for sure, but this was all happening as I was already feeling uncertain about my future. At the time I was in my second year of a 2-year position as a visiting assistant professor. Endless scrolling on mathjobs.org and applying for tenure track jobs had taken over my waking hours. It was a difficult year for hopeful academics in pure math. If my results were proven wrong, what chance could I possibly have of staying in the profession I had worked so hard to enter?

Later that day, I explained the situation to my husband, who reacted by making me mac and cheese with greens and garlic, followed by ice cream from the 7-11 across the street (because food is love).

Now you may have noticed that I only mentioned reading the abstract of this article. I sat with my dread for several busy days of teaching before returning to the article.

On Friday after class, I finally open the PDF again. I see that I'm reference numbers 54 and 55. I skim the paper and find that 54 and 55 are not listed in the section of papers with incorrect results. Relief! My results are okay!

A few days later, I read the entire paper. Wow! What an amazing catalogue of results. The authors were attempting to use a heavily-cited result that used Manin's work. They were confident that their work was correct, but for some reason things just weren't working as expected. They did a little digging and found that the result they were using was incorrect.

This lead to a lot of digging — digging through the literature, using Math-SciNet and Web of Science to find all of the articles that had cited either Manin's or the other result. It was over ninety other papers. They went through these papers and created a sort of sieve: papers that cited Manin but didn't rely on the result, papers in which using Manin or the other result didn't cause errors, and then the eight papers in which using Manin or the other result did cause errors. They contacted those authors and explained the situation.[3] This was a truly impressive undertaking, and their write-up of this process is a fascinating read.

Fast forward one year:

I survive the job market and start my dream tenure track job. This is quite the understatement, actually. I will spare you the negative details, though if you or someone you know has recently been on the job market then I am sure you will know how grueling the process is. And yet, somehow, here I am: thinking about math every day and teaching an incredibly diverse group of students in my favorite city. This is exactly what I wanted for myself and it is surreal to have things turn out this way.

In September 2018 I travel to the Conference on Open Questions in Cryptography and Number Theory, a.k.a. the Alice Silverberg birthday conference.[4] At the end of Day 4 of the conference (usually a tough time to stay focused, but the talks at this conference had all been quite engaging and the coffee was plentiful), there is an interesting talk on being wrong in math. The speaker begins with a story of a slight misquote of a statement Euler made based on an incorrect formula he wrote.

The speaker then moves towards the present and starts talking about elliptic curves[5] and higher genus curves. He says something about Jacobians and mentions Manin. My ears perk up. He starts explaining how he and his collaborator were finding inconsistencies in their results and that it was based on an error in another paper they were referencing.

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[3] It was reassuring to see that they had contacted the authors whose papers had errors. It turns out that if my own work had been incorrect, I would have found out long before the infamous Tuesday arXiv email.

[4] I love a good birthday conference, and it was a real treat to be able to attend a birthday conference celebrating the career of a female mathematician.

[5] After all, this was a number theory conference.

Wait... I think I know this story! I am almost overwhelmed with astonishment — could this be about the paper that I had briefly thought would thwart my career?

I had nearly forgotten about it and it was surreal to be sitting in the audience, listening to the story unfold, knowing how it ends and knowing that I was part of it!

I tap the shoulder of the mathematician sitting next to me who I had been chatting with about supersingular curves all week. I whisper to her, "this happened to me!" The speaker, Dr. Everett Howe, then starts listing the papers that they realized might be affected by the error he and his collaborator, Dr. Jeff Achter, found. Dr. Howe gets to slide 30 of 39. It's the moment that every girl dreams of her whole life: the first time that her name and not one, but two of her papers appear on the big screen at a conference. This is not how I imagined it happening, but I am thrilled nonetheless. I am part of this story.

At the end of the talk I raise my hand to offer another first: my first "question that's really more of a comment" at a conference. I tell a much shorter version of this tale, barely able to contain my excitement.

Why was I so excited? It was partly that I was so surprised to be reminded of the article that cited my articles, and partly I was just nervous to be speaking in a room full of number theorists whose work I admire. But in hindsight, this was also perhaps one of the first moments that I really felt like I was a part of the conversation and a part of the community (especially since I was sitting there with my name tag that listed my employer for my new tenure-track job). And who wouldn't be excited about that?

Acknowledgements

References

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[2] C. Herbert Clemens, *A Scrapbook of Complex Curve Theory*, The University Series in Mathematics, Plenum Press, New York, 1980.

[3] J.I. Manin, "The Hasse-Witt matrix of an algebraic curve", *Izvestiya Akademii Nauk SSSR Seriya Matematicheskaya*, Volume **25** (1961), pages 153–172 (in Russian). English translation published in *American Mathematical Society Translations: Series 2*, Volume **45** (1965), pages 245–264.