"Brilliance and Generosity of Heart": Elizabeth Meckes (1980–2020)

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Introduction

The mathematical community suffered an incalculable loss at the end of 2020 when Elizabeth Elder Meckes passed away from colon cancer at the age of 40½. This article offers a brief introduction to her life, a personal reflection Elizabeth wrote when Karen Uhlenbeck was awarded the Abel Prize, a response to Elizabeth's comments by Uhlenbeck, a tribute from Rafe Mazzeo, professor of mathematics and department chair at Stanford University, and a collection of thoughts to consider as the mathematical community moves forward with insights gleaned from Meckes' life.

Brief Biography

Elizabeth Meckes grew up in Cincinnati, Ohio where her parents, Richard Elder and Katherine Tepperman Elder, served on the chemistry and biology faculty, respectively, at the University of Cincinnati. A talented flutist, Elizabeth played in many school and community ensembles, including the Cincinnati Symphony Youth Orchestra. She attended Case Western Reserve University (CWRU), completing her

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Reflecting on Elizabeth Meckes for the Case Western Reserve University community, Dean Joy Ward noted that "I didn't have a great amount of time to get to know Elizabeth before she and her family left for Oxford, but even through just a few conversations I had the opportunity to witness the extent of her brilliance and the generosity of her heart" *[10, our emphasis]. The author would like to thank Mark Meckes for his thoughtful help with this article, particularly his willingness to check details and provide insights into Elizabeth's early life.*

undergraduate degree in mathematics in 2001 and a master's degree the following year. She met Mark Meckes at a high school band camp and the two married when she graduated in 2001. She traveled to Palo Alto to pursue a PhD in mathematics at Stanford from 2002–2006, working under the direction of Persi Diaconis. In her thesis on an "Infinitesimal version of Stein's method" she developed a "powerful tool for solving problems" [1]. On her personal website, Meckes described Diaconis as "fun" and encouraged readers to "talk to him sometime." Diaconis described Meckes as one who "pursued whatever mathematical problem she was tackling with all of her being. She was at the top of her field, driven, giving, and full of life" [10]. When she graduated from Stanford, she received the American Institute of Mathematics Five-Year Fellowship which provided (as the name suggests) five years of research support for an outstanding new PhD in pure mathematics. Her research considered questions in probability and analysis. As she put it, she tended "to be most interested in situations in which probability arises naturally in other fields, e.g. differential geometry, convex geometry, and number theory" [3]. Her 27 papers and two books have left a "considerable mathematical legacy."[1]

She spent a year at Cornell and then she and her husband accepted assistant professor positions at Case Western Reserve University in Cleveland, Ohio in 2007. They published their first joint paper that year. They collaborated on several other papers and published what she referred to as "a textbook for a first rigorous course in linear algebra (imaginatively titled)" *Linear Algebra* with Cambridge University Press in 2018 [3, 4]. All the while, Meckes maintained a commitment to work on behalf of all vulnerable groups of faculty, particularly in

[1]*Durrett [1] offers a beautiful overview of Elizabeth Meckes' work along with this analysis of her contributions.*

her role as chair of the Executive Committee of the CWRU College of Arts and Sciences. The following year she published her own 224-page book, *The Random Matrix Theory of the Classical Compact Groups*, with Cambridge [8]. Supported by a Simons Foundation grant, she was spending the 2020–2021 academic year with Jon Keating's random matrix theory group at the Mathematical Institute at the University of Oxford.

In the preface of *The Random Matrix Theory of the Classical Compact Groups*, Elizabeth acknowledged the contributions of her family when she wrote "[i]f my writing helps to illuminate the ideas I have tried to describe, it is because I got to talk it out first at the breakfast table" [8]. In a beautiful tribute to Elizabeth in "Eigenvalue is not a dirty word: My mathematical collaborations with Elizabeth Meckes," Mark Meckes pointed out that they were always joined by their children Juliette and Peter at that breakfast table [9]. In particular, he noted that their children were very much a part of their mathematical lives, both acquiring passports as babies to travel to conferences in Banff and joining them at various conferences and seminars around the world throughout their young lives.

For Meckes, outreach and mathematical writing went hand in hand. She wrote a two-part article for girls in the *Girls' Angle Bulletin*, a bimonthly publication with the aim of connecting K–12 students with professional mathematicians. Meckes intended for the first installment to introduce the idea of axiomatic probability and the law of large numbers [5]. The second installment offered what Meckes described as an "exposition" of the central limit theorem [6].

Perhaps not surprisingly then, Elizabeth collected her thoughts on paper when Karen Uhlenbeck was awarded the Abel Prize in 2019 [7]. In particular, this prize prompted Meckes to consider the question "Does it matter [that women in mathematics have female role models]?" To explore this query, she reflected on her personal journey as a mathematician in a broader community with dedicated initiatives to advance women in mathematics. She outlined the evolution of her thinking, which began with her initial skepticism and, after several observations and experiences, led to a more expansive view. That progression alone tells us Elizabeth Meckes maintained a willingness to reflect on and (re)evaluate her thoughts over time. In this case, however, she shared her personal analysis with us. She ultimately answered her own query with three definitive words: "Yes, it matters."

"Some personal thoughts I wrote down when Karen Uhlenbeck was awarded the Abel Prize" by Elizabeth Meckes

There's this fantastic quote from the great science fiction author Octavia Butler, about the lack of black women science fiction authors who could have served as role models for her: "Frankly, it never occurred to me that I needed someone who looked like me to show me the way. I was ignorant and arrogant and persistent (*sic*) and the writing left me no choice at all." I might have written that. When I was a mathematics student, I was so firmly convinced that I had what it took that it never occurred to me to care whether there were female role models around. This week, it was announced that Karen Uhlenbeck, professor emerita of mathematics at UT Austin, was awarded this year's Abel prize. The Abel prize is the most prestigious award there is for a senior mathematician (much closer to a Nobel prize for mathematics than the usually mentioned Fields medal), and Professor Uhlenbeck is the first woman to receive it. Now, in that rarified stratosphere of Abel-prize recognized mathematical brilliance, there is a woman we can look up to. Does it matter?

I was a student at the turn of the last century, when the mathematics community, along with many other male-dominated professions, had noticed that the expected influx of women somehow never seemed to materialize, and was looking for more active ways to bend the curve. In my experience, this meant mostly the appearance of "women in mathematics" groups, whose very existence I found vaguely offensive: how dare anyone tell me I needed extra support? As a graduate student, I read a piece in a professional publication by a famous (white, male) mathematician, offering the advice to people in underrepresented groups that, when choosing a graduate program, they should find one that had faculty in their demographic, to serve as role models. And again, my reaction was "How dare he?" How dare he suggest that I should have turned down a place at Stanford because there were no women on the faculty? Like Ms. Butler, it never would have occurred to me to do such a thing, and for the record, I loved Stanford and will always be grateful for everything I got out of my time there. First and foremost, a wonderful advisor who led me to beautiful mathematics.

The thing is, I don't know what Ms. Butler said next after that fantastic quote. But my career didn't end with being a graduate student at a famous university; life went on. I got exactly the kind of job I wanted: a tenure-track assistant professorship at the same institution where I had been an undergraduate, together with a prestigious fellowship that allowed me to focus on research. At first, I was way too focused on proving the next theorem to notice or care about any forms of gender bias around me. But little by little, I began to notice things. The students who complained that they were too intimidated to ask me questions because it all seemed too easy for me (isn't the professor supposed to know the material well?). The fact that I developed the habit of never stopping to breathe while making a point in a meeting, lest someone start talking over me. The aggressive questions during and after some of my talks. And I started to see why having peers or mentors who understood these experiences had some value.

I met Karen Uhlenbeck once. It was at the program "Women and Mathematics" at the Institute for Advanced Study. Every year, they run a two-week workshop on a current research topic for female students and postdocs, with four senior women giving a week's worth of lectures each.

In 2014 I was invited to be one of the lecturers. I felt that I didn't need a support group because of my gender, but I did recognize that maybe it did matter to at least some young women, seeing people who looked like them at the front of the room, and maybe that could be me. So I went and it was wonderful. And as much as I'd seen it as a vaguely altruistic gesture on my part, having the opportunity to meet and talk to the senior women organizers affected me in ways I didn't expect. I remember in particular talking to Karen and to Dusa McDuff, another towering figure of current mathematics. I never would have believed it, and my younger self would have been incensed at the very idea, but interacting with them propped up a little part of my self-image that I hadn't realized was sagging.

In March 2017, the *Notices of the American Mathematical Society* featured on its cover a head shot of Andrew Wiles, who was awarded the Abel prize in 2016. Professor Wiles proved Fermat's last theorem, a conjecture that had stood for over 350 years; such an achievement certainly merits all the awards we can throw at it. But I bet I wasn't the only woman who noticed that that issue of the *Notices* had a large picture of a famous male mathematician, that the other two names on the front cover belonged to men, and that there was a tiny, colorful banner declaring that it was Women's History Month. Next time, it will be Karen Uhlenbeck on the cover and that little banner about Women's History Month won't feel like a sad little bone thrown to the people who don't really matter. It will feel like a celebration of something real. Yes, it matters.

Karen Uhlenbeck's Response to Elizabeth's Reflections: "Go for it, gal!"

I was saddened to hear of the untimely death of Elizabeth Meckes, whose contributions to a range of subjects in probability are substantial. I am reminded that, when asked what were the greatest difficulties I have had in my career, I answer "ill health." I am indeed sad for her, her family, her students, and the profession.

I met Elizabeth only the once in 2014, when I was still peripherally involved with the WAM program at IAS. When I was her age, I knew or knew quite a bit about all the women in mathematics, and I am heartened to say that there are enough that I do not know even a tenth! So I did not know Elizabeth well at all. I was asked to write a response to her comments on my receiving the Abel Prize in 2019.

My first response was "Go for it, gal!" No one does anything creative or important by following people like themselves. Her initial reaction, on being urged to find a department with role models, of wanting to do the mathematics first, was very healthy. Mathematics culture also has its positive aspects. Most mathematicians encourage good students, quickly become involved with students' mathematical interests, abilities, and individual talents, and are able to put aside issues of language, gender, race, culture, and social class.

This does not mean these differences are easily overcome, but I believe many mathematicians now believe that they can be and try to act on this belief. I am not sure this was true 60 years ago when I was a student. Instead of being told to find a role model, it was off and on explained to me that women could or should not do mathematics. I paid no more attention to this than Elizabeth did to the advice she got.

Role models are important. I read all the nonfiction that Virginia Woolf wrote, and it is extensive. I learned about the difficulties of being a woman and of being ill but also of the possibilities and pleasures of ambition. I admired the famous male mathematicians of the past and present. I particularly recall reading Andre Weil's autobiography *The Apprenticeship of a Mathematician*. He tells the tale of getting a lot of mathematics done while incarcerated as a conscientious objector. I never thought the ideal life was necessary or even conducive to doing good mathematics, but I did always envy these particular figures for the intellectual life they were exposed to as children.

I also had the privilege of taking one course by a woman professor in my eight years in college and graduate school. Cathleen Morawetz taught second semester complex variables during my first year in graduate school at NYU. With the arrogance of youth, I was critical of her hair, her clothes, her teaching, and her mathematics (too applied). Later on when life got difficult, she became a beacon of success despite imperfection! I remember thinking: "If Cathleen can do it, so can I." I have always hoped to be such a figure for younger mathematicians.

I was asked to add an example of difficulties I faced and how I overcame them. The truth is, the mathematics was the easy part. As a woman, I was often isolated and asked to do things professionally that I had not seen a woman (and sometimes even a man) do. In my mid-career, this was very difficult. I could treat students the way I had been taught as a student, but how to function as a professor in an elite mathematics department, or how to chair a governing board? As I matured, I simply learned to always insist on talking it through and sharing a job with other mathematicians, students, and staff. In particular, Dan Freed and I undertook many joint projects from writing a book through forming a research group to helping start the Park City Mathematics Institute. When Orit Davidovitch came to me as a graduate student wanting a program of invited women speakers, I assigned her the job, providing suggestions and support. The Distinguished Women Lecture Series at the University of Texas is now a model for other programs. Later I came to rely heavily on a group of women friends. I started out a loner and turned to collaboration as a solution to managing new challenges.

The Women and Mathematics program at the Institute for Advanced Study, where I met Elizabeth, was an earlier project. When I was offered the chance to start this, the offer of staff support was the real enticement. I also immediately asked my

collaborator Chuu-Lian Terng, who was at the time president of the Association for Women in Mathematics, to share the job. This program has been important to both of us, as it is for most of the participants. Research has shown that group behavior varies a lot when the participants are mostly male or mostly female. For those of us entranced by the beauty of mathematics, it is startling to experience this "difference based on gender of participants" in a mathematical setting. Meeting many women mathematicians, after decades of functioning in a primarily male environment, was, among other things, simply fun. In addition for me, the existence of younger women like Elizabeth, and the even larger number of women of the age to be her students, is a justification for my own less than straight path. And I am sorry to have missed the opportunity to know Elizabeth better.

Tribute from Rafe Mazzeo, Chair, Department of Mathematics, Stanford University

I knew Elizabeth during and after her time at Stanford, and though her subject is not close to mine, I attended a few research talks she gave. Given the difference in fields, I might not have learned much, but in fact I did learn quite a lot—she had a very insightful and deep understanding of her subject and a great ability to make it come alive for listeners, even for probabilistic amateurs such as myself. I am heartbroken for her husband Mark and her children, as well as her many close friends. It is extremely bitter that two great women mathematicians associated with Stanford, Elizabeth and Maryam Mirzakhani, both passed away so tragically and prematurely. Elizabeth and Maryam had so much more mathematics to give the world.

Concluding Thoughts: Value Added

In a 2018 interview with *The Daily* at Case Western Reserve University, Elizabeth acknowledged that "I think a lot about the fact that I'm a research mathematician—that's a really important part of my professional identity, but I'm also a professor and I teach students. I think a lot about what my value added is—what am I giving students that they couldn't get from just picking up a book?" [2]. Her value added came from living her life with "brilliance and generosity of heart." She advanced the discipline of mathematics *and* the people who pursued mathematics—students and colleagues.[2] Despite her initial reluctance about programs that focus on women in mathematics ("how dare you?"), Elizabeth came to recognize the positive impact of these experiences for women at all levels in the profession. Unfortunately, however, her life shows that even women who earn PhDs at Stanford and receive prestigious awards that allow them to pursue a research year at Oxford still feel the need to hold

their breath when they speak for fear someone will interrupt them. So there is room for improvement. The recent issues of the *Notices* celebrating Women's History Month in 2019, 2020, 2021, and now 2022, have taken steps in the right direction. These issues have all offered more than a little banner in the corner of the cover of the publication. They celebrate rich contributions of women in mathematics, including the sterling life of Elizabeth Meckes. She matters. They matter.

References

[1] Rick Durrett, *Obituary: Elizabeth Meckes 1980–2020*, Institute of Mathematical Sciences, February 23, 2021. https://imstat.org/2021/02/23/obituary-elizabeth-meckes-1980-2020/

[2] *5 questions with… research mathematician, associate professor Elizabeth Meckes,* The Daily, Case Western University, March 9, 2018.

[3] Elizabeth Meckes, Case Western Reserve University Website. https://case.edu/artsci/math/esmeckes/

[4] Elizabeth Meckes and Mark Meckes, *Linear Algebra*, Cambridge: Cambridge University Press, 2018.

[5] Elizabeth Meckes, *The Laws of Probability: What Makes a Coin Fair?*, Girls Angle Bulletin **9** (October/November 2015), no. 1, pp. 10–11. http://www.girlsangle.org/page/bulletin-archive/GABv09n01E.pdf

[6] Elizabeth Meckes, *The Laws of Probability: Zooming In*, Girls Angle Bulletin **9** (December/January 2016), no. 2, pp. 6–8. http://www.girlsangle.org/page/bulletin-archive/GABv09n02E.pdf

[7] Elizabeth Meckes, *Some personal thoughts I wrote down when Karen Uhlenbeck was awarded the Abel Prize.* https://case.edu/artsci/math/esmeckes/Uhlenbeck_Abel_prize

[8] Elizabeth Meckes, *The Random Matrix Theory of the Classical Compact Groups*, Cambridge: Cambridge University Press, 2019.

[9] Mark Meckes, *Eigenvalue is not a dirty word: My mathematical collaborations with Elizabeth Meckes,* Southeastern Probability Conference, May 2021. https://www4.math.duke.edu/media/watch_video.php?v=34UGRH3WDANH

[10] *Remembering Professor of Mathematics Elizabeth Meckes,* The Daily, Case Western University, December 20, 2020.

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Credits

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[2] *As her colleague at Case Western Reserve observed, the university "is a better place because of Elizabeth's service and commitment to raising up her colleagues" [10].*