An Interview with Jill C. Pipher

Evelyn Lamb

Every other year, when a new AMS president takes office, the *Notices* publishes interviews with the outgoing and incoming presidents. What follows is an edited version of an interview with Jill C. Pipher, whose two-year term as president began on February 1, 2019. Pipher is a professor of mathematics and vice president for research at Brown University, and was founding director of the Institute for Computational and Experimental Research in Mathematics (ICERM). The interview was conducted in fall 2018 by freelance writer Evelyn Lamb. An interview with Immediate Past President Kenneth A. Ribet appeared in the March 2019 issue of the *Notices*.

Notices: *How do you see the mathematics profession changing, and what kind of challenges do those changes pose?*

Pipher: Over time, mathematics has become more collaborative. There's an increase in social and team approaches. I think that, on the whole, this is very healthy for the profession. It should entail that mathematics as a profession will be able to attract people with different work styles and ways of contributing, resulting in more diversity. An increase in team approaches and collaboration results in a comparable increase in output and in publications per person. An individual researcher is able to be part of many more projects.

One of the more slightly worrisome aspects of this is the escalation of what a good graduate student resume looks like. Those graduate students who are lucky enough to have really collaborative advisors, or to be in environments where there are active research seminars and visitors flowing through, or who have the good fortune to participate in institute programs or opportunities like the AMS Math Research Communities are going to have resumes that look more like the resumes of postdocs a generation ago. The worrisome aspect is that it could create a starker division of "haves" and "have nots" when it comes to graduate student job opportunities.

Another thing I want to say about the profession is that I think that mathematics has been steadily broadening its scope over the last few decades with increased interaction with computer science, with the social sciences, with biology and other sciences. This is not brand new; it's been expanding in scope for a while now. I think this expansion has really blurred boundaries between applied and pure math, or at least inspired more connections between pure and applied math. That's also a healthy development for the field.

Notices: *And your work kind of spans applied and pure mathematics, correct?*

Pipher: Yes, most of my work is in analysis, and that aspect is pure math, proving theorems. But I also do research in cryptography, and that is not about proving theorems. It's really done with certain applications in mind.

Notices: *You mentioned that you see the diversity of the profession increasing.*

Pipher: Let me just say the profession *should* entail an increase in diversity as you're able to attract people with different work styles. But this whole subject of diversity in the profession is a larger one.

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Notices: *What do you see as the role of the AMS in promoting diversity? What tangible things do you think the AMS can do to help really increase diversity and inclusion in the profession?*

I'd like the AMS to foster a broader view of what it means to be a mathematician.

Pipher: I'd like to talk about that in the context of my priorities for AMS. Continuing to expand upon the work of past presidents in diversity and inclusion in the math community is really one of the four or five priorities that I have identified for my presidency.

First of all, I'd like to see a new committee—hopefully, ideally, from my point of view, a policy committee—devoted to diversity and inclusion. This is not to isolate the efforts, but to help to distribute them and to help the Society focus on this mission. I also want to see the AMS reach out to people in our community who are already working very hard on diversity and inclusion efforts in their institutions, in their particular communities, to bring their expertise and ideas to the AMS and to help us with our efforts. That's something I think that we can do a better job with. I'd like to examine the policies and the processes at AMS that encourage or discourage diversity in everything from our publications to our prizes.

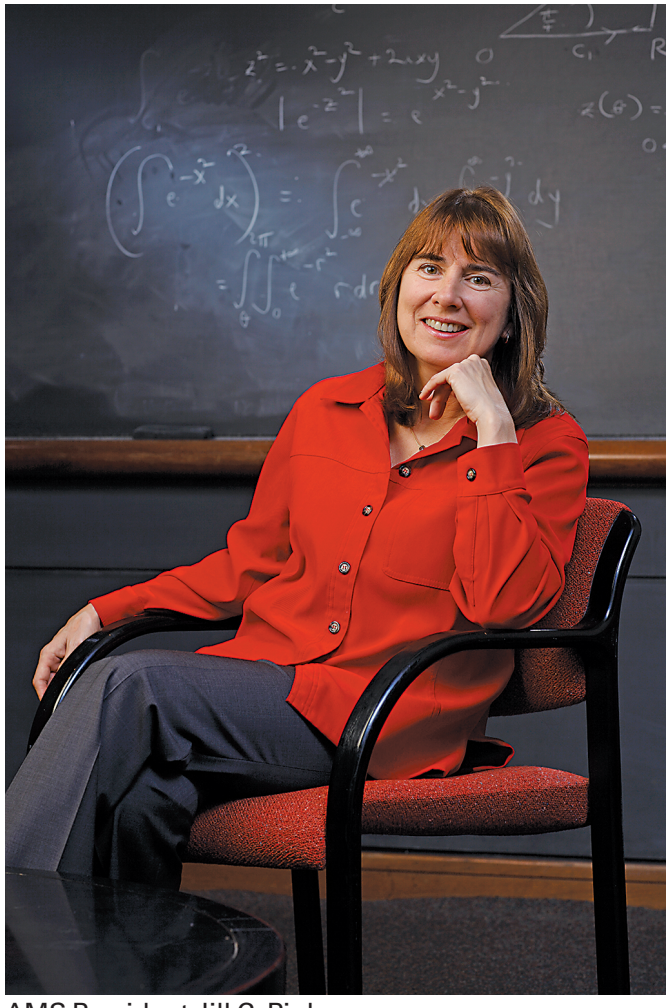
I think that transparency and communication are central to establishing that the AMS truly takes this issue seriously. And finally, I think that the AMS could take a leadership position in taking climate issues seriously. For example, the APS, the American Physical Society, has a program where it facilitates climate reviews of departments at the request of the chairs. I think it's a good model for us. It's something that's being discussed within AMS now.

The second priority I want to mention is advocacy. Advocacy for mathematics and communication about mathematics to a broad constituency is very important. Advocating for research with federal funding agencies, foundations and congressional offices is already part of my job as Vice President for Research at Brown. I've also for several years been a member of the SIAM [Society for Industrial and Applied Mathematics] Science Policy Committee, which is something I'd like to continue. It offers me a somewhat different perspective than I get from membership in the similar AMS committee.

As director of ICERM, I've had a lot of interaction with DMS [Department of Mathematical Science] and other NSF [National Science Foundation] directorates. And I look forward to more work in this capacity. I really intend to support the work of the Washington office of the AMS, and I look forward to working with Karen Saxe, who has been a great leader of that office.

Notices: *When you're talking about advocacy for mathematics, apart from research funding, what does that involve?*

Pipher: It involves communicating mathematics to a lay audience. What is a mathematician? What is mathematics? Why is it important? For example, the congressional hearings that AMS and MSRI [Mathematical Sciences Research Institute] collaborate on twice a year in Washington are great examples. Twice a year, a mathematician is invited to give a general-audience talk about mathematics to an audience which includes congressional staffers and members of Congress themselves. It's a great opportunity to show what the mathematical community is doing for the good of society. This is the kind of advocacy that is foundational to everything else, to getting people to understand why mathematics is so important and exciting.



AMS President Jill C. Pipher.

Notices: *Are there any other priorities you want to mention?*

Pipher: I'd like the AMS to work to foster a broader view of what it means to be a mathematician. Our profession is much bigger than academia. Clearly academic research mathematics is a central part of what the AMS should be supporting. But there are more careers and more opportunities in mathematics beyond academia. And if we start with this perspective, then the AMS might be able to take a leadership role in professional development opportunities for students—both undergraduates and graduates—who will, of necessity, be pursuing non-academic careers. These careers will be mathematically rewarding, but they won't be careers as faculty members or professors. I want the AMS to be their organization too.

I think that the partnerships that AMS has developed, like those with the NSF and with the Simons Foundation, are important. Two terrific programs have resulted: the Mathematics Research Communities [MRC] and the Travel Awards. I've served on the selection committee for the MRC and there are many more excellent proposals than can be funded for a program that is doing an outstanding job of getting graduate students involved in cutting edge research. I hope to help identify and develop more such partnerships.

And speaking of the MRC, I am thrilled with the increased focus of AMS on the "next generation" of mathematicians. I will pay close attention to the Society's role in providing opportunities for students and in helping recent graduates find rewarding careers in the mathematical sciences.

Notices: *You are I think somewhat unique in terms of other past presidents in having a background in industry. You co-founded a company, so you spent some time working outside of academia.*

Pipher: I have. I think that helps me appreciate the ways in which mathematicians can contribute to many different endeavors in the world and how interesting and valuable it is to have these experiences [outside of academia].

I would like to mention another priority, which may seem smaller by comparison with others, but there is a larger context for it. Within the AMS, I'd like to revisit the list of committees that we have and do some real consolidation. The larger context is this: I want service on an AMS committee to be truly impactful and rewarding, and result in outcomes that the very busy people we are asking to serve on these committees can point to with great satisfaction. I want to be sure that organizationally our committees are high-functioning, running well, and having an impact.

And then finally, I'm still learning a lot about the AMS; I'm listening to what's important to members of the AMS. I'm still forming priorities and developing ideas for what I'd like to do.

Notices: *Going back to your point about broadening the profession, it's something that outgoing president Ken Ribet also mentioned, when I talked with him, really acknowledging that a lot of people who get degrees in math won't be doing jobs within academia. Are there particular priorities or perspectives you feel like you've gotten from being outside of academia that might help academics in their work?*

Jill C. Pipher lecturing at Brown University.

Pipher: The thing about an academic research career is that in many ways, an individual researcher drives their own research agenda. And of course, one's career is more successful when aligned with general trends in the profession, where the funding is going, and so forth. So we can't say that as academics we're totally independent. The level of independence of an academic career is not there in an industry career. I talk to people who have worked as mathematicians in the NSA [National Security Agency]. And of course, they can't discuss the kinds of problems that they're working on. But I've heard many of

them say, "Well, I'm working on some really fascinating things, some great problems, and it's very challenging and rewarding. And then it's done at five o'clock, and I go home and do other things. I don't take my work home." Many industry jobs have a more defined and perhaps more balanced day than we have as academics. Many of the people I know working in academia are working all the time.

In industry, you probably have to like working with teams and working on group projects, which many more mathematicians seem to be gravitating towards in any case. It's a different kind of career, but it's also a mathematically rewarding one. When a graduate student graduates and goes into a career in industry or government or whatever, if it's not academic, I just don't want to hear somebody say, "Oh, they left math." Because they're not leaving math. They are going on to a non-academic mathematical career. It has to be part of our culture to appreciate and value multiple career paths.

I believe that valuing multiple career paths has to simply be part of the culture of our mathematical community. In fact, this attitude is a good example of what I mean by "inclusion" as I think about committees or initiatives focused on "diversity and inclusion". These two concepts—diversity and inclusion—are typically lumped together, but they are distinct notions, and equally important. By now, most people understand what diversity means. However, "inclusion" seems to be a little more elusive. I want to stress that inclusion is not an afterthought—it's about creating a welcoming environment, one where people are comfortable to be themselves.

Notices: *How have you been involved in the AMS in the past, and what led you to get involved in the first place?*

Pipher: I've been a member of AMS in order to support all the ways the Society advances the profession and individual careers—through its publications, conferences and meetings, advocacy, and special programs for students and researchers at all levels, like the Math Research Communities, the travel awards, and the fellowships. The benefits of membership in a professional society are twofold: what you get, and what you can give. At this moment in my career, membership in the AMS gives me the further opportunity to actively contribute to and help shape the priorities of the Society. These include supporting the next generation of mathematicians, advocating for the importance of mathematics in science and society, and recognizing and promoting mathematical research.

Notices: *Can you talk a little bit about what it was like to be the founding director of ICERM? It sounds very intimidating to found an entire new research center.*

Pipher: Sure! Got a couple hours? [laughter] Just kidding. But I could talk about that a lot.

First of all, the Institute was founded by a remarkable team of people in math and applied math, who all contributed huge amounts of time and ideas to the proposal and its implementation. It was an incredibly collaborative effort from our team, the Brown administration, and the departments. Really, the start of this whole process was very auspicious, and there was a lot of support at all levels of the university. I was very energized to do this job and to do it well.

It's a lot like a startup company that's gotten some venture capital. Suddenly you have some money, and you have to build something. The first year was hiring staff. The key staff positions—the assistant director, the IT director, and so on—were key to making everything else work. Then we worked weekly with the architects who were planning the renovation, and with the weekly construction management team meetings after that. That was the opportunity to tell the architects and the construction team what a math institute should look like, what did we really need. One of the things we needed was to be able to write everywhere, and that was realized at ICERM.

In our proposal, we had formed our science advisory board and our Board of Trustees, so those boards were in place, but we still had to jump in (with the help of those board members) and build two years of semester programs all at once, plus our summer undergraduate research programs and independent workshops. There were lots of days at the very beginning that I just felt like my head was spinning at the end of the day. I might even have gotten a little cranky here and there, but I did feel like I had a lot of help, and that was key. After the proposal was in, the co-PIs on the grant continued continued to work alongside me to support all the efforts of the Institute. That was Björn Sandstede, Jeff Hoffstein, Jeff Brock, and Jan Hesthaven. Without the help of our boards and their advice, it would not have gone as smoothly as it did.

Being the director was a very satisfying professional experience. I came to know and appreciate a lot of mathematics that was new for me. I met a lot of incredibly talented and dedicated people whose research I was thrilled to support.

I believe that our programs have been, and continue to be, tremendously beneficial to the grad students and postdocs that we encourage to participate and that the Institute supports. They come, and they spend the three months of the program enjoying not only the benefits of the scientific aspects of the Institute—the mathematical activities and events, the lectures and so forth—but we also provide a professional seminar series for them with information about the profession, about how to apply for jobs, about how to create resumes, about ethics training in research. I think that is very beneficial for young people, and that was something I was especially proud of. Finally,

the special events that ICERM hosted while I was director, like the AWM [Association for Women in Mathematics] 40th anniversary Research Symposium, which was one of the very first things we did in 2011, and the Blackwell–Tapia Prize conference, and CAARMS, the Conference for African American Researchers in the Mathematical Sciences, were all very meaningful events for me personally.

All in all, it was a tremendously exciting and deeply significant professional experience.

Notices: *I'd imagine getting to know researchers in a lot of really different fields of math has to be a benefit as you're moving into the presidency of the AMS.*

Pipher: It did certainly broaden my perspective in the field. I think having that background means there are certain things that I won't have to learn on the job that are relevant to my objectives in this position at AMS, and also to the expectations of the position. I'm excited to bring that experience to this job.

Notices: *You mentioned that you might be interested in expanding the number of prizes that the AMS offers, or prizes in mathematics in general. Can you talk a little bit more about that?*

Pipher: I can only speak to what I think is important, but of course, I can't plan to do something like this on my own. First, I'd like to get a sense of the interest of the community and the appropriate governance committees of the AMS in such an enterprise. When I compare mathematics to the other physical sciences, I think that mathematicians are under-recognized. There are just too few awards and prizes to adequately recognize all the great contributions to research and to the profession. At the Association for Women in Mathematics, we started these research prizes during my presidency. Right from the very start, the research prize nominations were incredibly competitive and anguishing—so many good people for each individual prize! It helped underscore for me the need for more recognition in our community. So I would like to start this conversation about prizes in the appropriate committees in the organization and see what other people think and if we can take some steps to improve the situation.

Notices: *We touched a little bit on public understanding of math and public communication of math. How do you feel that the public perception of math has changed in the past few years or decades?*

Pipher: I think it's slowly changing to reflect a greater appreciation of the ubiquity and power of mathematics. That's partly a function of the expansion of the scope of mathematics in fields like computer science, and biology, and neuroscience, and so forth. This is just anecdotal, but it used to be that every time I had a casual conversation with a stranger, like on a plane, and the word math was mentioned, I would hear, "Oh, it was my worst subject," and there would often be the word 'hate'. But I've noticed a shift. I'm discovering more people who are responding positively, who find or who found math interesting, and especially more parents who want to support their children's skills and interest in math.

I had a great experience connecting with parents who wanted to support their daughters' interest in math at an ICERM program called Girls Get Math; the program I founded about five years ago with the help of a private donation from the Phoebe Snow foundation. It's a one-week summer day camp for rising 10th and 11th grade girls who express an interest in math, not self-identified-definitely-going-to-be-math-majors necessarily, but who have expressed enough of an interest to get a letter of recommendation from their high school teacher. This program serves about twenty-five or thirty high school girls in our community. What we wanted to do was create a curriculum and a model that could go nationwide, so that anybody who wanted to run a Girls Get Math program in their community could do that with materials and computer labs that ICERM provided. At the end of the week, we have an awards ceremony. The parents are invited, sometimes their high school teachers come, and it's really meaningful to meet the parents of these girls, about half of whom are on full scholarships for this program, and see how much it means to them that their daughters are expressing an interest in math...how much they want to support that interest. Maybe I don't really have more than anecdotal impressions of a changing public perception, but I feel positive and optimistic.

Notices: *I believe you are only the third woman to be President of AMS, and I think also maybe only the third person who isn't a white man. I wonder, do you feel a lot of pressure from that? In general, in your career, you've probably often been one of the only women, or the highest-ranking woman, in various settings. How do you feel about that?*

Pipher: It's a complicated question. Yes, I'm very keenly aware that there have been only three women who have been President of the AMS in 130 years. That's a burden that minorities in any profession face, the burden of representing not just your own best efforts, but the best efforts of your entire gender or your entire ethnic group. I have to avoid thinking like that because it's distracting. I feel that I have a great opportunity to help an organization that really matters, that's important, that has a tremendous impact. And I view it as an opportunity to be of service, and so I'm trying not to think about myself personally in this role, but rather what I can do or what impact I can have on the Society itself.

Notices: I'd imagine, though, there might be the flip side where you do feel happy to be a role model for a large number of people, having a leadership roles like this.

Pipher: In the last decade or so, there has been a fair amount of research on the importance of role models. Some studies have concluded that implicit stereotypes can be reduced in the presence of positive role models, and others suggest that exposure to female role models in STEM can help close the gender gap. All of this reinforces my personal view of the tremendous importance of role models. I was a graduate student in the early '80s at UCLA, working in analysis, when S.-Y. Alice Chang arrived as a newly tenured professor. She was impressive and confident, and was also the first female professor in science that I ever talked to or got to know. Her mathematics and her career path has always been an inspiration to me.

I understand that my own career path may be inspiring to girls and early-career women in mathematics—a fact that is both gratifying and daunting. I am grateful to have opportunities to support and encourage the next generation of women mathematical scientists. At the same time, it is both challenging and disconcerting to feel that one "represents" an entire group while trying to pursue a research career in science. When I graduated in 1985, there were very few women in my field (besides Alice). At conferences, I would rarely see other women. Sometimes, I was the only female speaker. Today, young women studying science in college report that they carry the burden of feeling that their performances represent their gender, not just themselves. I understand and remember that feeling.

So, I would say that the issue of being a role model is mixed. It's both a privilege and a burden. From my present vantage point, I most keenly feel the privilege of this role. But I still remember the burdens from an earlier stage in my career.

Notices: When you're not working, what kind of things do you like to spend your time on?

Pipher: Thinking about math. [laughter] Which is not so much of a joke. Given my current job and how much administration I have to do, when I get a chance to go to a conference or block out days to work with a collaborator, I feel like I'm on math vacation But outside of math and work, I like spending time with with my family. I like playing the piano. And I enjoy traveling.

Notices: What are some of the math questions that you're currently thinking about when you get to go on math vacation?

Pipher: I'm continuing to work on solvability of boundary value problems for elliptic and parabolic equations with non-smooth coefficients. This research, at the interface of harmonic analysis and PDE, is part of a large program aimed at quantifying how the properties of coefficients of the equation, particularly smoothness, affect the behavior of the solutions. In addition, we want to have a sharp understanding of the interaction between the geometric properties of the boundary of the domain on which the solution is defined, and the regularity of solutions. For example, if a function is harmonic in the upper half-space or the ball, and it vanishes on a portion of the boundary, then near that piece of the boundary the solution decays like the distance to the boundary. But if the boundary has corners or Lipschitz singularities, then the rate of vanishing is merely a Hölder continuous function of the distance. More specifically, my research concerns questions of solvability of a range of boundary value problems—Dirichlet, Neumann, Regularity—for linear elliptic and parabolic divergence form equations with non-smooth coefficients in domains with singularities on the boundary. There is a large, active community of analysts working on these problems and I've benefited from some great collaborations over the years, and most recently with Martin Dindos, Steve Hofmann, Carlos Kenig, Linhan Li, and Svitlana Mayboroda.

I'm also continuing to think about some problems in post-quantum cryptography and homomorphic encryption, in collaboration with Jeff Hoffstein, Joe Silverman, William Whyte and Zhenfei Zhang.

Notices: Post-quantum cryptography definitely sounds very scary to me. I guess I have these sci-fi dystopia things in mind, computer pirate hackers.

Pipher: Public key cryptography is the tool that makes it possible to have secure on-line financial transactions, but the public-key cryptosystems that are currently in wide use would be broken by a quantum computer. This is thanks to quantum algorithms, such as Shor's algorithm, that would run in polynomial time on a quantum computer. When will we be able to overcome the serious obstacles in building a scalable quantum computer? That's a question I won't try to answer. Let me just say that there is great pressure from government agencies like NIST [National Institute of Standards and Technology], from government intelligence agencies [and offices] like NSA and GCHQ [Government Communications Headquarters], and from other bodies such as the National Academy of Sciences, to identify algorithms for public key cryptography and secure key exchange that are resistant to quantum speedups.

The NTRU public key encryption system, that I am a co-inventor of, uses an algorithm that remains resistant to the speed-ups afforded by quantum computing. That is, no one has yet found a quantum algorithm that can find the shortest vector in an integer lattice faster than a classical computer. So I have a vested interest in the creation of a quantum computer—I'm all for that. [laughter]

Beyond cryptography, people are working hard to understand what a quantum computer can do more efficiently than a classical computer. The big question is: When can we find quantum algorithms that realize exponential speedups over their classical counterparts?

Notices: [The creation of a quantum computer] would make your work more valuable.

Pipher: Absolutely. That's my conflict of interest disclosure for the article. [laughter]

Notices: Thanks for taking the time to talk with me, Jill.

Pipher: Thank you.

Evelyn Lamb

Credits

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