AT: Welcome to the Infinite Women podcast. I'm your host, Allison Tyra, and today I'm joined by Matt Kaplan, author of the new book, *I Told You So: Scientists Who Were Ridiculed, Exiled, and Imprisoned for Being Right*. So I think that title is pretty self-explanatory. And to be honest, my main takeaway was that science is broken because humans largely suck.

MK: I would largely agree with that statement. Science, while it holds itself to be a separate activity, it is ultimately a human endeavor. And people are very flawed. People get jealous, people get desperate, people get mean. And unfortunately, that leads to a lot of bad behavior. But if we're going to complain about science – and boy, can I – I think it's really important to remember, science has done an awful lot. We are so far ahead on so many diseases and cracked so many problems. So science has accomplished a lot. But the engine of science is clunky. It is prone to break down. And it could be so much better. And talking about it is the first step in getting us there.

AT: Well, it seems like fundamentally, the issue is that, like a lot of things like capitalism, for example, the structures that we have built, I would say largely because of capitalism, honestly, reward bad behavior. So for example, you talk about Louis Pasteur lying, plagiarizing, destroying other people's careers, and succeeding because of that. And then one of the things that really made me want to punch someone when reading this book was you talk about describing these actions to contemporary scientists, and them lauding him for this behavior and saying, “oh, he knows how to play the game.” And at one point, you say to another scientist, “have you ever considered the game might be broken?”

MK: Yeah, we're actually talking about two different things here. One, I was talking to a radiologist in California who said, “yeah, boy, Pasteur, he knew how to play the game.” And I just thought, “are you kidding me? Are you kidding me? This man ruined lives and totally skewed science in France. He’s celebrated a national hero while driving several people to their graves as paupers who did significant work and were forgotten. And you're saying he knew how to play the game?” And separate from that, I was at a school fair here in the UK. And I was talking to someone who revealed to me that they were an immunologist at a major institute here. And they said they knew Kati Karikó, who had helped develop the mRNA mechanism that was used in the COVID vaccine and won the Nobel Prize for it. But only after being demoted, threatened by the Department of State in the US with deportation and being fired. And Kati was a genius. And this guy said to me, and I can't say his name, because I totally ambushed him at a school fair. He did not know who I was. And so he's now in my book and doesn't realize who he was talking to. But he said, “yeah, they were right to fire her. She wasn't publishing anything.” And I said, “are you serious?” He said, yeah, “if you want to climb in science, you have to play the game.” The exact words that I talked about with this radiologist like eight months earlier. And thinking about how much Kati had suffered for all kinds of stupid reasons, I blurted out, “have you ever considered that the game is broken?” And he stuttered and stammered and then went to go and get some punch. And I felt bad because there was no way for this guy to know that here I am sitting in this little hamlet in Britain, writing a book about scientific dysfunction. This poor immunologist landed with me randomly talking to me about our kids. And I ambush him with this issue of scientific dysfunction. And he really hadn't considered the possibility that science was broken and that we really needed to change the way we operate.

AT: So a while ago, I was on a podcast about heresy. And I was basically saying that any belief system is fundamentally the same, whether that's religion, whether that's our entrenched biases. And in this case, I would argue that one of the reasons that people react badly when you challenge the status quo, when you challenge the set beliefs of whatever scientific field it is, which we'll get into examples of that, because you have some really fascinating women in this book. But fundamentally, I would argue that one of the reasons, apart from, greed, guilt, not wanting to be wrong, jealousy, ego, you touch on a lot of different things in the book. I would argue that people who are entrenched in the system have to believe that the system works. And

so if you challenge that, it breaks their brain.

MK: People who are in the system, who are thriving, benefit from believing that the system works. Because they've got where they've got. And they like to believe that the system, because of their hard work and their genius has elevated them to the top. So there is a real power in believing that the system is great. But this comes with a giant caveat. There are a lot of people at the top of their game who are top-tier scientists, who will absolutely tell you, “oh God, no, this is not working well.” Let's start with Kati Karikó. Kati Karikó has won the Nobel Prize. You can't expect more in a scientific career than earning the Nobel Prize in medicine. So there is that. But you can go way further. I was just sitting with Dan Lieberman at Harvard University. He's really focused on evolutionary medicine. He is a top-tier Harvard professor who is a world expert on how you prevent people from getting really awful diseases. He focuses on diseases of disevolution because he's an evolutionary biologist by training. This is a weird area to go into. Why? Because Harvard is based in the United States of America. America, last time I checked, is capitalist. If you are trying to prevent disease, you are not feeding the system. Because America depends upon “you get ill, you will pay me your doctor to make you better. And by extension, you will pay us, the pharmaceutical company, to give you a drug that will make you better. You are ill. You are feeling terrible. You are desperate. You will pay whatever it takes to not die.”
So there is a powerful incentive to drive that system. Dan breaks the system. He says, “I look at the way people behave, like me sitting here at my desk, rather than standing or running after zebra on the plains of Africa with a spear to go and get my breakfast, which is what my body evolved to do. Instead, I'm sitting here with my cup of coffee that was harvested by someone else. I didn't pick these coffee beans. I didn't milk the cow that put the milk into this coffee. I didn't do all the physical activity that's necessary for me to be sitting here. I'm just sitting here talking to you. And Dan points out that actually that lifestyle will leave me with lower back pain, diabetes, and all kinds of other serious disorders. But no one wants to fund it. Why? Because the system is set to support “you get ill, you pay to get medicine,” not you pay to prevent being ill. It has to be really, really bad for you to pay to prevent. So like you would pay for a flu vaccination so that you don't get the flu because the flu was awful. You really don't want it. But by and large, most people don't pay to prevent disease. And it's really hard for him to get funding in his lab as a result, because it doesn't fit with the model of the system. He's thinking outside the box. And that creates a problem.

AT: And that's a big recurring theme is that people who are outside the system or perhaps on the fringes, so that could be early career students or researchers. It could be people who, like in this case, are in a niche area.

MK: Outside the box can be an idea that is outside the norm, challenging a paradigm that already exists. So I talk a lot about Mary Schweitzer in the book, a female paleontologist who has said, “I think stuff can preserve in the fossil record that all the textbooks say can't exist.” But it's also, is this person different? Mary, back in the late 1990s, was and still is female. I write it in my book. In the 1990s, as a student at Berkeley, I really struggled to understand that there were female paleontologists because I had no professors who were. I had read no books by female paleontologists. All the paleontologists who had been celebrated to me were male. And I was ashamed when I ran into Betsy Nichols and she'd done all this work on marine reptiles. And I thought, “ooh, it's a female paleontologist.” I simultaneously thought, “well, of course there should be a female paleontologist.” And simultaneously thought, “but I understand why I didn't think there would be.” So it's about thinking different. It's also about being different. I talk a lot about Ignaz Semmelweis in the book, who is Hungarian, but he in the Victorian period is living in Vienna. And as a Hungarian, Hungary was a vassal state of Austria, of the Habsburg, under the Habsburgs at the time, because he was a second-class citizen. He got treated badly. His ideas were not taken as seriously. And I think that's part of what Kati Karikó faced, not just female, but an outsider from the United States. She was Hungarian. She had an accent. She had ideas that were outside the norm. All of this stuff that puts you outside the mainstream, including being female, puts you in a challenging position. Different is not just ideas. Different is also ethnicity. It's culture. It is sex and gender.

AT: Speaking of Kati Karikó specifically, one of the things that you talk about in the book over and over again in different ways is the importance of being a science communicator, which makes sense because that is very much your job. But it is also a skill that so many scientists are not actually taught, whether that's how to communicate to other scientists effectively, how to communicate to the public effectively. So for example, there's a story about this guy published his findings, but he also published the names of all of these doctors and midwives whose actions were essentially killing women, and that's not diplomatic. And so to tie that to Kati Karikó, you talk about how the fact that English is not her first language is one of those barriers that she's facing. So it's not just you need to understand the science, you need to have good ideas. You also need to be able to effectively communicate those ideas and not call out every single one of your peers in a public paper because then you get run out of town.

MK: Yeah. So there are a lot of things to pick up on there. First of all, on top of being Hungarian and female and working on messenger RNA, which was deemed a dead end in the late ‘90s and not useful in any significant way. So you're working on something that's paradigmatically not considered acceptable and not worth funding. So she had all of that working against her. On top of all of that, Kati is a living whirlwind. Interviewing her was, of course, a privilege. She's a Nobel laureate. It's wonderful chatting with her. Keeping up with Kati was an incredible challenge. And therein lies the rub because scientists have long believed that their job is to do the research and their work will disseminate and the public will understand why they're being funded. Let's face it, a lot of science is funded by the government. And that's really a giant mistake. We need to appreciate that science does not exist in a vacuum. Science needs the public on side and we need to be explaining it to the public. Now, you're going to have some scientists like Sheldon Cooper in *The Big Bang Theory* who absolutely cannot communicate the purpose of their work without being derisive and downright insulting. And for those scientists, I say, well, let them do their science. But everybody else, and there are a lot of them who can talk about what they're doing and why it matters, because that's not a big ask, needs to perfect that. That's really, really important. (AT: If you don't want to get run out of town by midwives.)
So child bed fever or puerperal fever was a disease that women would get shortly after childbirth. And if they got it, they died. There was no cure. It was beyond horrific. Shortly after childbirth, they would develop a fever. They would have black and blue splotches around their thighs and lower abdomen. They'd become swollen, eventually delirious. And the pain on their abdomen was so severe that they could not tolerate the pressure of sheets laying across them in the hospital beds. They would die in frozen screams of agony five days later. It's astonishing to me because there are relatively few people who seem to care. There was a lot of interest in smallpox and tuberculosis and dysentery and rabies. All those diseases were getting a lot of attention. Child bed fever got very little attention. Why? Well, there's no real documentation as to why, but I can argue pretty clearly that men don't get child bed fever. And all of the doctors at the time were male. And so there wasn't a real incentive because, “well, I'm not going to die from it. So why should I bother studying to defeat it?” Alexander Gordon was different.
So we're talking late 1780s here. Alexander Gordon felt sympathy for all of the women in Scotland who he treated who had puerperal fever. And there were two major epidemics of the disease. And while he believed in the old ways of thinking, so he was still very much a humors doctor. And humors were this concept that came from ancient Greece that you had white bile, black bile, phlegm, and blood. And these four things make up the constitution of your body. And that when they're out of whack, you fall ill. And if you've got too much phlegm, the patient needs to be drained of their phlegm. And you do that with hot pools and steam. And you know what? That's not a bad idea. If someone's got a whole bunch of junk clogging up their airways, putting them in a hot, steamy room when you have no antibiotics at your disposal is a perfectly reasonable mechanism for treating the symptoms of an upper respiratory infection. Patient has a fever. Well, they clearly have bad blood. So the bad blood needs to be drained. And so that was done for years. And in the defense of the lunatics who called themselves doctors who did this, it did lower the fever. If someone had a fever and you drained them of a couple pints of blood, their fever would go down for all the wrong reasons. But you would basically corpsify

them. You definitely are forcing the body to produce new blood cells. You're making the body work hard and raise temperature as the way the body fights disease goes away while it has to work hard to produce new blood cells. So you are forcing the body to lower its temperature for all the wrong reasons.
Alexander Gordon was well-schooled in all of this stuff. But alongside all of that, he did something extraordinary when faced with all of these women in Scotland. The first epidemic was 1789. And the second, I think, was 1792. Those two epidemics, thousands of women caught puerperal fever. And as one of the few obstetricians in Scotland, he dealt with it. He kept notes. He kept notes on who caught the disease, who didn't, and which doctors and which nurses and which midwives treated the mothers. And as he did that, he noticed a pattern. So he would have patient A, B, C, D, E, F, G. And he would have doctors 1, 2, 3, 4, 5, midwife 1, 2, 3, 4, 5. And he just kept track of who went where, who got the disease, who didn't. And he noticed if patients A, C, and F caught puerperal fever, doctor 3 often went from A, C, and F all within an hour. Or midwife 7 went from A, C, and F within one morning. So he noticed these trajectories of people catching disease. And then he even noticed if midwife 3 went to A, C, and F on one day and patient G caught puerperal fever like three days later, he would notice that midwife 3 was usually involved. So he started picking up these patterns and working out that certain people were responsible. And this was huge. He was working out how the bacterium that causes the disease, which we know is a staph bacteria now, we know how it was spreading because people were handling the patient, touching the birth canal, which is a very easy way for bacteria to get into the body, and spreading disease. And yeah, they were washing their hands. Yes, they used soap, but it didn't matter because soap and water don't kill a lot of the bacteria that cause these diseases. And he had no understanding of that. But he did publish all of the results. And he named everybody, including himself, who had been responsible for the spread of the disease. And a very large group of women, most of them nurses and midwives, formed an angry mob and chased him out of Aberdeen. He went back to the Navy and died there of tuberculosis a year later.
I think the women had a good reason to form an angry mob because while listing all of these names, he also doubled down on the use of bloodletting, which while bloodletting was used extensively in the 1700s and 1800s, all around Europe, bloodletting during childbirth or after childbirth was considered sacrilege. You really weren't supposed to do that. But these women were suffering from fevers after birth. So it seemed like taking blood from them was a good idea. And he really, really increased the blood draw and took a lot of blood from these women. They were going to die anyway, because there was no cure for puerperal fever. But the nurses and midwives really didn't like it. And they really didn't like their names being listed as being responsible for the deaths of all of these women who had died. So that's why they formed an angry mob. They had every reason to be angry. I don't think there was anything they could do to bring about a better outcome under the circumstances. That's not the case for later detectives who dealt with puerperal fever. During the 1800s, both Ignaz Semmelweis and Oliver Wendell Holmes went on to discover a lot of the stuff that Alexander Gordon did. They both really could have succeeded in massive ways. And again, the system worked against them. And it's really sad because all along, millions and millions of women around the world were dying every year from puerperal fever.

AT: Now, bringing this back to more contemporary examples, because there aren't really any women scientists in the historical side of the book, which I do want to get back to later. But to touch on the women that you talk about in a contemporary setting, you mentioned Mary Schweitzer, a female paleontologist. But there was also a student that you open the book talking about being at a conference where people were very upset at this young woman.

MK: You're talking about Alison Moyer. Let's go back in time here. It's 2012. I was at a conference as a paleontologist by training and write a lot about evolutionary biology in *The Economist*. I had been sent out to this conference to pull together two, three stories covering the latest in paleontology and why people should care. Because paleontology actually and evolution plays a lot of a role in modern medicine and is very

interesting. I had been covering the conference all day and I was tired, very jet lagged. But I've made it a habit throughout my career to attend poster sessions. You have PhD students. “Look, look, I have a plesiosaur that was bitten by sharks. That tells us that it was a feeding frenzy because I've got seven different shark teeth embedded in this plesiosaur bone.” So I love going on to the poster room floor. It's in the evening always, which kind of sucks when you're coming from Britain because you're tired. Five hours ahead, trying to walk around a conference room floor at 8 p.m. is hard. But I love, I love looking at what PhD students come up with. My editor of 17 years, Jeff Carr, was so supportive of this. He and I really worked hand in glove to cover a lot of PhD and undergraduate student research, which was so often presented at these things. And so I was looking at some posters, chatting with some PhD and undergraduate students, which is such fun.

And suddenly I heard the C word shouted from the other side of the conference room hall, then screaming and shouting and the F word. I just thought, “what?” I went running to the other side of the conference hall and I turned a corner and there is a blonde young woman, maybe 20, 22, surrounded by eight or nine angry old white men. And I'll never forget, one of them was balding on top and his head had gone incandescent red. We don't think that humans engage in the kind of mammalian color signaling threat displays, but actually balding old white man with bright red forehead, that's like a baboon flooding its ass cheeks with hormones to change its color to show you that it's tough. I looked at this and thought, what the hell? I kind of snuck around the side to see what is this poster? ‘Cause it's a poster. It's not even a presentation. It's just a poster on a wall with either an undergraduate or a PhD standing there to talk about it. And like all these people are swearing at this young woman. And I thought, what?

So I wandered over to have a look. And of course, this was another piece about color in dinosaurs. During late 2000s, early 2010s, dinosaur feathers were everywhere. We had worked out that you could find impressions of dead dinosaurs in the mud. And it revealed that, oh wow, this dinosaur species, let's say Velociraptor was covered in feathers or, oh, look, T-Rex had feathers or, oh, look, this dinosaur had feathers. Everything suddenly had feathers and a bunch of labs were making the argument, “whoa, we can look at the feather impressions under a microscope and see melanosomes.” Melanosomes are these little pigment molecules that are found in modern-day bird feathers that tell us what color the feather was. And so these labs were getting a ton of academic attention by publishing articles with T-Rex with little purple feathers on its stumpy little arms or Velociraptor looking like a parrot because they said, “we can see what color this dinosaur was.” That's fine. Interesting idea. That's cool. I had my misgivings about that as a paleontologist myself, but as a journalist, I listened, I read the papers, I thought about it.

This PhD student, Alison Moyer, gave this a lot of attention to, and she did exactly what a PhD student should do. She said, “I wonder if this is right. I wonder if we really can see melanosomes after a feather decomposes and becomes a fossil.” So she did what she was supposed to do. She collected a bunch of colorful feathers and she buried them in different sediments in the garden. She left them there for a year. She dug them up, put them under the microscope and said, “I can't see any melanosomes.” More specifically, she said, ”I see a lot of bacteria. The bacteria look a lot like melanosomes. I think what we're seeing in the fossil record may very well be fossilized bacteria rather than melanosomes. We should not be making the arguments that we are making because we might be wrong here.” That's the scientific process. That's what we're supposed to do. But rather than walk up to her and say, “gosh, that's really interesting. Can you talk me through exactly what you did?” Or “I'd like to try to replicate what you did in my lab because I doubt that you're accurate. I think there might be flaws here.” Rather than have a civil and engaged conversation, the senior scientists at the labs that were responsible for this work lost their heads and their solution was to go on the attack.

And talking about an outsider here, right? We're talking about a PhD student, female in a field that was still very much male-dominated and challenging an idea that was rapidly becoming mainstream in the field. All of these things made Alison an outsider. These folks annihilated her. I went with her and her PhD supervisor, Mary Schweitzer to dinner. Now, Mary, also a maverick in the field. She was the one who said, “I think soft tissues can preserve in the fossil record. Things like cartilage and blood cells, feathers, some of this stuff could be preserved under the right conditions.” So she also had faced withering criticism. She had endured, not

because she had a powerful personality. Mary is pathologically shy, but because she had Jack Horner, who is a very, very powerful, was a powerful paleontologist for years. He got snagged up in the Epstein scandal and has since really fallen into disgrace. But Jack is very protective of his academic offspring. And no one was going to mess with Mary Schweitzer while Jack was around back in those days because he would beat the ever-loving crap out of them. There was just no way you would get away with any kind of attack on Mary. And he co-authored tons of stuff with her and really was there to protect her from everyone who said, “you can't have blood vessels preserving in the fossil record. That's crazy.” Mary really led the charge on that.
But I went for dinner with Mary and Alison afterwards and was really struck by how much the gloves had come off and dispirited by how deaf the rest of the paleontological community was to what Alison was discovering. She went to another conference a year later where the attacks continued. And at that point, she said, “you know what? Enough is enough. I don't want to do this anymore. I'm done.” And she quit science permanently. And there's a bright young thing who we lost because scientists just were misbehaving. And it's sad and we can definitely do better.

AT: Well, speaking of Mary's story in particular, if I recall correctly, coming back to that question of an outsider, the idea that, “oh, those actually could be soft tissue cells,” I believe came from, she had gone to a veterinarian to check something. And then the veterinarian took an image to a conference. And then a second veterinarian said to that first veterinarian, “hey, this looks like…,” and then that was actually the origin. So when we're talking about outsiders, this idea that having an outside perspective can be incredibly valuable and help your work. And yet we don't value those outside perspectives is deeply frustrating.

MK: So Mary was looking at fossils under the microscope and she saw what looked like blood cells. We're talking about late ‘90s here. And as a PhD student herself, she said, “there's no way it could be blood cells.” But all these outsiders were looking at and saying, “yeah, those are blood cells.” But she was so scared to tell anybody what she had found because it was effectively heresy in the paleontology community to say the soft tissues could preserve. She took her findings, she put them in a desk drawer and she locked it. Eventually the rumor mill got running and word came back to her PhD supervisor, Jack Horner, and he showed up in her office and said, “I hear you've got something for me to see in your desk.” And she said, “it's not what you think.” And he said, “prove to me it's not.” So that's a big deal. But Mary faced all of these headwinds because female, another giant reason she was now outside, or aside from the fact that she was saying that soft tissue could preserve in the fossil record, which was also heresy. Mary is a devout Christian and to a field dominated by evolutionary biologists, that is such an outsider position to take. In fact, when she first showed up in Jack Horner's lecture theater, she walked up to him and said, “hi Jack, my name's Mary. I'm a new earth creationist.” And he said, “I'm Jack Horner. I'm an atheist. Have a seat.” It was a confrontational position that she took from the beginning. And it really shook the foundations of her life when she got into paleontology because people viewed her with such derision because she was a believer. Your position on God shouldn't have any place in how you're viewed by the academic community. But it does.
And the fact that you're female shouldn't have anything to do with whether or not you get ahead in paleontology, but it did. I think it still does. There's still residual sexism in paleontology and a lot of fields. So these are really serious problems. So breaking news, a 290 million-year-old carnage sternum has been uncovered in a fossil drenched in petroleum. Bacteria do not like petroleum. They will not eat stuff smothered in petroleum. This little ancient proto-lizard that's just gone from being an amphibian to a lizard, just starting to crawl around on land. Because it's encased in petroleum, its soft tissues, Mary Schweitzer's finding, were preserved. And the fact that cartilage, which normally gets eaten up by bugs, is there is a huge deal because it shows that early on, this little lizard had its ribs articulated and connected to its shoulder, which shows that as it was learning to walk, it was learning to breathe all at the same time. Because your sternum connects your movements to your lungs when you're a tetrapod. I was so struck by it because this is Mary's legacy. And now it's just being accepted. “Well, of course, under certain circumstances, you can find blood cells and cartilage in

the fossil record.” It's rare, but now it's accepted as doctrine. Now it's part of the conversation. She had to fight for 28 years, a horrible bloody battle to be taken seriously. And now, mostly because Jack protected her, but also her ideas were right, which has a huge impact. It is now widely accepted. And it just filled me with glee writing this.

AT: So to bring it back to maternal and infant health, there's another story of a contemporary woman in your book, María Gloria Domínguez-Bello, who's another outsider.

MK: So you talk about childbirth and puerperal fever, and we still have so many unknowns about what goes on during childbirth. And one of the big questions that's being asked today is, does having a cesarean section, a C-section, have a health impact on your child? Domínguez-Bello has said, when you're born through the birth canal, you have this moment where your nose, ears, and mouth are exposed to all of the bacteria found in your mother's birth canal. There's a lot of bacteria there. And it's like slapping the immune system. You get your mother's feces and bacteria all around your nose and mouth. Of course, that gets cleaned off when the child is born, but some of it gets into the body. And that is a seeding process whereby some important bacteria from the gastrointestinal tract end up in the baby. If you're born from a cesarean section, which of course could never have occurred a million years ago with our ancestors, you need modern surgery to be able to do it and not have the person die. You don't get any of those bacteria. So Domínguez-Bello asked the question, is it possible that the cesarean section leaves your immune system changed and vulnerable? So she ran these experiments with babies whereby some babies born via C-section were swabbed with vaginal secretions from the mother right when they were born. And some babies were swabbed with distilled water right when they were born. And she said, “after just a couple of years, I can see that the microbial populations on the skin and in the body are different in the babies who are swabbed with the microbes compared to the babies who are swabbed with fresh water,” suggesting that there is a big difference.
But again, this is outside the norm. Why? Because to do her work, Dominguez Bello needs long-term funding. And that's crazy talk. In the modern scientific environment, getting funding to track babies from birth to 10 years of age when they might develop allergies, asthma, and eczema is almost impossible. You can't get funding for 10 years. That's crazy talk. And so she has to effectively engage in tremendous manipulation of funding and research grant application to get the resources that are necessary to do her work and to monitor kids over a long period of time. Because this isn't something where you swab the babies and immediately say, “oh, these babies developed allergies and immune problems and these babies didn't.” You need to monitor them for years to see if there's immune dysfunction. And she just can't get the funding. It's a nightmare. And that's another outsider, a person who wants, God forbid, to run research for, oh goodness, 7 to 10 years. The best you're going to get out of the National Science Foundation are 2 or 3 years. Maybe 4 at a push. And NIH is the same. You're not going to get funding long-term. And this is just so short-sighted. It's so stupid. They want to see fast results. But in order to do really important work, sometimes you need time. And the funding environment is just not geared towards that.

AT: Well, apart from the long-term aspect, there's also the outsider issue of, she is an ecologist. She's not an OB. She's not a medical doctor. She's coming at this from an ecosystem standpoint. And I'm curious if the long-term funding is part of that issue that you were talking about earlier of that focus on treatment over prevention. Because apart from the fact that there is more money in treatment than there is in prevention, let's be honest about that. The simple fact is, if you are trying to prevent something, I assume that typically is going to take a lot longer to prove whether or not there is a correlation there, as opposed to, “okay, we tried to treat something, they didn't get better, so it didn't work.” So I would assume that the timeframes are typically shorter on treatment than they would be on prevention, which is what María is working on.

MK: In humans, yes. So if you create, for example, a vaccine and you vaccinate 100 people and you want to

demonstrate that those people are now immune to a certain disease, it's unethical to inject those people with the disease. You can't do that, unless you're Louis Pasteur, in which case you can. (AT: He is not a model of ethics!) He did this stuff in sheep with anthrax, where 50 sheep were vaccinated with a proto-vaccine that he lied about, incidentally. He had stolen the vaccine from someone else, but he said he had created it. Lovely individual. And then injected those sheep with anthrax, and he had 50 sheep that were injected with saline solution, and he infected all of them with anthrax. And of course, the 50 that had been injected with saline solution died of anthrax. And the 50 that had been vaccinated with his proto-vaccine, and when I say his proto-vaccine, I mean the proto-vaccine that he had stolen from another veterinarian who he discredited and destroyed. Again, lovely individual. Those sheep survived.

So prevention is possible to be tested rapidly when you're not dealing with people. To demonstrate that prevention works in people is much harder because you have to study them over long-term, and you need long-term funding to do that. And long-term funding was hard to get before science had been battered by funding cuts. Now, with funding cuts being quite devastating, it's really, really hard for any long-term medical studies to be conducted. And this is just crazy because the funding cuts are largely driven by, in the United States, a Republican perspective that science isn't efficient and the funding could be better used somewhere else. Pathogens do not care which political party you belong to. So it is in absolutely everyone's best interest to defeat the diseases because the diseases do not have a political agenda. And yet, we consistently politicize treatment and research against horrible, horrible diseases and say, “let's not fund that because that's a lefty issue.” It's a human issue. And incidentally, there are a lot of really, really big research centers and universities and labs in deep ruby red states where staff and institutes are going to lose funding with funding cuts. And it's going to hit Republican budgets pretty badly, just as much as it will hit Democrat ones. It's just colossal damage across the board. And it makes no sense for humanity. We should all be against disease anyway.

AT: So this might just be because I focus on gendered history. But when I was working on my book *Uncredited*, about the whys and hows of women not being credited for their work, I noticed a lot of more powerful men silencing younger, less powerful, whatever that may be, women in order to steal their work. So they're being attacked for being right, with the reason that this more powerful man wants to steal their work. And with the exception of Louis Pasteur doing this to at least two veterinarians, I believe you mention in the book, I don't recall that being a major theme of people stealing work and that's the reason that they're attacking others.

MK: So you see in science a lot, territorial battles where each researcher is trying to be first to discover something. And I discuss this a lot with Joseph Lister, who worked out that you needed to clean medical instruments with antiseptic to stop surgical patients from getting postoperative infection. He was discredited and vigorously attacked by James Simpson, who was a contemporary in Victorian Britain, and who also very badly wanted to be first to defeat postoperative infection. James Simpson did not criticize and attack Joseph Lister because he actually disagreed with what Lister was doing, or felt that there was anything really wrong with what Lister was doing. James Simpson went on the attack because he wanted to be first. And we see exactly the behavior playing out today. I'm a science journalist. There are plenty of correspondents out there who talk to crying people all the time. If my job was reporting from disaster scenes or as a war correspondent or something, I would have interviewed a lot of crying people in my time. But I'm a science correspondent. Alison Moyer cried at the dinner table after having the ever-loving shit beaten out of her by these old white men. It was horrible to watch and made me so angry. It was a major impetus to write this book. In some ways, this book is kind of a, “you people are so wretched and deserve to be ashamed of yourselves” book, because it spurred me to go and write this.

And in fact, actually, the key moment was during the pandemic when I was speaking to a female immunologist about the way in which the COVID virus was interacting with the human immune system and was talking to me about the cytokine storm that ultimately we worked out was actually killing people. It was an immune overreaction. And I said, “that's really cool. I want to write about that tomorrow.” And she said, “oh, you can't.”

And I said, “why not?” And she said, “because Matt, this is immunology and I'm a woman.” And I thought, “are you kidding me?” And that combined with my memories of Alison and seeing this stuff over and over again was a major force to lead me to ultimately say, “I want to write a book about this.” You have a lot of people who go on the attack, not because they think you're wrong, but because they want to be first.
And going back to the Zoological Research Center, I was sitting with a researcher, female, who was doing a ton of work with rhino embryos and creating the embryos of critically endangered, nearly extinct rhino in the lab and trying to work out whether or not the embryo was an actual embryo or a parthenote. A parthenote is where a female egg begins replicating without the introduction of male sperm. And it happens more often than you would think, literally a virgin birth, except that in rhinos and in humans, a parthenote will almost never come to term. The animal will die. And if it was born, it would not survive long. They do very poorly. She was trying to work out, is this a parthenote? Is it not? And she started crying to me in the lab about how this other research group had come to talk with her. They'd been disparaging of her work and weren't sharing information. In fact, they were hoarding vital information because they didn't want her to succeed because it would be terrible if her lab got the rhino first. They wanted to be the first to resurrect this rhino from near-extinction. And there was this PR person in the room babysitting me for the day. And clearly the fact that the researcher who I'm talking to was now crying and saying there is dysfunction in the scientific community between our lab and this other rhino lab who are hoarding information to try to be first to save the rhino, just like James Simpson was trying to be first to defeat post-operative infection and destroying Joseph Lister just because he didn't want him to beat him to the punch. This press person interrupted the conversation and said, “it's not because they were trying to hoard information. It's… because they're all men.” I have it in my notes. “Press officer confirms the other lab is hoarding information. Chauvinism?” Because that's so much better. They're not sharing information, not because they want to hoard information. No, no, it's not because they want to be first. It's because they're a bunch of chauvinistic pigs. That's why this kind of stuff is still alive and well, and it needs to stop. Forget the fact that it doesn't help the rhino one wink. We should all be working together to solve the problem as opposed to trying to be first. But whether it's information hoarding or chauvinism or what have you, it's just bad behavior. We shouldn't be doing it.

AT: Apart from the fact that also, if you guys work together, your chances of success increase and sharing that success is better than both of you failing. That aside, because I feel like that's just obvious and yet.

MK: Actually, I'm not sure about that. I can take a rifle and shoot myself in the foot with a counter argument that is worth discussing. And that is, what is the benefit of competition? I think competition in science is a good thing. I think that having labs each working independently to solve problems is a good thing, but it needs to be healthy. It can't be this taking the gloves off and beating each other up to be first.

AT: Counter argument. Katharine Dexter McCormick and the birth control pill. So for anyone who's not familiar, Katharine Dexter McCormick is the reason we have the pill. She had a shit ton of money and she put a lot of it into developing the pill. And Margaret Sanger wanted her to give money to a bunch of different labs who, like you were saying, were competing to try and develop this. And she said, “Nope, I am going to give it all to this one project and it is going to get done because I'm going to concentrate my resources on a single focused lab.” And we got the pill. And I will say she was also an MIT grad and everything, like she knew science. And so I have to wonder how much of her reasoning was because she knew science.

MK: I was just sitting with Paul Salomon Mischel, an oncologist at Stanford University. Paul Salomon has identified a way in which cancer is behaving that is quite extraordinary whereby cancer doesn't follow the rules of standard mitosis. Mitosis is the process where a single mother cell splits and sends its genetic information into two daughter cells. He has revealed that cancer cells are basically taking a page out of the bacterial playbook and taking some of their genetic information out of their chromosomes and shuffling it around in a

quite horrendous way that makes a subset of cancers, about 20%, regardless of whether pancreatic, liver, lung, roughly 20% are engaging in this very serious gene shuffling when they replicate. And it's confounding our way of treating people. And it makes these cancers very, very stubborn and almost always fatal. He has created this extraordinary alliance of labs that are non-competitive working together to solve a problem. They all share credit every time they publish and he is making huge strides forward and it's non-competitive. So there's an argument to be made.

Similarly, when I've interviewed Kati, Kati has said multiple times, “look, I talked to scientists and they ‘go, oh, I'm so sad. This other lab has solved the problem before me. I am now not going to get the glory.’” And Kati's like, “that is wrong! You should celebrate! They solved the problem that you've been working to solve. It is we, not me! It is we work together to solve the problem. You should celebrate that science has succeeded.” Yes. And she is right. But if we're going to function in that way, we need to overhaul funding so that when you come in second, you don't get defunded because scientists have to pay their mortgage too. They have to pay for food on the table. And when you create financial systems that screw the scientists, when they come in in second or third place, you sabotage the ethic that is required for us to work together. So as long as we have the financial underpinnings of you must be first to get the glory and the funds, you put people in a position whereby they're torn between wanting to do the right thing and needing to be able to pay for milk and bread and eggs. These are kitchen table issues for scientists.

And we can't be so moral as to ignore them. So I do ask, to what extent is competition healthy? And I think therein lies the rub. Competition needs to be healthy. It needs to be good-natured. The discussion must remain respectable. You cannot be calling anyone the C word at a conference. You can't be screaming so loud that you put a PhD student in tears. You can't create such a toxic environment such that a researcher trying to bring in a species back from the brink of extinction is crying to a journalist about the state of affairs in their field. That's just crazy. We cannot be doing that. It doesn't do any of us any good – or the rhino might I add.

AT: And one of the ways that this is counterproductive that you get into in the book is not even on the competition side, but you talk about cold mice.

MK: Betsy Repaski. Yeah, she's awesome. Another modern female scientist. Betsy's terrific. 2010, I was interviewing Betsy about research that she had published. And I found the results so interesting because she was saying mice kept at room temperature have immune systems that are hamstrung. When you work with mice in the lab, the standard procedure is to have the room set at 20 degrees. 20 degrees is like what? 73 Fahrenheit? Comfortable for us, but it has the added benefit of being cool for the mice. So they drink less water and they pee less, which means you have to change their litter less often. So it's a money saver and your lab techs are happier because it's not sweltering. If the room was at a temperature typical for mice in a nest, it would be like 28 or 30 degrees. It would be hot. As a lab tech, you would be sweating and boy, would those mice be peeing. They would be peeing a lot. And so Betsy asked the question, “do mouse immune systems function differently at 20 versus 30 degrees?” And she ran some experiments and went, “oh my God, the mouse immune system is notably different. Mice that are in 20 degrees are effectively hypothermic.” What's comfortable for us makes the mouse feel very uncomfortable. It would be like you and I sitting all day in a room that's like 10 degrees or 50 with no warm clothes. And can you function in that kind of room? Yes, you can. Would you become immune compromised in that room? Oh yes. You're much more likely to fall ill because your immune system is having to work harder.

We are now in 2026. Literally 16 years after she published her paper and she has had to fight tooth and claw to get attention. Why? Because it's expensive to change all of the mouse enclosures around the world to now take into consideration the fact that the mice have to be in warmer temperatures. And more importantly, if you're going to do the work, you want to see how a mouse functions with a new pancreatic cancer drug, you should test the mouse with a pancreatic cancer drug at 20 degrees and you should test it at 30 degrees. And that kind of work is only just now being taken seriously because creating an experiment where the mice can be

held at 30, held at 20 and given the same drug and had everything else kept the same costs money. And it's different. And it requires you to have to change your ways. And there's been a huge lag in uptake simply because Betsy is thinking outside the box and she's proposing that the way we've done things for years may not be right. And is the fact that she's female, again, a factor? In her case, I think it's harder because oncology has seen a lot of women join its ranks and she is talking largely about how temperature affects cancer outcomes and maybe being female is what has really mattered. I don't think so, but it may have played a part.

AT: As I mentioned earlier, you do have all these women in a contemporary setting that you talk about, but from the standpoint that I come at, it's always women's history. So it was really striking to me that having written my book *Uncredited* and having hundreds and hundreds of examples of largely women in the sciences and the reasons that they are penalized in all sorts of different ways when a lot of times they are right. It really struck me that you didn't have any historical women. So I wasn't sure if just in terms of the narrative, because you are following that line of puerperal fever, if there were no significant women in that particular storyline, other than, you know, all the women who are dying and the midwives who often were having better outcomes because they weren't doing things like touching cadavers before they stuck their hands up a woman's birth canal. So what's going on there? Where are the women?

MK: So you do have really important women in medicine. You've got Florence Nightingale. She was hugely important, but she didn't deal with puerperal fever. She didn't conduct academic research in the same way. And so her story didn't really feature in because I was trying to connect really the puerperal fever problems to modern science. And there weren't a lot of women associated with puerperal fever. You do have female paleontologists like Mary Anning, who was a British fossil collector along the Dorset coast. She was collecting these marine reptiles that are now enshrined on the walls of the British Natural History Museum. She was a legend in the paleontology community, but also considered kind of this enigmatic figure because “you can't be a paleontologist and a woman.” So she was a fossil collector rather than a paleontologist. But that was just the terminology that was used because the men running the paleontology field couldn't conceive of the fact that a woman could be a paleontologist.

AT: Well, from what I recall of her story specifically, I believe it was also a question of her living was finding these fossils and selling them to rich men. And so then they would be the ones with their names on the collections. They would be the ones with their names on the papers. Like she wasn't getting acknowledged for their work, even if all the men in the field knew, “oh, you want the good fossils, you go to Mary.”

MK: Yeah. So there is certainly that. It's not just rich men, though. It's also rich organizations. So museums and national collections would pull in stuff from Mary and they did pay her well for it. But in the same way, you still have people who are fossil collectors today who build relationships. I was talking about this cartilage specimen that was dug up in Oklahoma, soaked in petroleum. The fellow who dug it up has his name on the paper, but he's not a scientist. He's a collector. Mary made some interesting observations in her time. And if women could have been scientists, she probably would have been.
In the same way, Lady Montagu, was not a paleontologist. She wasn't really a scientist, but she was living in Turkey as the wife of, I believe, an ambassador from Britain. And she noticed that women in the Turkish baths never had scars from smallpox. And she asked around what's going on. How do you people not have smallpox? And they introduced her to this concept of inoculation. And Lady Montagu learned that there were monks and apothecaries who would collect pus from a smallpox pustule, put it onto a leaf, leave it out in the sun for a certain amount of time, and then scrape the dried pus into a powder and then blow it up someone's nose. That person would then get smallpox, but they would get a weakened version of smallpox that instead of having a 30% chance of killing them would have a 1 or 2% chance of killing them and be less likely to leave scars and create permanent disfigurement and all kinds of other very serious medical ailments afterwards. And

so being hideously scarred herself and having lots of friends and family who had died from smallpox, Lady Montagu cared about this. She got her, I believe it was her son, inoculated in Turkey. But the folks doing the inoculation would not inoculate her daughter because her daughter was considered too young to be inoculated and too much of a risk. So Lady Montagu collected all the notes, brought them back to Britain and shared them with a doctor who she paid off to do the inoculation on her daughter. But word got out to the royal family, I believe it was the Princess of Wales at the time, who then inoculated her own children. And before you knew it, inoculation was spreading like wildfire around the monarchs of Europe. Many, many powerful monarchs like Catherine II and Maria Theresa of Austria, even Louis XVI in France, got inoculated against smallpox because it was just such a serious threat. And that really stemmed from Lady Montagu doing what she did. But not a scientist. She was an important figure who spread information on smallpox inoculation, but she didn't do the testing herself.

AT: And just got to shout out my episode with Ann Foster because we talk about Caroline of Brunswick and we talk about Mary Wortley Montagu and all that in that episode, if you want more context around that story specifically. But I have to push back against this idea that women weren't doing science. I understand why that's the popular perception. I literally wrote a book about it. But for example, I've got an episode with Lydia Reeder about Mary Putnam Jacobi, where we talk about she was following the scientific method. She was doing proper science at a time when most of the men were not. They were just faffing about doing often horrific things that had no basis in logic, reason, or fact.

MK: This is not to say that women were not curious and women were not engaging in the scientific method. The problem is that history is written by the victors and the victors all the way up until 1900 were male. We almost didn't even know about Gregor Mendel, the monk in what is now the Czech Republic, who was working with pea plants and worked out the basis for genetics. Why? Because he wasn't a scientist. He was a monk and he was testing with pea plants and crossbreeding. And it took years for his work to be discovered by the right people to understand that he had actually been engaging in science without being a scientist. This is not to say that there were lots and lots of women who we don't know about who were engaging in science and didn't ever get the credit they deserved because their work wasn't being documented or the ecosystem was simply completely set against them. So they were forgotten by history. And while that is horrendous, it is fact.

Listen to Vulgar History's Ann Foster on Princess Charlotte or read the transcript.

Listen to Lydia Reeder on Dr. Mary Putnam Jacobi or read the transcript.

AT: I think the difference here is that I am talking about people who did science and you are talking about people who were paid and recognized and professional, which is actually something that has come up before. I've got an episode about amateur astronomers, for example, and we talk about the difference between the women who were working in the observatories, specifically in Australia at this time, because we'd already done an episode about them. And then she came back and we talked about amateur astronomers who were still corresponding with professionals. They were doing the science, but they weren't recognized as such. And ironically, the term scientist, do you know where it comes from? (MK: No, go ahead.) So it was actually for a woman, Mary Somerville, who was working across all of these different disciplines. And so apart from the fact that they couldn't call her a man of science, which was, I guess, the default term, I believe it was William Whewell, a Cambridge don, supposedly coined the term scientist to describe her, not just because of the gendered aspect, but because of that interdisciplinary nature that she was working across all these different fields. So when you say, there weren't women scientists, I'm like, “the first ‘scientist’ was a woman.”

Listen to Dr Toner Stevenson’s episodes on: the women of the Astrographic Catalogue (transcript) and Australia's early amateur astronomers (transcript).

MK: I don't say there weren't women scientists. I say we don't have them recorded. And the paper trail is poor. (AT: Oh, I know.) So, this is the critical issue. I love the term scientist, if that's accurate, that “scientist” was used to describe women. One of the major changes in language I've seen in my career as a journalist has been the term “fisherman,” because I write about marine biology all the time. Over the past 26 years, I've seen “fishermen” shift to “fishers” or “fisher folk,” because there are fisher women, and you can't call them fishermen. And so the language has adapted to do that. But the problem is the paper trail record. And even with the men, a lot of the paper trails are either absent or wrong. There are so many people who have been forgotten. I write extensively about Galileo, who we won't talk about here, because we just don't have time. But the stuff we think we know about Galileo was largely wrong, because history is written by the victor. Who was the victor? Pope Urban VIII. Pope Urban VIII totally won, because he demonstrated that he had complete power over the faithful and could suppress heresy when he needed to, while simultaneously not actually torturing Galileo. And he penned what he wanted people to hear. Never mind that memos were found 150 years later revealing what actually happened. Because the narrative had been crafted by the pope, that's what everyone, including most people today, still believe, even though it's been discredited. So it's not just about losing records. It's also about the story that we are told and then clinging to the stories that we've been told because we think they must be true. And that also undermines women in science throughout history.

AT: Yeah. And you could say the same thing about Pasteur, which you get into in the book. But documentation makes up, I would say, the first quarter to third of my book, Uncredited. And I describe it as a multi-tiered sieve. So what gets documented in the first place, what gets preserved, and then what actually gets presented to the public. And you're losing all of these stories at every level. And even what we do get is often biased. And so that's something that we talk about on this podcast all the time. Bringing it back to scientists today, what advice do you have for particularly young people, since we know they are more susceptible to this kind of response if they say something that people aren't going to like, but really, I guess for anyone, what is your advice for if someone discovers something that they know is going to piss people off?

MK: My main argument in the book is we've got to keep the gloves from coming off. But that is advice for the larger scientific community to remember that we are all in this for the sake of humanity. We are all trying to push the envelope on scientific discovery for the sake of people. And when we lose our shit, because an idea is too far out there, or it's coming from someone who's a newbie to our field, or it's coming from someone who's young, or someone who's female, we do ourselves, all of us a tremendous disservice. So we need to be more tolerant. Yes, there are crazies out there. They are going to put forward ideas that are going to make us go, “what? Why are you proposing that?” Don't. Don't do that. Say, “okay, well, that's interesting. Talk to me. Explain why. What's your argument? Walk me through what you did.” It might be crazy, and that's okay. But don't be mean. We got to be respectful. As for the people who have the ideas and are the outsider, because their idea is outside the norm, or because they are from a group that's outside the norm, i.e. ethnic minority, young, a chemist in the field of geology, an ecologist in the field of oncology, or wait for it, a woman, any of these things, my advice is follow Darwin. Follow Joseph Lister. These are people who were in exceptional danger, but used diplomacy – follow Galileo – used diplomacy and alliances with others to protect themselves as they put their neck out and became vulnerable. Joseph Lister used the strength of his students to ultimately win the war against James Simpson. Charles Darwin built very powerful allies in the way that Mary Schweitzer had Jack Horner to beat the ever-loving crap out of anyone who came and attacked her. Darwin was pathologically shy and really couldn't debate to save his life, but he built friendships that did that for him. Galileo, we all remember him as this incredible astronomer. Galileo was first and foremost an incredibly charismatic diplomat. He built these friendships at the highest echelons of early Italian society, and those relationships saved his life. It's diplomacy, it's charisma, and a lot of scientists just are not trained in any of this. Many scientists are great researchers who just don't have charisma, and that's gonna have to be okay some of the time. We can't do anything about that, but we got to get the message out that we are all in this together,

and that beating each other up and being disparaging gets us nowhere.

AT: Join us next time on the Infinite Women podcast, and remember, well-behaved women rarely make history.