[SLICE OF MIT THEME MUSIC]

ANNOUNCER: You are listening to the Slice of MIT Podcast-- a production of the MIT Alumni Association.

JOE MCGONEGAL: It's Joe McGonegal and the Slice of MIT Alumni Books Podcast. And I've got Lucy Jones on the phone. A PhD from the class of 1981, who is the author of *The Big Ones: How Natural Disasters Have Shaped Us and What We Can Do About Them.* It was published by Doubleday this April.

Dr. Jones is the founder of the Dr. Lucy Jones Center for Science and Society, with a mission to foster the understanding and application of scientific information in the creation of more resilient communities. Dr. Jones is also a research associate at the seismological laboratory at Cal Tech.

Thanks for discussing the new book with us. What makes this year a unique time in history to be talking about the big ones?

LUCY JONES: It's a time when we both have the ability to better prevent disasters, right? What the earth does is inevitable, but how our structures and engineering respond to it is not. And we can do a lot, and more all the time because of technology. At the same time, the rate at which the big ones are happening in the meteorological realm is increasing because of the disruption of climate change. And our vulnerability to all of the disasters is increasing because of increasing urbanization. So it's both the best of times and the worst of times for looking at natural disasters.

MCGONEGAL: You retired after 33 years of federal service with the US Geological Survey in March 2016, and had a little more time on your hands to put a book together. I'm talking to you during a month of epic wildfires in California-- Southern California, where you live.

JONES: Yes.

MCGONEGAL: You've lived in California your entire career. And does your intimate knowledge of California's dangers ever inspire you to leave, or thoughts of leaving?

JONES: No, I've never thought about leaving California. I went out east for school. I went to Brown as an undergraduate, and said, oh, I've got to get back to California. And instead, people at MIT

bribed me into going with offering me a trip to Afghanistan my first summer, and then work in China. And I stayed on the east coast, but came back as soon as I could.

Every place has some risk of natural disasters. Everywhere we've put human society-- cities are preferentially built at places at risk from disasters. We need the rivers for water, so we put ourselves at risk from floods. We're in coastal areas and at risk from hurricanes. And even the faults create seams that trap water in the desert, or that trap oil. Los Angeles is here because of the discovery of oil at the beginning of the 20th Century. And those are all preferentially on the fault.

So every place has them. Somehow, California, it seems more obvious, partly because we have this image of a paradise. We don't have our snow storms and all of the usual problems from weather. But compared to all of the other risks in life, I am far more likely to be murdered in America than I am to die in a natural disaster in America. And also as a scientist, I know that what happens to me during a big natural disaster is to some degree controllable. I can reduce my risk in a lot of ways. And I'd rather do that and stay here.

MCGONEGAL: The book takes us through some of the most famous-- and some less so famous-- earthquakes over history. But let's talk about California, and specifically, we've got almost 15,000 alumni living in northern California, Bay Area, around the Hayward Fault and the San Andreas fault. What are unique about those faults in their history, right now?

JONES: Well, both the Hayward and the San Andreas fault are some of the faster moving faults of California. So they average only a couple of hundred years, or even a little less between earthquakes. Now, that's only average. So even though it's been-- what is it? 150 years since the last big earthquake on the Hayward Fault, that doesn't mean that the earthquake has to happen now.

In fact, when we get places where we can see a long history of earthquakes, the intervals are best described with a Poissonian distribution. A memory list distribution, which seems to not match what we think how earthquakes happen, but in fact, it appears that the timing of earthquakes is better described by like a triggering process, when we happen to exceed the stress in some small part of the fault, and then it propagates through to the rest of it.

So the Bay Area always has the highest per capita earthquake risk in the country, because the big faults run right through the city. Southern California has the highest risk-- the most money to be lost-- but we spread it over a lot more people.

MCGONEGAL: Tell me how your MIT education is alive and well in the writing of this book.

JONES: The book is really the summary of my career, in many ways, turned into a story. My thesis at MIT was around statistical seismology, how to understand the probabilities of earthquake clusters. And I used it in going to China, which ended up being one chapter of the book, looking at how earthquake prediction was pursued, in the end, not that successfully in China. But then also, I looked at the L'Aquila earthquake in Italy, where some seismologists were actually both accused and convicted, but then acquitted on appeal for manslaughter. It was said, for not predicting the earthquake. In fact, for giving unreasonable reassurances that there wouldn't be an earthquake was really what the key issue was.

So all of the things I did through my career in studying earthquakes inform how I see natural disasters, and trying to take a more human approach of what does the science mean for us.

MCGONEGAL: Artificial intelligence. We hear some news these days about AI, and it helping us understand climate change. Talk about it in terms of understanding seismology.

JONES: Oh, there's some very exciting stuff going on right now. There's some of the new entrants into the field. It's more about how to use the information from the earthquakes to understand the earth and see their spatial distributions. The AI has not given us great insight into predicting earthquakes, because what it seems to be is that the underlying process is inherently random, and AI is one of the ways of not fooling yourself into thinking there's a pattern when it isn't actually there. But there's a lot of new opportunities for the automated systems.

And, of course, although we can't predict a future earthquake, we can tell you that an earthquake is under way, and get that information to you before the waves themselves arrive at you. Not prediction, but a warning of a matter of usually just a few seconds. The principle is simple, the application is very complex, because the earth is a complex place, and the waves going through are complex. And some really interesting questions about whether an earthquake knows how big it's going to be before it happens or not. Anthropomorphic way of saying that, but the information about the size of the Earth may be not in the Earth before the earthquake begins.

So those are all quite interesting questions, and the application of AI is turning into a very powerful tool. Because, in fact, we have recorded millions of earthquakes in California since seismic network was first digitized. And it's a huge database from which we can train the

computer systems to do a better job of getting the information out of those waves and turning it into something useful.

MCGONEGAL: But you would say, more in the short-term, more descriptive analysis than prescriptive, or predictive.

JONES: Well, it's because there's a lot of use of them to go from the waves to what actually is going on in the Earth, which is what the study of seismology fundamentally is. Because the earthquake process seems to be fundamentally random, you aren't going to then be able to predict-- just because somehow you're doing it with a computer-- if indeed it is random at its core, and that's the way it's looking.

MCGONEGAL: Talk about the process of writing the book. What was harder-- writing the book or publishing the book?

JONES: The publishing part turned out to be quite easy. It's an interesting thing, how it can happen. I worked with an agent to create a book proposal, which was both trying to say what it is I wanted to do. It's also creating that original organization. When you write a scientific journal article, it's 10 pages. This is hundreds of pages. And providing a coherent story arc is a challenge.

I did it through that book proposal process. That was used to get a publisher-- to bring a publisher on board. And then the process of actually writing the book once I had that framework was relatively easily-- especially because my editor from Doubleday was fantastic. And he really helped me move from writing as a scientist to writing as a storyteller. Same fundamental information, but a really different way of conveying it.

MCGONEGAL: And tell me what other books you're reading right now.

JONES: Oh, I just read *The Language of God,* from Francis Collins, looking at the whole thing of DNA, and genetics, and evolution, which is a pretty fascinating way of looking at it.

MCGONEGAL: Lucy Jones, PhD class of '81 is the author of *The Big Ones: How Natural Disasters Have Shaped Us And What We Can Do About Them.* And it's available, now, at your local bookstore or wherever you buy your books. Dr. Jones, thanks for joining us.

JONES: Oh, thank you for having me.