

CLIMATE

Hit Them with the Hockey Stick

Michael E. Mann set out looking for a big scientific problem and wound up at the center of a political storm over climate change. Now he tells his side of the story

Interview by David Biello

IN BRIEF

WHO

MICHAEL E. MANN

VOCATION | AVOCATION

Climate modeler and scourge/target of climate change contrarians

WHERE

Pennsylvania State University

RESEARCH FOCUS

Improving climate models and climate communications

BIG PICTURE

"Being a climate scientist these days is not a 9 to 5 job. It's a 0 to 24 job."

CLIMATOLOGIST MICHAEL E. MANN IS MOST FAMOUS FOR WHAT HE CALLS ONE of the "least interesting" aspects of his work. In the 1990s he used data from tree rings, coral growth bands and ice cores as proxies for ancient temperatures, combining them with modern thermometer readings. This annual record of temperature variations over the past millennium offered insights into natural climate cycles. As an "afterthought," he included a graph of average temperatures in the Northern Hemisphere going back to the 1400s in a 1998 paper (he later extended it to A.D. 1000). That "hockey stick" graph, which shows temperatures bouncing up and down before rapidly rising more recently, became an icon of climate change.

It was also a focus of controversy. Although the U.S. National Research Council reviewed the hockey stick and endorsed its conclusions in 2006, Mann and his research came under often hostile public scrutiny, culminating in "Climate-

gate"—the theft and publication of his and his colleagues' personal e-mails in 2009. Mann's employer, Pennsylvania State University, subsequently investigated him for research misconduct (and cleared him in 2010). And Virginia Attorney General Ken



Cuccinelli has filed suit against the University of Virginia, Mann's former employer, to investigate his work there (at press time, the case is still pending). His detractors, Mann says, "never stop."

Mann is now hitting back with his own account, *The Hockey Stick and the Climate Wars*. SCIENTIFIC AMERICAN spoke with Mann about his research, the controversy and his hope for averting catastrophic climate change. Excerpts follow.

SCIENTIFIC AMERICAN: What first drew you to climate studies?

MANN: My undergraduate degrees were in applied math and physics, and I went off to graduate school to study theoretical physics. When I realized that the opportunities were becoming quite limited, I started looking to see where I could use the physics and math that I had learned to work on a big problem—one that had some real-world implications. I opened up the catalogue of applied science at Yale University and came upon the section that described some of the work that folks in the department of geology and geophysics were doing on developing theoretical models of the climate system. And that just sounded fascinating to me.

At that time, there was a legitimate scientific debate about the reality of human-caused climate change having yet been observed. My work actually had little to do with that debate.

You started studying natural variability in temperature, right?

There's an irony there. Some of my early research was celebrated by contrarians in the climate change debate—I coined the term "Atlantic multidecadal oscillation" [AMO]. They love to argue that it's responsible for just about everything, when, in fact, the reality is far more nuanced. These oscillations do appear to exist, but they can't explain climate change.

Think of the AMO as a really long-term cousin of El Niño. This oscillation in the climate system takes several decades to go from one phase into the other. That's actually what got me interested in proxy data [such as tree rings]—because if you're trying to tease out a 50- to 70-

year oscillation and you've only got 100 to 150 years of instrumental observations, you run into obvious problems.

These proxy data are natural archives that, by their nature, record some attribute about the climate. The thickness, for example, of trees rings is a function of the warmth of the growing season or, in some circumstances, the wetness of the growing season. So you can potentially tease climate information out of tree rings.

By combining the information from lots of different proxy data, you start to put together a more global picture of what's going on, and you can immunize yourself from the danger of relying entirely on any one type of proxy. Each has its own strengths and weaknesses.

The most famous outcome of that work is, of course, the hockey stick graph.

How did that come about?

These are very imperfect thermometers provided by nature. Probably the main challenge was figuring out a way to relate that very noisy information to the modern surface-temperature record in a way that would then allow us to estimate temperatures back in time over the surface of the globe. It's only from looking at the relative pattern of temperature around the world that you can get insight, for example, into the history of El Niño.

The least interesting thing you could do with these spatial patterns once you built them was to average all those data to get a single number for each year—the average temperature of the Northern Hemisphere—and plot that back in time, which is what yielded this hockey stick curve.

The long-term temperature slowly declined from what is sometimes referred to as the Medieval Warm Period, a relatively warm time about 1,000 years ago, into the depths of the Little Ice Age of the 17th, 18th and early 19th centuries. That's the handle, if you will, of the hockey stick.

Then, at the end, that rapid rise is the blade of the hockey stick: the warming of the past 150 years, which takes temperatures beyond anything that we had reconstructed as far back as we could go. That single result got all the attention.

Who first called it the "hockey stick"?

It was Jerry Mahlman, who used to direct NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, N.J. It turns out the term was actually used previously in the context of ozone depletion. There was some history of using the term "hockey stick" to describe the sort of data series where you're going along, and all of a sudden there's a huge spike at the end.

Do you regret the name?

There's always the danger that applying a simple term like that to something that's complicated creates a caricature of the science. There's a veritable hockey league now of reconstructions like ours that shows the same basic pattern.

The United Nations Intergovernmental Panel on Climate Change (IPCC) featured the hockey stick prominently in its 2001 report. Was that wise?

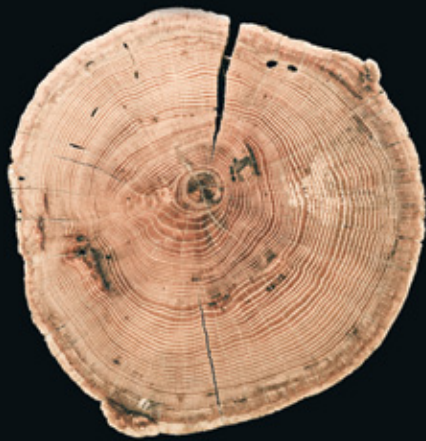
In retrospect, it probably wasn't the most prudent decision, because it played right into the argument that contrarians like to use: that somehow the science depends on one particular study or even one particular author of one particular study. And if you can somehow discredit that one study or that one person, the entire scientific case collapses.

There had, in fact, been several reconstructions that told a similar story in the technical report. By the time the IPCC report came out, there were three [additional] reconstructions that came to more or less the same conclusion.

How do you feel about being called the whipping boy of climate science?

At times I felt like: "Bring it on." I'm confident about the robustness of our scientific work. I think that if the climate change deniers thought they had found an area of the science that they could discredit by trying to go after a single scientist—me—I think they've been in for a disappointment.

The e-mails stolen in 2009 included some of yours, though they weren't the most controversial. What was that like?
The people who stole these e-mails and



Climate proxy: Natural archives such as tree rings provide clues to past climates.

posted them: How would they like someone to take their diaries, their private communications and expose them to the world out of context? The fact that climate change deniers needed to resort to criminal activity to try to discredit our science on the one hand disgusted me. It angered me. It angered, I think, many of us in the scientific community.

There was a concerted campaign to use these stolen e-mails to manufacture an echo chamber of climate change denial propaganda in the lead up to the Copenhagen summit. There was an attempt to use misrepresentations, false allegations, smears based on these out-of-context e-mails to have scientists fired.

At one point, an influential Republican legislator in the state of Pennsylvania threatened to withhold funding for Penn State if the university didn't take some sort of action against me because of the purported improprieties. So it was ugly.

We've lost three years to do something about climate change, and that's a huge opportunity cost. Each year we wait, it gets that much more difficult to stabilize carbon dioxide concentrations below levels that might very well be dangerous. I think that [Climategate] was a crime against humanity. It's a crime against the planet.

How do you respond to claims that there was a "trick to hide the decline?"

There are at least five things that are false about that statement, but the most obvious is that there was no reference to a "trick to hide the decline." That was taking two different parts of an e-mail and merging them together in a way that com-

pletely changes the sense of what was actually being discussed.

What's especially ironic about the claim that [climate scientists] were trying to hide the decline in global temperatures was that this e-mail was written in early 1999. It was on the heels of, by far, the warmest year we had ever seen, 1998. So if you were a scientist writing an e-mail at that time, you couldn't possibly imagine there was anything approaching a decline. If anything, there was an apparent acceleration of warming taking place. The "decline" simply referred to some bad tree ring data.

How does the opposition to climate science compare with past anti-scientific crusades?

It's hard to believe that in the 21st century we are still confronting rejectionism of science when so much of modern life depends so critically on the technological infrastructure that we've developed because of science. The very people who are denouncing what science has to offer in a wide variety of areas [benefit from] the contributions of modern science.

What effect has this had on scientists?

Maybe it's emboldened other scientists to fight the disinformation effort afoot in our field and also in many other fields of science. No longer can scientists stay isolated in their laboratories and trust that the impact of their work will percolate honestly and productively into the public discourse. Scientists need to be proactive in ensuring that their science is communicated as accurately as possible.

Any comment on the lawsuit against you and the University of Virginia?

It's really unfortunate that people with antiscientific views, who regard science with disdain, can rise to the highest levels of government in this country. That's very scary.

What role does politics play in science?

It's perfectly appropriate for science to inform one's view of policy matters. What's wrong is for one's policy views to influence the way one does science.

Years ago climate change was not a

political issue. My colleague [Ohio State University glaciologist] Lonnie Thompson puts it very well when he talks about the loss of mountain glaciers. The ice has no agenda. It doesn't matter if you're a Republican or a Democrat. The ice is retreating. Sea levels are rising. They're not happening for political reasons. What we do about it is, of course, a political matter.

Are the impacts of climate change showing up faster than predicted?

Changes have been taking place faster than the models projected. With respect to sea-level rise, with respect to temperature changes, with respect to carbon emissions, and in just about every case, the changes have occurred either at the upper end of the projections or even above the range of the projections.

Arctic sea ice might be the most profound example, where the observed decline in summer Arctic sea ice is way outside the projected range. The great irony is that the climate scientists, if anything, have been too cautious and too conservative.

You say you still have hope. Why?

If we look to history, in the end, science and honesty won out—perhaps later than we would have liked.

We acted later than we should have with tobacco. We acted later than we should have with ozone depletion and the banning of chlorofluorocarbons. We presumably suffered far greater damage and loss of life because we delayed action. But we did take action. ■

David Biello is an associate editor.

MORE TO EXPLORE

Surface Temperature Reconstructions for the Last 2,000 Years. National Research Council. National Academies Press, 2006. www.nap.edu/catalog/11676.html

Dire Predictions: Understanding Global Warming. Michael E. Mann and Lee R. Kump. Prentice Hall, 2008. The Hockey Stick and the Climate Wars: Dispatches from the Front Lines. Michael E. Mann. Columbia University Press, 2012.

SCIENTIFIC AMERICAN ONLINE

To hear a portion of the interview as a podcast, visit ScientificAmerican.com/mar2012/mann