

Opening the “Black Box” of Climate Change Science: Actor-Network Theory and Rhetorical Practice in Scientific Controversies

Richard D. Besel

In this essay, Joseph Barton’s controversial congressional investigation of the well-known “hockey-stick” study of climate change, produced by Michael Mann, Raymond Bradley, and Malcolm Hughes, is analyzed through the critical lens of actor-network theory. Turning to the works of Bruno Latour, Michel Callon, and John Law, this essay illustrates how the hockey-stick node of this rhetorical climate change actor-network was successfully defended by invoking the entire actor-network as an inventional resource. Suggestions for improving environmental communication and the theoretical linkages between rhetorical criticism, rhetoric of science, and actor-network theory are discussed.

In 1998, *Nature* published an article authored by Michael Mann, Raymond Bradley, and Malcolm Hughes (MBH98) titled, “Global-Scale Temperature Patterns and Climate Forcing over the Past Six Centuries.” Based on their analysis of tree rings, ice cores, and coral reef samples (referred to as “proxy climate indicators”), the authors argued human-released greenhouse gases were the dominant “forcing” for temperature changes during the twentieth century, with the previous eight years being the warmest on record.¹ As with most contemporary scientific studies, Mann, Bradley, and Hughes displayed their data with a variety of charts, figures, and graphs, one of which included a time reconstruction of Northern

Richard D. Besel, Department of Communication Studies, California Polytechnic State University. Correspondence to: Richard D. Besel, California Polytechnic State University, Department of Communication Studies, One Grand Ave., San Luis Obispo, CA 63407.

Hemisphere mean temperature that appeared similar to a hockey stick on its side.² According to Gavin Schmidt, a climate scientist at NASA's Goddard Institute for Space Studies, the 1998 hockey-stick article was "groundbreaking."³ The key findings of the article received widespread scientific attention when they were included in the Intergovernmental Panel on Climate Change's (IPCC) 2001 report as a means of bolstering the IPCC claims that "the 1990s had been the hottest decade in 1,000 years."⁴ The hockey-stick figure also received public attention with its inclusion in Al Gore's 2006 movie *An Inconvenient Truth*, contributing to the figure's role as a visual icon within the environmental movement. The MBH98 findings certainly appeared to be accepted by the scientific and activist communities within a few years of its publication.

Although the hockey-stick study received widespread support from those who believed human-induced global climate change was happening, after realizing the article's importance, skeptics also turned their attention to the publication. In 2003, *Energy & Environment* published a critique of MBH98. Stephen McIntyre, an amateur statistician and longtime mining industry employee, and Ross McKittrick, an economist at the University of Guelph, accused Mann, Bradley, and Hughes of writing an article full of errors and defects. McIntyre and McKittrick argued the hockey-stick figure was "primarily an artifact of poor data handling, obsolete data, and incorrect calculation of principal components."⁵ Although questions about the scientific and statistical principles underlying the MBH98 study are worth considering, the rhetorical significance of the 2003 critique is to be found in its later use by skeptical policy makers.

Prompted by what is often referred to as the "M&M" critique, politicians who were skeptical of human-caused global climate change latched onto the M&M article as sufficient reason to doubt the MBH98 study. In 2005, House Energy and Commerce Committee Chairman Joseph Barton (R-TX) began a controversial and unusual investigation of the MBH98 article. In a letter sent to Mann, Bradley, and Hughes, Barton cites the 2003 M&M study as one of his reasons for demanding the three MBH98 authors provide the House committee with detailed information about "all financial support you have received related to your research," "the location of all data archives relating to each published study for which you were an author," and "all agreements relating to... underlying grants or funding."⁶ Following the letter, the House committee held hearings in July of 2006 dedicated to "investigating" the results of the hockey-stick article.

Barton's attempts to bring a scientific disagreement into the deliberative halls of Congress ignited a heated controversy about the politicization of science that merits the attention of rhetorical scholars. Although Barton's letter to Mann, Bradley, and Hughes certainly subjected the scientists to "unprecedented scrutiny," as one journalist noted, the response from other politicians was no less unusual.⁷ In a publicly released letter, House Science Committee Chairman Sherwood L. Boehlert (R-NY) demanded Barton cease his investigation, fearing "such attacks could chill future scientific inquiry." Although it was highly unusual to have one committee chair publicly scold another, Boehlert even went so far as to call Barton's probe an

attempt to “substitute congressional political review for scientific review” and a “misguided and illegitimate investigation.”⁸ Boehlert was not alone. Alan Leshner, representing the American Association for the Advancement of Science, believed the inquiry to be “a search for a basis to discredit the particular scientists rather than a search for understanding.”⁹ Ralph J. Cicerone, President of the National Academy of Sciences, noted that Barton’s inquiry focusing on individual scientists could be “intimidating.”¹⁰ What is at stake in this controversy is captured in a letter written to Barton by 18 of the nation’s most influential scientists: This investigation could compromise “the independence of scientific opinion that is vital to the pre-eminence of American science as well as the flow of objective science to the government.”¹¹ According to journalist Dan Vergano, climate change skeptics turned the MBH98 article “into a symbol” that represented “all the shortcomings of the scientific argument for global warming’s reality.”¹²

If the political attack against the MBH98 study was rooted in synecdochally situating the hockey-stick article as representative of all global climate change studies, the rhetorical defense of the human-induced climate change argument further warrants scholarly attention for what it can tell us about the rhetorical uses of scientific actor-networks in an age where communication scholars are concerned with the acquiescence of the public sphere of deliberation to the technical sphere of science.¹³ MBH98 supporters not only defended the specifics of the study by Mann, Bradley, and Hughes but they also rhetorically invoked the entire corpus of scientific research, what science studies scholars have called an actor-network, in favor of human-induced climate change to mount a second and more potent defensive position.¹⁴ In a life world where calls for transparency can be used to uncover unjust and immoral actions—or as a stalling tactic to prevent just and moral actions—this case highlights the role of actor-networks as a theoretical element necessary to understand technical-public interactions.

In this article, I contend the Barton/MBH98 controversy can be understood best as a specific instance in which scientific actor-networks find rhetorical currency in the process of politicizing science. To borrow from one pioneer of actor-network theory (ANT), Bruno Latour, this controversy is not just a “trial of strength,” it is a trial of rhetorical strength.¹⁵ In other words, while material mattered, rhetorical positioning was just as important. To support this claim, I will first turn to the Science and Technology Studies (STS) literature on scientific actor-networks, especially as they are conceptualized by thinkers who follow Bruno Latour, Michel Callon, and John Law’s lead. I argue actor-networks are not only rhetorical, as many ANT scholars claim, but that the entire network can and is often invoked in rhetorical practice as an inventional resource, an important insight that will help scholars further understand how scientific controversies are engaged in contemporary contexts. Next, I offer a detailed analysis of the Barton/MBH98 congressional hearing as an example of how actor-networks have been invoked in scientific controversies about global climate change. I conclude by discussing the practical implications of this analysis for understanding climate change rhetoric and the connections between ANT and rhetorical theory.

Actor-Networks and the Rhetoric of Scientific Controversy

Despite ANT's canonical stature in STS, its presence in rhetoric of science publications is virtually nonexistent and its influence in the Communication Studies discipline is minimal at best. Rather than discussing ANT explicitly, many rhetoric of science publications only reference ANT in passing, if it is mentioned at all.¹⁶ This article seeks to explicitly engage actor-network theory to further understand the use of rhetoric in scientific controversies. This engagement has the rhetorical figure of an antimetabole at its core; while ANT scholars borrowed from rhetorical theory to understand the internal workings of science, I will borrow from the works of ANT scholars to further scholarly understanding of rhetorical theory. Although a number of scholars outside of Communication Studies have used and contributed to ANT in some form, three individuals dominate much of the ANT literature: Bruno Latour, Michel Callon, and John Law.¹⁷ In what follows, I sift through the STS literature to offer an explanation of the key concepts associated with ANT that should be of interest to communication scholars. This is not to say that ANT is a monolithic theory. On the contrary, given the diversity of positions taken on ANT, I offer this explanation as one possible assemblage of how ANT concepts may be appropriated by rhetorical scholars.¹⁸

Bruno Latour's approach to science is so innovative because of his insistence on abandoning all *a priori* assumptions about how science worked in favor of an approach that attempted to study what it was scientists did in actual practice. For Latour, science does not progress in a linear fashion with knowledge incrementally building on previous discoveries. In a sense, Latour advances a post-Kuhnian understanding of science; one where scientific shifts can be analyzed without subscribing to a predetermined view of scientific action.¹⁹ Looking to scientific controversies, Latour argues competing scientists attempt to convince audiences that their particular theory is better than others' through the use of rhetoric, laboratories, and scientific "black boxes."²⁰ Following Latour's lead, Robert W. Smith and Joseph N. Tatarewicz clarify how the concept of a black box has been understood within science studies by calling it "a technical artifact" that is often used for a specific scientific function without an awareness of the artifact's internal workings.²¹ The inputs and outputs of the box are known, but the processes used to arrive at those outputs are often taken for granted.²² Yuval P. Yonay further explains that black boxes are not necessarily restricted to physical artifacts or technologies; instead, black boxes consist of "knowledge which is accepted and used on a regular basis as a matter of fact."²³ Yonay also notes that "the process of making a black box does not require consensus of opinion."²⁴ For example, a newly created computer program could become a scientific black box if it is used within one community despite its rejection by another. The very idea of whether or not an object is a black box at all can be the focus of the scientific controversy. The hockey-stick graph in the MBH98 article can be understood as an "inscription" that has been produced by a sociotechnical assemblage of black boxes.

According to Latour, simply having a black box to produce a few “inscriptions” is not enough to demonstrate any one scientific theory is better than another. After all, a black box and its inscriptions might not be accepted by everyone involved in the given controversy. Instead, scientists advocating a particular theory must engage their competitors in a “trial of strength” where each side marshals black boxes and their inscriptions, accepted and not, to convince others.²⁵ It is only after a particular theory has emerged victorious in this agonistic process against its competitors that it becomes reality and knowledge. Thus, according to Latour, “If, in a given situation, no dissenter is able to modify the shape of a new object, then that’s it, it *is* reality, at least for as long as the trials of strength are not modified.”²⁶ This newly established knowledge then must resist future challenges if it is to maintain its privileged position.

The actual process of overcoming one’s competitors in a trial of strength not only involves the appropriation of black boxes and inscriptions one has already established and used but it also includes the recruitment of “allies” to form a “network” of “nodes” that supports a specific scientific understanding, an alliance of supporters. Although Latour considers black boxes and inscriptions kinds of allies, allies also include other scientists and understandings. Recruitment of allies allows competing scientists to “harden their cases and make them more defensible,” where allies are seen as “anything that bears upon the strength of the contribution in question.”²⁷ The roles allies play in a network is explained by Latour: “The word network indicates that resources are concentrated in a few places—the knots and nodes—which are connected with one-another—the links and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere.”²⁸ However, networks are not always easily identifiable assemblages. According to Callon and Law:

Entities—human, non-human, and textual—aren’t solid. They aren’t discrete or clearly separated from their context. They don’t have well-established boundaries. They aren’t, as the jargon puts it, distinct subjects and objects. Instead, they are sets of relations, for instance in the form of networks. And they are co-extensive with those networks.²⁹

Thus, people, machines, and texts constitute and are constituted by a “heterogeneous network” of allies.³⁰

Simply having a network of actors supporting a scientist’s specific theory or claim is not enough to guarantee success in a trial of strength. These actors must also be introduced into discourse when attempting to persuade others. However, because scientific networks are often so large that having each actor speak on his or her own behalf, or having machines reproduce all of the inscriptions used to make one’s case, is often difficult if not impossible, Latour has noted the necessity of scientists to engage in “translation.” John Law has even gone so far as to suggest ANT is also known as the “sociology of translation.”³¹ By translation, ANT scholars are referring to “the interpretation given by the fact-builders of their interests and that of the people they enroll” in support of their specific claims.³² This “enrollment” is the

way actors take on “the task of speaking in the name of other entities.”³³ In other words, rhetoricians might view this act of translation as a way of invoking rhetorical fragments or another’s voice in one’s own rhetoric. This is similar to Michael Calvin McGee’s observation about “textual fragments” as rhetorical discourse.³⁴ Studies in environmental communication have noted the way scientific information has been translated to serve moral and/or theological ends, especially within the genre of the rhetorical jeremiad.³⁵ But this does not mean environmental translations must be limited to this particular rhetorical form. Translations are as flexible as humans are creative.

At this point it should be clear why studies using ANT are relevant to the work of rhetoricians: ANT scholars articulate an understanding of how science works that acknowledges and embraces the role rhetoric plays in scientific controversies and practices. ANT views texts as made up of fragments always connected to their previous contexts, even if only by a trace. ANT thus provides a critical perspective that moves beyond the traditional “close reading” approaches used in rhetorical criticism and environmental communication research.³⁶ In other words, ANT critics use what Leah Ceccarelli calls a “close textual-intertextual analysis” and more.³⁷ This is not to say close readings are not worth doing. On this point I must be clear: This article does not claim to have found the single, best way to study scientific controversies or rhetorical practice. This article does, however, use ANT to emphasize a different perspective for analyzing the way texts, contexts, and material are put into *relationships* with one another. ANT is concerned with the myriad of relationships that exist within scientific controversies. ANT allows rhetoricians an approach that takes into account the complexity involved in the scientific enterprise, especially in an age of Big Science and complex environmental problems such as global climate change.³⁸ I will now turn to the hearing convened by Joseph Barton to illustrate how ANT can be used as a critical framework to illuminate pressing problems in climate change communication.

Rhetorical Actor-Networks Go to Washington

Viewing the MBH98/Barton hearing through a lens informed by actor-network analysis of science explains the alleged “witch hunt” in terms that dig below the surface of political posturing. Although the witnesses and politicians involved in the July hockey stick hearing may not have been explicitly aware of actor-network theory, their arguments can nonetheless be understood from this perspective. Articulating the controversy in language familiar to actor-network scholars can guide our rhetorical investigation. However, before analyzing the texts, a few contextual comments are in order.

The initial hearing dedicated to “investigating” the MBH98 study was scheduled to take place on July 19, 2006, before the Committee on Energy and Commerce’s Subcommittee on Oversight and Investigations. At the request of Representative Barton, Dr. Edward J. Wegman of George Mason University and Dr. Gerald R. North of Texas A&M University were asked to evaluate the MBH98 article in light of the

M&M critique. Trained as statisticians, Wegman and North were the first two members of the panel to testify. Although they did note there was some merit to the M&M critique, they did not go so far as to say climate change was not a reality. In addition to Wegman and North, Dr. Thomas R. Karl of the National Oceanic and Atmospheric Administration, Dr. Thomas J. Crowley of Duke University, and Dr. Hans van Storch of the GKSS Research Center were also asked to testify about the state of climate change knowledge, the IPCC process, and their understanding of what the hockey-stick article contributed to climate change discussions. Finally, Stephen McIntyre was also invited to testify about the M&M critique. Although Michael Mann was invited to testify, he was unable to attend the July 19 hearing. At Dr. Mann's request, Dr. Crowley testified in his place. As we shall see, the July 19 hearing was not exclusively about the MBH98 study or the M&M critique. Instead, much of the testimony focused on the larger argument about global climate change—attempts to invoke the larger actor-network to defend one important node.

Although Dr. Mann did not testify on July 19, he did testify at the second hearing held on July 27, 2006, a date more amenable to his schedule. Dr. Wegman and Mr. McIntyre were invited to testify a second time. In addition, Dr. Ralph J. Cicerone, President of the National Academy of Sciences, Dr. Jay Gulledge of the Pew Center for Climate Research, and well-known climate change skeptic Dr. John R. Christy of the University of Alabama at Huntsville were also asked to testify. Despite Mann's attendance, this hearing also had the larger climate change arguments as its primary focus. As expected, each of the hearings also followed a standard order: First, representatives offered their opening comments; second, witnesses testified; and finally, time was set aside for question-and-answer sessions.³⁹

Controversy over the inscriptions and black box nature of science saturated the July 19 hearing from the start. After Representative Ed Whitfield (R-KY), chairman of the subcommittee, attempted to put the MBH98 study in its proper context by noting how Al Gore's movie and the IPCC report had drawn public attention to the issue of global climate change, he noted what he and Barton had in mind for the outcome of the hearing: "But as I said, the real purpose of this hearing is, let us just open the book. Let us look at everything. Let us look at the criticisms of all parties and see exactly where we are on this important issue of global climate change."⁴⁰ This different articulation of a metaphoric vehicle, from a scientific box to an accounting-oriented book, does not detract from the action desired, an attempt to "open" the otherwise "closed" object of science. It is this attempt to reveal the procedures of the wizard-scientist behind the curtain that animates Barton's investigation. However, Barton's desire to open the black box that produced the hockey-stick inscription for the alleged purpose of scientific transparency in a democratic society confronted by environmental threats is not what concerned observers found objectionable. Instead, observers were aware of the possibility that claims of being concerned with transparency could be used as a smokescreen for Barton's real purpose, an attempt to undermine claims for the existence of global warming. According to Representative Tammy Baldwin (D-WI), "These people have a plan. They want this hearing to stand for the proposition that there is not a consensus

on global warming and they have stalled action for a decade or two and they think they can drag it out even longer.”⁴¹ During one question-and-answer period, Representative Jay Inslee (D-WA) noted that Dr. Wegman was being asked to testify “to try to win a debate with some industries in this country who are afraid to look forward to a new energy future for this Nation, and the reason you are here is to try to create doubt.”⁴² In other words, the potential use of the hearing as a representative symbol of all that is wrong with climate science was seen by many as a trial of strength.

That the hearings were perceived as a trial of strength can be seen in the statements of those involved in the hearing process. For example, Representative Henry Waxman (D-CA) said he was “concerned that some are going to hear about Dr. Wegman’s statistical criticism of the early Mann study and somehow conclude that global warming is still an open question.”⁴³ However, the hearing was not confined to questions about the statistics in the MBH98 study. At stake was the larger environmental question of whether or not global warming was happening: According to Representative Charles Bass (R-NH), “Ultimately, the issue underlying the hearing today and any others that we have is not going to be about math, it is going to be about the effect of the extraction of enormous quantities of hydrocarbons from the middle of the Earth and from underground and the combustion of those hydrocarbons and the resultant impact that that has, if any, on the climate of the world.”⁴⁴ Many of the participants knew the stakes were high.

If the hockey-stick article represents one rhetorical node in the actor-network assemblage of climate change science, MBH98 advocates often invoked the strength of the network as an inventional resource of defense during the July 19 hearing. Seeing the node as a synecdoche of the entire network, they used the entire network to defend the node; they engaged in an act of translation. Representative Bart Stupak (D-MD) defended the MBH98 study on the grounds that “the field of large-scale temperature reconstruction has advanced since that time.”⁴⁵ In other words, the network had expanded to strengthen the single node that was being questioned. Representative Inslee commented, “[W]hat we will find is that every single study ever that has looked at proxy data for temperature has indicated we are in a unique circumstance and carbon dioxide is going through the roof.”⁴⁶ The collection of proxy nodes are all on the side of the network, according to this translation. Representative Baldwin pointed to the conclusions of a number of studies and empirical observations: “The truth is alarming. Sea levels are rising. Glaciers are melting and storms are becoming more intense, and the result is the near extinction of animals such as polar bears, the compromising of coastal ecosystems, and the threatening of human life as heat waves become prevalent and disease-carrying insects grow more abundant.”⁴⁷ What is worth noting from these excerpts is that the MBH98 study never discusses any of the topics mentioned above. In fact, MBH98 could not have addressed many of these studies, as they followed its publication. All of the items that were part of the climate change actor-network not mentioned in the MBH98 study were simply used as a defensive “circling of the wagons” against the skeptics’ attacks.

In addition to the policy makers, the scientists who were testifying likewise invoked the entire network to defend the MBH98 study. Dr. Karl noted that the MBH98 study had been verified by “a completely independent data set.”⁴⁸ Dr. Crowley testified that he examined the MBH98 hockey-stick inscription and concurred with the author’s findings after he “deliberately took a very different approach.” For Crowley, the MBH98 study appeared to be “robust in terms of its pattern.”⁴⁹ Dr. North summarized the point—despite his critique of the MBH98 study—in his testimony: “Surface temperature reconstructions are only one of many lines of evidence supporting the conclusion that the climate is warming in response to human activities. These long records give context and perspective to the issue but they are not the primary evidence. In fact, human-induced climate change is quite real.”⁵⁰ Indeed, an entire network of evidence concurred with the conclusions found in the MBH98 node.

The rhetorical use of an existing actor-network did not go completely unnoticed by skeptics and statistical challengers. For example, Dr. Wegman began wondering about the “apparent isolation” of the MBH98 study. Thus, Wegman and his team attempted to understand the paleoclimate community “by exploring the social network of authorships in the temperature reconstruction area.”⁵¹ Their finding suggested that “authors in this area of the relatively narrow field of paleoclimate studies are closely connected. Dr. Mann has an unusually large reach in terms of influence.”⁵² In other words, Mann’s work in many ways functioned as what Callon would call an “obligatory passage point” in the network.⁵³ Wegman suggested that “it would be naive to think that there are not competing social networks within a discipline area.”⁵⁴ North drew a similar conclusion: “This is pretty competitive business, and I will tell you, if somebody can find a way to knock down someone else’s theory, that is their road to recognition and fame. We all do that. That is part of the game and we really enjoy that part of the game.”⁵⁵ Policy makers like Representative Marsha Blackburn (R-TN) also began reflecting on Wegman’s observations: “These revelations point to the lack of independent peer review and how it is practically impossible to replicate or verify Dr. Mann’s work by those not affiliated with the network of scientists.”⁵⁶ However, this awareness of the network was narrowly focused on paleoclimate studies. Even McIntyre was forced to engage only proxy-oriented studies.⁵⁷ Thus, critics only addressed a specific subset of nodes available to MBH98 defenders. Indeed, part of what makes responding to an entire network as large as one involving climate change studies so difficult is the breadth of nodes that have to be engaged.

Although the entire climate change actor-network was referenced in some way or another as a defense of the MBH98 study, a counter-actor-network was being invoked by skeptics during the July 19 hearing. Barton references Wegman’s criticism of the MBH98 study and the M&M critique. Challengers also attempted to enroll allies by referencing black boxes that allegedly supported their cause, another act of translation. For example, Representative Blackburn discussed studies about “solar activity” and translated “satellite data” to argue warming was due to “the 1998 El Nino.”⁵⁸ Mr. McIntyre also attempted to use Dr. Wegman’s report to bolster his claims against

the MBH98 study, despite Dr. Wegman's ultimate conclusion that global climate change was a real phenomenon.⁵⁹ Given the competing networks, it is not surprising that Dr. Wegman noted there are "two networks that are trying to promote different agendas."⁶⁰ However, the presence of the counternetwork was not nearly as robust as its competitor. For example, in a question-and-answer period between Representative Barton and Mr. McIntyre, it is clear that those in the counternetwork found it difficult to advance their case because so few allies were associated with their cause:

REP. BARTON: Let me ask you something, Mr. McIntyre. Since you had the gump-tion to criticize Dr. Mann, how have you been received in this community? Are people patting you on the back and inviting you to their Christmas party and saying right on, way to go, we really appreciate it, or are they kind of giving you the cold shoulder and ask why the hell you did what you did?

MR. MCINTYRE: I would say cold shoulder would be overstating the friendliness of it. I would say that I have been reviled and . . .

REP. BARTON: And so your skepticism for scientific truth has not been welcomed with open arms. Is that a fair statement?

MR. MCINTYRE: I would say it has been an uphill fight. Having said that one finds certain allies and certain moments of comfort.⁶¹

Despite their attempts to enroll allies into their counternetwork, skeptics found themselves at a significant disadvantage. However, the conversation above could be read as an attempt to elicit a feeling of sympathy for McIntyre as an unaccepted outsider who is just trying to do what he believes is right. With only a handful of allies to provide "moments of comfort," even McIntyre realizes his counternetwork will have difficulty denying the network of nodes connected by his opponents.

Although critics referenced a counter-actor-network, this was a minor strategy compared to their attempts to limit the hearing to concerns related to the single MBH98 node of the network, a clear, yet unsuccessful, attempt to remove the power of the entire actor-network from informing the deliberative process. Take the example of Representative Michael Burgess (R-TX): "What we are here today to discuss is the broader issue of the use of sound statistical analysis and the peer review process through the lens of the hockey stick temperature studies, but the focus of our hearing today is to examine the statistical analysis and methodology used when evaluating the influential report on global warming written by Dr. Mann."⁶² Notice the symbolic reversal that takes place in this quotation. While MBH98 defenders wish the debate to focus on the "broader issue" of climate change's existence, Burgess wants the hearing to focus on the "broader issue" of the use of statistics in Dr. Mann's work. The first interpretation enables the use of the entire global climate change actor-network as a means of defense. The second interpretation rules out any reference to climate change actor-networks. This second interpretation also allowed MBH98 defenders to emerge as victors in Barton's trial of strength. How can the hockey-stick study be a general symbol of all that is wrong in climate change science if critics simultaneously situate their objections to the hockey stick in terms of a specific statistical critique? After all, not all climate change studies deal with these

specific statistical procedures. A rhetoric that uses one node as representative of a problem ubiquitous to an entire actor-network cannot simultaneously separate that symbol from the network to prevent its defenders from invoking other nodes. However, this contradictory rhetorical position did little to keep MBH98 defenders from framing the controversy in the broader terms of global climate change's existence, thereby allowing for the introduction of an array of actor-network support. That the strategy of MBH98 defenders was successful is evident in the adjustments that were made by challengers during the July 27 hearing.

MBH98 challengers were well aware of the strategy used by defenders during the July 19 hearing. Representative Barton noted, "It is clear from last week's hearing on global climate temperature studies that we face issues involving more than the particulars of Dr. Mann's specific hockey stick study."⁶³ To many MBH98 defenders, it even appeared that many of the July 27 witnesses were being brought in to challenge the climate change network as a whole rather than investigate the MBH98 study. Representative Stupak noted, "[I]t appears that these critics have lost interest in simply attacking Dr. Mann's work. Now the purpose of today's hearing is to cast doubt on all scientific evidence of global warming."⁶⁴ Challengers quickly corrected the paradoxical position they created for themselves in the last hearing. They realized that using the MBH98 study as a synecdoche was an unsuccessful strategy when confronted by the full weight of the updated network.

Many policy makers who believed climate change was a real phenomenon chose to continue their defense of the MBH98 study by invoking other nodes in the network. Representative Waxman argued "latter studies, as well as many independent paleoclimate reconstructions by other scientists" came to the same conclusions as the MBH98 study.⁶⁵ Representative Inslee insisted on addressing ice cores studies that were "independent of Dr. Mann's research."⁶⁶ Policy makers who believed climate change was real did little to alter their strategy in the second hearing.

Although the witnesses in the first hearing also referenced other nodes in the climate change network, there was a significant amount of discussion focused on the MBH98 procedures. The second hearing shifted away from focusing on the details of the MBH98 study. Instead, larger questions about the network as a whole were engaged almost exclusively. Mann himself continued to use newer and independent studies—other nodes in the network—to defend his work: "My research in this field, not just the initial work that my colleagues and I published in the late 1990s, but my recent research as well suggests late 20th Century Northern Hemisphere average temperatures are unprecedented over at least the past 1,000 years."⁶⁷ Mann was clear in noting that their conclusion was "not based on single studies or isolated research but is confirmed by many studies using different sets of data and independent statistical methods."⁶⁸ Mann even went so far as to claim:

Every climate scientist who has performed a detailed reconstruction of the climate of the past 1,000 years using different proxy data and different statistical methods has come up with the same basic hockey stick pattern, that is to say a reconstruction that agrees with our original reconstruction within its estimated uncertainties.⁶⁹

What mattered for Mann was not so much the details of the procedures he and his colleagues used in the original studies but the overall strength of the claim they were attempting to advance. For Mann, newer studies, procedures, and data sets were sufficient reasons to believe the initial claims of the MBH98 study.

Other scientists testifying during the second hearing also shifted their focus away from the MBH98 study to questions of whether or not the entire network could be challenged. Dr. Christy, for example, did not address the MBH98 study at all. Instead, he chose to engage climate change issues that had very little to do with proxy studies. Dr. Gullede also ignored the details of the MBH98 study. Cicerone ignored the MBH98 study in favor of emphasizing the claim that global climate change is real by turning to “weather station records and ship-based observations” and “decreases in Arctic sea ice thickness.”⁷⁰ The debate over the MBH98 study had completely shifted during the second hearing. The details of the node had become secondary to the robustness of the network, thus allowing the MBH98 study to survive its trial of strength.

Conclusion

In this article, I used a critical approach informed by Actor-Network Theory to analyze climate change rhetoric relevant to the MBH98/Barton hearings of 2006. This case study offers important lessons for scholars interested in climate change communication and the rhetoric of science.

In terms of climate change communication, this analysis has revealed how those who believed in climate change successfully defended their position when one key node of their network was attacked. By rhetorically invoking other nodes in the network to support the single node that was attacked, global warming believers were able to use the weight of the entire network as a potent intentional resource. In other words, the allies in the network were translated and enrolled to defend the single node in Barton’s challenge for a trial of strength. Scientists, environmental activists, and policy makers who believe climate change must be addressed should take note of the arguments used during this hearing. As future debates over climate change issues continue to surface, which is almost certainly going to be the case given the most recent IPCC reports, advocates should be cognizant of the strategies used by MBH98 defenders.⁷¹ When important nodes are attacked, MBH98 proponents successfully invoked the entire network in their defense. However, skeptics should also pay attention to the strategic choices made by those challenging the MBH98 article. When confronted by a robust actor-network opposing their position, they simultaneously attempted to invoke a counternetwork while also isolating the node in question. As the MBH98 case illustrates, using both strategies proved to be an unfruitful endeavor. This is not to say that we can arrive at any clear “laws” about scientific rhetoric, but it is to suggest that when it comes to rhetorical practice, this case study has shed light on the range of strategies available to various stakeholders involved in the battle over the construction of scientific reality, a battle that we must remember is one of the most important “morally compulsory” battles of our time.⁷²

Scholars interested in rhetoric of science will also find this case study worthy of attention. The use of ANT as a framework for rhetorical criticism in this article certainly builds additional bridges between the work of Science Studies scholars and rhetoricians. However, there is still much to be done. Even in this one case, I have only examined the way one node of a network was defended by invoking other nodes of the network. What I have not explored was the outcome of scientific controversies that are based on choosing a winner between two or more competing networks. With the global climate change debate, this is a real possibility that should be explored in future applications of this network-oriented approach. What are the rhetorical implications of scientific actor-networks engaging economic actor-networks in a trial of strength over global climate change policy? This is a possibility that could not be explored given the textual evidence of the hearings used in this essay, but nonetheless is a question worth exploring in further detail.

As we further understand rhetorical “trials of strength,” we should also be aware of the long-term implications of this approach. We must remember that incorporating ANT into rhetorical studies is not a matter of explaining scientific controversies with the language of scientific populism. After all, many climate change scientists believe their statements are one of many ways diverse audiences can come to understand the constitutive components of material reality. Nor does this approach wish to reduce rhetoric to being “mere” rhetoric, a means of transmission for “stuff that really matters.” An approach to criticism that takes ANT scholars seriously is one that addresses the very issues that concern science communication scholars the most: What is the relationship between science and rhetoric? How are science and rhetoric used in the public sphere? How do we govern given our epistemological and ontological constraints? ANT offers rhetorical scholars another way to think about answers to these questions and speaks to the very idea of what it means to critically address the intersections of rhetoric, science, and politics. It is my sincere hope that this article acts as an important contribution to an academic conversation that is already underway, but far from finished.

Notes

- [1] Michael Mann, Raymond S. Bradley, and Malcolm K. Hughes, “Global-Scale Temperature Patterns and Climate Forcing over the Past Six Centuries,” *Nature* 392 (1998): 779–787.
- [2] Recent investigations concerning what constitutes a “hard science” have suggested that the use of charts, figures, and graphs are one common and essential way scientists make information concise, mobile, and persuasive. See Laurence D. Smith, Lisa A. Best, D. Alan Stubbs, John Johnson, and Andrea Bastiani Archibald, “Scientific Graphs and the Hierarchy of the Sciences: A Latourian Survey of Inscription Practices,” *Social Studies of Science* 30 (2000): 73–94.
- [3] Tom Avril, “A ‘Hockey Stick’ Graph Starts Fight; A Scientist Soon to join Penn State Found a Spike in 20th-Century Temperatures that is Central to a Debate over Academic Freedom,” *Philadelphia Inquirer*, July 30, 2005, A1.
- [4] David Ignatious, “A Bid to Chill Thinking; Behind Joe Barton’s Assault on Climate Scientists,” *The Washington Post*, July 22, 2005, A23.

- [5] Stephen McIntyre and Ross McKittrick, "Corrections to the Mann et al. (1998) Proxy Data Base and Northern Hemispheric Average Temperature Series," *Energy & Environment* 14 (2003): 751–771. Mann, Bradley, and Hughes responded to the M&M critique by correcting "several errors" but still insisted that "none of the errors affect our previously published results." Michael E. Mann, Raymond S. Bradley, and Malcolm K. Hughes, "Global-Scale Temperature Patterns and Climate Forcing over the Past Six Centuries," *Nature* 430 (2004): 105. McIntyre and McKittrick later extended their critique. See Stephen McIntyre and Ross McKittrick, "The M&M Critique of the MBH98 Northern Hemisphere Climate Index: Update and Implications," *Energy & Environment* 16 (2005): 69–100; Stephen McIntyre and Ross McKittrick, "Hockey Sticks, Principal Components, and Spurious Significance," *Geophysical Research Letters* 32 (2005): L03710.
- [6] Ignatious, "A Bid to Chill," A23.
- [7] Paul Brown, "Republicans Accused of Witch-Hunt Against Climate Change Scientists," *The Guardian*, August 30, 2005, 11.
- [8] Juliet Eilperin, "GOP Chairmen Face Off on Global Warming; Public Tiff over Probe of Study Highlights Divide on Issue," *The Washington Post*, July 18, 2005, A4; Andrew Revkin, "Two G.O.P. Lawmakers Spar over Climate Study," *The New York Times*, July 18, 2005, 14.
- [9] Brown, "Republicans Accused of Witch-Hunt," 11.
- [10] Eilperin, "GOP Chairmen Face Off," A4.
- [11] Brown, "Republicans Accused of Witch-Hunt," 11.
- [12] Dan Vergano, "Global Warming Roils Congress," *USA Today*, July 18, 2005, 7D.
- [13] G. Thomas Goodnight, "The Personal, Technical, and Public Spheres of Argument: A Speculative Inquiry into the Art of Deliberation," *Journal of the American Forensic Association* 18 (1982): 214–227; Thomas B. Farrell and G. Thomas Goodnight, "Accidental Rhetoric: The Root Metaphors of Three Mile Island," *Communication Monographs* 48 (1981): 271–300; David Zarefsky, "The Decline of Public Debate," *USA Today*, March 1998, 56–58.
- [14] For a canonical example of how actor-networks are referenced in science studies, see Bruno Latour, *Science in Action* (Cambridge, MA: Harvard University Press, 1997), 180.
- [15] Latour, *Science in Action*, 78.
- [16] Examples of articles and book chapters that mention ANT-related concepts in passing include Chantal Benoit-Barne, "Socio-Technical Deliberation about Free and Open Source Software: Accounting for the Status of Artifacts in Public Life," *Quarterly Journal of Speech* 93 (2007): 211–235; Darin J. Arsenault, Laurence D. Smith, and Edith A. Beauchamp, "Visual Inscription in the Scientific Hierarchy: Mapping the 'Treasures of Science,'" *Science Communication* 27 (2006): 376–428; Kenneth J. Gergen, "The Checkmate of Rhetoric (But Can Our Reasons Be Causes?)," in *The Rhetorical Turn: Invention and Persuasion in the Conduct of Inquiry*, ed. Herbert W. Simons, 293 (Chicago, IL: University of Chicago Press, 1990); Richard Harvey Brown, "Reason as Rhetorical: On Relations Among Epistemology, Discourse, and Practice," in *The Rhetoric of the Human Science*, eds. John S. Nelson, Allan Megill, and Donald N. McCloskey, 188 (Madison, WI: University of Wisconsin Press, 1987); Alan G. Gross briefly mentions Latour in his earlier rhetoric of science work, but only enough to dismiss him. See Alan G. Gross, *The Rhetoric of Science* (Cambridge, MA: Harvard University Press, 1996), 140–141; Alan G. Gross, "The Origin of Species: Evolutionary Taxonomy as an Example of the Rhetoric of Science," in *The Rhetorical Turn: Invention and Persuasion in the Conduct of Inquiry*, ed. Herbert W. Simons, 91 (Chicago, IL: University of Chicago Press, 1990). In his later work, Gross does not mention ANT scholars at all, despite writing about compatibility between sociology and rhetoric. See Alan G. Gross, *Starring the Text: The Place of Rhetoric in Science Studies* (Carbondale, IL: Southern Illinois University Press, 2006). A notable exception to omitting ANT from rhetorical studies is found in William J. Kinsella, "A 'Fusion' of Interests: Big Science, Government, and Rhetorical Practice in Nuclear Fusion Research," *Rhetoric Society Quarterly* 26 (1996): 65–81.

- [17] In addition to Latour's *Science in Action*, see Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (New York: Oxford University Press, 2007); Bruno Latour. "Drawing Things Together," in *Representation in Scientific Practice*, eds. Michael Lynch and Steve Woolgar, 19–68 (Cambridge, MA: The MIT Press, 1990). See also Michel Callon and John Law, "On Interests and Their Transformation: Enrolment and Counter-Enrolment," *Social Studies of Science* 12 (1982): 615–625; Michel Callon and John Law, "After the Individual in Society: Lessons on Collectivity from Science, Technology, and Society," *Canadian Journal of Sociology* 22 (1997): 165–182; John Law and R. J. Williams. "Putting Facts Together: A Study of Scientific Persuasion," *Social Studies of Science* 12 (1982): 535–558; John Law and John Hassard, eds. *Actor Network Theory and After* (Malden, MA: Blackwell Publishing, 2007). For examples of how Latour, Callon, and Law have been embraced by Science Studies scholars, see Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39," *Social Studies of Science* 19 (1989): 387–420; Mike Dent, "Managing Doctors and Saving a Hospital: Irony, Rhetoric, and Actor Networks," *Organization* 10 (2003): 107–127. See also the special issue of *Organization* introduced by Hassard, Law, and Lee. John Hassard, John Law, and Nick Lee, "Preface," *Organization* 6 (1999): 387–390.
- [18] For articles that problematize the traditional view of ANT, see Frederic Vandenberghe, "Reconstructing Humans: A Humanist Critique of Actor-Network Theory," *Theory, Culture & Society* 19 (2002): 51–67; Daniel Neyland, "Dismissed Content and Discontent: An Analysis of the Strategic Aspects of Actor-Network Theory," *Science, Technology, & Human Values* 31 (2006): 29–51. Latour has also noted that ANT is not a finished project. Bruno Latour, "On Recalling ANT," in *Actor Network Theory and After*, eds. John Law and John Hassard, 15–25 (Malden, MA: Blackwell Publishing, 2007).
- [19] Although actor-network theory and Kuhnian concepts have similarities, ANT offers a more detailed explanation of scientific transitions. Kuhn's understanding involves the use of "normal science" in one paradigm eventually giving way to another paradigm because of "anomalies" within scientific practice. My concern in this article is with ANT as a critical tool, not with the distinctions between Kuhnian and Latourian conceptions of how science works. See Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, IL: University of Chicago Press, 1996).
- [20] Latour, *Science in Action*, 2–3.
- [21] Robert W. Smith and Joseph N. Tatarewicz Smith, "Counting on Invention: Devices and Black Boxes in Very Big Science," *Osiris* 9 (1994): 102.
- [22] Trevor Pinch. "Opening Black Boxes: Science, Technology, and Society," *Social Studies of Science* 22 (1992): 487–510.
- [23] Yuval P. Yonay, "When Black Boxes Clash: Competing Ideas of What Science is in Economics, 1924–39," *Social Studies of Science* 24 (1994): 41.
- [24] *Ibid.*, 42.
- [25] Latour, *Science in Action*, 78.
- [26] *Ibid.*, 93.
- [27] Yonay, "When Black Boxes Clash," 41.
- [28] Latour, *Science in Action*, 180.
- [29] Callon and Law, "After the Individual," 170.
- [30] John Law, "Notes on the Theory of Actor-Networks: Ordering, Strategy, and Heterogeneity," *Systems Practice* 5 (1992): 380.
- [31] *Ibid.*, 380.
- [32] Latour, *Science in Action*, 108. Callon and Law have also observed translation in written documents when they write translating is a process in which "different claims, substances or processes are equated with one another." His process results in readers becoming

- “provisionally ‘enrolled’ in the scheme of the authors, and fall into line.” See Callon and Law, “On Interests and Their Transformation,” 619.
- [33] Yonay, “When Black Boxes Clash,” 44. In reference to audience adaptation techniques used in written documents such as scientific journal articles, John Law and R. J. Williams also use the word “array” to refer to enrollment attempts. See Law and Williams, “On Interests,” 537.
- [34] Michael Calvin McGee, “Text, Context, and the Fragmentation of Contemporary Culture,” *Western Journal of Speech Communication* 54 (1990): 279.
- [35] John Opie and Norbert Elliot, “Tracking the Elusive Jeremiad: The Rhetorical Character of American Environmental Discourse,” in *The Symbolic Earth: Discourse and Our Creation of the Environment*, ed. James G. Cantrill and Christine L. Oravec, 9–37 (Lexington: University Press of Kentucky, 1996); Dylan Wolfe, “The Ecological Jeremiad, the American Myth, and the Vivid Force of Color in Dr. Seuss’ *The Lorax*,” *Environmental Communication* 2 (2008): 3–24.
- [36] In addition to being generally used by critics, “close reading” or “close textual analysis” approaches are also widely used by environmental communication scholars. For examples, see Laura Johnson, “Environmental Rhetorics of Tempered Apocalypticism in *An Inconvenient Truth*,” *Rhetoric Review* 28 (2009): 29–46; Barbara Willard, “Rhetorical Landscapes as Empistemic: Revisiting Aldo Leopold’s *Sand County Almanac*,” *Environmental Communication* 1 (2007): 218–235; Wolfe, “The Ecological Jeremiad,” 3–24.
- [37] Leah Ceccarelli, *Shaping Science with Rhetoric* (Chicago, IL: University of Chicago Press, 2001), 6.
- [38] For a specific application of how ANT has been applied to questions of Big Science, see William J. Kinsella, “A ‘Fusion’ of Interests: Big Science, Government, and Rhetorical Practice in Nuclear Fusion Research,” *Rhetoric Society Quarterly* 26 (1996): 65–81.
- [39] Much of the literature that addresses hearings and Congressional procedures indicates the MBH98 investigations were at least structurally “standard” with opening statements, witness, and question-and-answer periods. See Roger H. Davidson and Walter J. Oleszek, *Congress and its Members* (Washington, DC: Congressional Quarterly Press, 1981), 220–221; Walter J. Oleszek, *Congressional Procedures and the Policy Process* (Washington, DC: Congressional Quarterly Press, 1978), 66–68.
- [40] House Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, *Questions Surrounding the “Hockey Stick” Temperature Studies: Implications for Climate Change Assessments*, 109th Cong., 2nd sess., July 19, 2006, 3.
- [41] *Ibid.*, 122.
- [42] *Ibid.*, 100.
- [43] *Ibid.*, 67.
- [44] *Ibid.*, 18.
- [45] *Ibid.*, 6.
- [46] *Ibid.*, 12.
- [47] *Ibid.*, 32.
- [48] *Ibid.*, 136.
- [49] *Ibid.*, 135.
- [50] *Ibid.*, 48.
- [51] *Ibid.*, 38.
- [52] *Ibid.*, 38.
- [53] Callon argues some nodes or actors are so important to the network that they are must be engaged before the rest of the network can be encountered. These nodes become critical network channels. Actors will often create these passage points to ensure their indispensability to the network. Sometimes these narrow passages in the network function as a

“funneling” device. See Star and Geisner, “Institutional Ecology,” 390; Callon and Law, “On Interests and Their Transformation,” 619.

- [54] House Subcommittee, *Questions*, 63.
- [55] *Ibid.*, 64.
- [56] *Ibid.*, 34.
- [57] *Ibid.*, 234.
- [58] *Ibid.*, 34.
- [59] *Ibid.*, 235.
- [60] *Ibid.*, 116.
- [61] *Ibid.*, 251.
- [62] *Ibid.*, 23.
- [63] House Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, *Questions Surrounding the “Hockey Stick” Temperature Studies: Implications for Climate Change Assessments*, 109th Cong., 2nd sess., July 27, 2006, 619.
- [64] *Ibid.*, 608.
- [65] *Ibid.*, 622–623.
- [66] *Ibid.*, 633.
- [67] *Ibid.*, 636–637.
- [68] *Ibid.*, 637.
- [69] *Ibid.*, 638.
- [70] *Ibid.*, 670.
- [71] Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report: Summary for Policymakers* (Valencia, Spain: Intergovernmental Panel on Climate Change, 2007).
- [72] Bill McKibben, *The End of Nature* (New York: Doubleday, 1999), xxv.