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Roundtable Review Editor:

Jacob Darwin Hamblin

Jacob Darwin Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (Oxford University Press, 2013). ISBN: 9780199740055

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Introduction by Michael Egan, McMaster University

H-Environment and its readership owe Jacob Hamblin a great debt for his energetic and thoughtful curation of the list's roundtable reviews over the past several years. They are a stimulating boon to the field, and provide a unique venue for engaging with literature and the ideas that drive our collective work. This kind of editorship is often a thankless task, no less when one's own work should be reviewed in this forum. Hamblin was understandably reluctant to include his work in the series, and it took more than a little persuasion (over drinks at the ASEH meeting in Toronto) for him to allow me to guest-edit this edition.

Given the growing interest in the Anthropocene as an organizing tool for reading recent global environmental history, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* warrants our careful consideration. My own growing interest in disaster science and methods of understanding and anticipating environmental vulnerabilities meant I was anxious to study this work. During the Winter 2014, I also had the opportunity to assign *Arming Mother Nature* in an undergraduate course titled "The History of the Future." As Dolly Jørgensen notes in her commentary, *Arming Mother Nature* is a book about imagining. Hamblin's book served the course well and highlighted not just how historical actors acted, but also how they imagined and anticipated future scenarios. Not just what they did, but also what they thought they were doing. Vulnerability, as Hamblin's actors understood it, was a future tense idea, not dissimilar other elements of our current environmental lexicon, such as sustainability and resilience. That the book succeeded in engaging an undergraduate classroom is also, I think, testament to Hamblin's strength as a narrator, and it goes some distance in explaining *Arming Mother Nature's* success in reaching audiences beyond the strictly academic. The book is filled with anecdotal snippets that come together to tell a fascinating story about the emergence of Cold War environmental catastrophism.

Which is to say *Arming Mother Nature* rewards inquiries from a variety of different perspectives. It offers intriguing challenges to and (at the same time) affirmations of James C. Scott's ideas about the state's role in changes in the environment. Scholars wanting to explore questions pertaining to the Anthropocene might also find fuel for discussion. The scales of technological (and imaginative) capacity present in these pages would be an awesome tribute to the power of human ingenuity if it weren't for the devastating means and ends that inspired them. Similarly, Hamblin taps into the expanding literature on militarization and environmental history, and reminds us that war and environment intersect beyond the theatre of battle.

Inasmuch as Hamblin and this book wear multiple intellectual hats, it seemed appropriate to recruit reviewers who represented some coverage of this breadth. Because of her expertise in the history of science and meteorology—not least her current interest in weather control as a state tool—I asked **Kristine Harper** to

provide a commentary from that perspective. **Libby Robin** has been leading a large-scale project on the history of future natures, and I thought the aforementioned connection with past planning and anticipating, especially as it related to global change, warranted some consideration. And **Dolly Jørgensen** has been spearheading new initiatives between environmental history and environmental humanities. Combined with her background in the relationships between environmental history and the history of technology, her perspective on *Arming Mother Nature* allowed for another quite distinct analysis.

Before relinquishing the conch, I should like to echo Hamblin's traditional thanks to the roundtable contributors for their efforts in submitting their reviews (each in an especially timely manner). As ever, *H-Environment Roundtable Reviews* is an open-access forum and is available to scholars and non-scholars alike, around the world, free of charge. Please circulate.

Comments by Kristine C. Harper, Florida State University

In *Arming Mother Nature: The Birth of Catastrophic Environmentalism*, Jake Hamblin attempts to connect scientific and engineering efforts related to weapons development during the Cold War to the emergence of “catastrophic environmentalism”—the idea that humans might be the ultimate cause of horrific natural disasters. In so doing, he makes three arguments: (1) during the Cold War, scientists and military leaders worked together to determine how to exploit natural vulnerabilities and thus manipulate them for the purposes of total warfare, (2) that this ongoing scientific research led people to believe that the control of nature inherent in these efforts was already possible for the US and the USSR, and (3) the Cold War’s geopolitical situation influenced how not only scientists, but economists, and political and military leaders responded to apparent human-induced harm to the natural environment.

Indeed, instead of looking at just one kind of “environmental warfare,” Hamblin considers that any scientific/technological tool that could change the earth on any scale to fit the bill. Consequently, weather, biological, and chemical warfare all fall into this category, since if related techniques actually worked as planned, one might realistically expect that the environment, i.e., people’s living conditions, would change—and not for the better.

His book is divided into three sections. The first focuses primarily on the use of organisms (e.g., bacteria or pathogens harmful to humans, or insects that could strip crops of their foliage) or radiation as a weapon of total war. In this case, if bacteria could be spread successfully, people might be killed immediately, or they might be made so sick that others would need to care for them, thus diverting resources from the war effort. The mechanisms envisioned (and tested) for delivering these organisms included air dropping bird feathers—with or without the birds—to carry rust spores onto fields of grain, or introducing insect pests for which there were no natural defenses. Alternatively, one could skip the pests and just spray defoliants, or perhaps poison the soil with radiation—and make it useless for a longer period of time. In any case, with increasing uses of pesticides and a corresponding decrease in plant diversity, every nation had become more susceptible to just such an attack. Therefore, those who would plan for launching such an attack would also need to be working on how to repel the same. And thus Hamblin makes his point: the same people who were working on the offensive version of the plan would also need to work on the defensive version, whether it was to ward off an enemy’s planned attack or an inadvertent “plague” caused by human actions.

While this section makes an interesting read—who would have thought about packing bird feathers (minus the uncontrollable birds) carrying a grain rust into bundles and then dropping them onto fields?—it is written for those with a biological background. The pathogen and disease names listed on page 44 are offered without explanation (and without a pointer to the table on pages 46 and 47

that provides more information). But even that table uses terms that will likely not be familiar to the average reader of the book. Throughout the section—and the remainder of the book—several paragraphs go by without a citation, which makes it difficult to identify sources for crucial information. Some of the narrative emerges from the correspondence between just two or three people—but their names only appear in the endnotes, and we have no idea who they are or how they came to be involved in these projects. (A wrap-up of this entire section would have been helpful as well.)

Part Two, “Forces of Nature,” focuses on environmental warfare related to the earth sciences, i.e., the deliberate modification of the earth and its oceans and atmosphere for good (the allies) or ill (the enemy). The idea here was to look for natural weaknesses in these systems and then exploit them for the benefit of the manipulating side. However, to find those weaknesses, nations needed to monitor these geophysical systems, gather continuous streams of data, and then analyze them with the aid of computer systems. Once the weakness was identified, then it could be enhanced to create a problem for the enemy. For example, one might seed clouds in a moisture-packed frontal system to increase the rain- or snowfall amounts, bogging down enemy forces or flooding out agricultural or industrial areas. Similarly, one might enhance drought conditions to the detriment of agriculture or reduce hail damage from thunderstorms.

Hamblin argues that because of the need to find these vulnerabilities, the earth needed to be under constant surveillance. In one sense, he is certainly correct: the collection of observational data about the atmosphere, oceans, and earth were necessary for Cold War military uses (weapons systems operate in all of those environments and are affected by them). But these same data were also needed for numerical weather prediction models that were operational in the mid-fifties, and later for oceanographic and earth-systems models as well. While the military services were much enamored of the idea of using the weather as a weapon against enemies or as a diplomatic tool with possible allies as early as the late forties, the everyday problem of predicting the weather for aviation, maritime, and ground-based interests was of critical importance for civilians as well. Environmental control as a defensive or offensive military tool was still, as Hamblin calls it, a “wildcat idea” during the forties, fifties, and into the sixties, while computer-generated predictions were solidly in place even if their skill-level was less than optimal. In any case, the predictions would not improve without significantly more and better data from throughout the world being processed on faster computers capable of handling increasingly sophisticated models that incorporated more variables. Yes, weather satellites were airborne in the early sixties—but those data were not being fed into models, and it would take decades before the eyes-in-the-sky would have sufficiently sensitive sensors for a variety of variables capable of filling in the blanks. For most of military-related meteorology, the push was on for better forecasts over a longer time period that could be tailored to specific missions rather than for weather control.

Discussions of large-scale control of earth systems only comprise a few chapters of the book. Nevertheless, they could have been more effective with the use of more descriptive terms when discussing the people involved, and what they were trying to do. The term “scientist”—often used to introduce authorities—covers a lot of ground. What kinds of scientists were these folks? What kinds of scientists were pushing environmental control and why? Alternatively, what kinds of scientists were opposing environmental control and why were they opposed? When dealing with weather control, the pro-control group did not include many meteorologists outside of Irving Krick and his former Caltech colleagues, who were making a lot of money from cloud seeding for farmers and ranchers in the West. Irving Langmuir (discussed here) was a chemist accustomed to working in a laboratory where he could control all of the variables, and John von Neumann (also discussed) was a mathematician who had a virtual atmosphere in his head and was trying to create a virtual atmosphere in a computer. Most meteorologists were quick to acknowledge that it was possible to control the atmosphere in small areas (e.g., using fans or smudge pots to combat freezing temperatures in an orchard), but they were not going to advocate for controlling precipitation when cloud physics remained an active area of research. Were some military meteorologists working on weather control techniques? Yes, but they were not making much ground until the mid-sixties, and they represented just a handful of the total number of atmospheric scientists working for the armed forces, in and out of uniform. Consequently, this section’s effectiveness was lessened by concentrating on the work of a relatively small number of people among the many types of geophysics specialists who were taking advantage of newly available data from the International Geophysical Year and other international projects of the period that provided access to simultaneous data collection opportunities.

Part III, “Gatekeepers of Nature,” moves the story forward into the 1970s and connects the science of the environmental movement to earlier and ongoing research in the environmental sciences writ large. In much popular literature—and much environmental history work—the environmental movement of the 1960s was given a significant boost by the publication of Rachel Carson’s *Silent Spring* in 1962, and was primarily focused on the biological/ecological portions of the environment. Pesticide use and its impact on all types of life received the primary emphasis in the early sixties. By the first Earth Day in 1970, the impact of industrial and domestic pollutants on rivers, streams, lakes, and their inhabitants had become a major issue. Similarly, worries about a rapidly increasing global population, which had been facing drought-induced and politics-exacerbated food and water shortages during the same period, led many to doubt the long-term future of “Spaceship Earth.”

Hamblin argues that the same scientists who had been conjuring up ways to trigger catastrophes that could potentially wipe a large portion of the earth’s population—or at least our enemies’ populations—were now predicting a more imminent catastrophe brought about by (mostly) inadvertent modifications to the earth system. While people who thought that disposing of nuclear waste in the ocean was a viable idea were not trying to poison the world—and people who saw widespread

use of pesticides as a way to get rid of undesirable critters often failed to consider the loss of more desirable ones which would be equally affected—in many ways humans’ desire to find and deploy technological fixes for whatever ailed them were producing unanticipated results with long-term consequences for the planet’s health. What to do? Attack the problem as if they were on a military mission, the same as they had been doing since the beginning of the Cold War. But not every problem responds to a military-inspired solution, and the increasingly complex problems of the late twentieth century were not going to fall to quick technological fixes. Analyzing global problems from local perches does not generally yield solutions that will be amenable to the whole. And as the Cold War wore on, the environmental changes experienced around the world triggered a variety of finger-pointing reactions as well as high-level international diplomatic efforts that amounted to the participating nations trying to lessen the impact on their populations even while touting the need to work together. As in the previous sections, a lack of sources for numerous paragraphs brimming with critical material, and a lack of detail about the types of scientists involved (and why they were important to the process), weakens the argument. Similarly, Hamblin’s emphasis on Nigel Calder’s edited book *Unless Peace Comes* (1968) seems to be misplaced. While the chapter authors were well-respected scholars, they were not discussing what was possible at the time—but letting their minds spin out all kinds of ideas that had more of a science fiction flavor. I am not sure that those ideas tell us much about mainstream scientific thought at the time, nor about how the average scientist was affected by Cold War geopolitics.

Lastly, based on the archival materials Hamblin used—from the US National Archives, the UK National Archives, and the NATO Archives—I was hoping for a more trans-national approach. Instead, I found a more US-centric approach, with the UK and NATO archives contributing British and NATO assessments of US attempts to control the environment for military purposes. What might a more systematic trans-national approach look like, and what materials might provide the basis for achieving it? I would suggest that archival collections from the US presidential libraries might be a good place to start. Those archives not only yield reports but also memos and other informal correspondence about environmental control that moved between the White House, DoD, the State Department, domestic cabinet secretaries (especially Commerce, Interior, and HEW), and members of Congress—all discussing a variety of concerns about environmental issues and national security. For example, in the Lyndon Baines Johnson archives, the correspondence among LBJ, Walt Rostow, U.S. Ambassador to India Chester Bowles, and the Departments of State and Defense concerning the use of weather control to combat the Bihar drought provide incredible insight into the thought processes behind this decision.¹ When combined with the peer reviewed writings of scientists within and

¹ For example, Walt Rostow to Lyndon Baines Johnson, 29 December 1966, and State Department and Defense Department to Chester Bowles, 29 December 1966, National Security Files, Country File India, Box 131, India Memos and Misc. 1 of 2, Vol. 8, 9/66–2/67, Lyndon Baines Johnson Presidential Library, Austin, Texas.

outside government who were studying both the physical and biological environmental sciences, those sources would provide enough declassified material to support a fairly complete analysis of US diplomatic, defense, and domestic policy vis-à-vis environmental questions. The tricky part would be to get similar documents from other nations, in particular a sample of NATO nations (followed by collections in Australia and New Zealand), and a sample of non-aligned nations. Although it would be delightful to obtain records from the former Soviet Union, that may remain challenging. However, the translated papers of geophysicists and life scientists might at least fill the gap, particularly when combined with pronouncements from government and Communist Party announcements and publications. Indeed, this could be a fascinating study for a multi-national team of historians, economists, political scientists, and scientists intrigued by big picture questions about the Cold War's influence on scientific and technological development in the environmental sciences.

Comments by Libby Robin, ANU/NMA

Arming *Mother Nature* sits at the crossroads between environmental and military history. It is, perhaps, the beginning of a newer genre: a history of the Anthropocene. Most of the action takes place as the Great Acceleration takes off in the 1940s and 1950s. It reminds us how fortunate we have been to survive the Cold War, a war that was so much more than nuclear: it was 'total war', in Hamblin's terms, bringing together the sciences that created biological, toxic, chemical, climatological and other weapons of (civilian) death. Total war was another reason for collaboration between sciences that from the 1960s were known as 'environmental'.

Death might not be so quick as with a bomb or with a direct military strike, but the new environmental warfare had the potential to wipe out civilians, crops and cultures, and to completely incapacitate an enemy. Letting natural processes do deadly work was a dangerous game: it could wipe out humanity. Nevertheless, through arming mother nature, militarism could be taken to a new level, and it could be cost-effective and 'efficient', the leading strategists argued in the so-called 'postwar' years.

One of the strong historical dimensions of the book is the depiction of the state of the world in 1945, following the horrific war that cost 60 million people their lives, including 25 million Soviets, about 14 percent of the Soviet Union's prewar population. The Holocaust's six million was significant because over 60% of these people killed by the Nazis were civilians. In the next decade or so, the years when nuclear research and experimentation was at its most fast and furious, there were many further civilian casualties. Not all the tragedies led to quick deaths: for example, widespread rape in the Soviet Zone of Germany led to a 20-fold rise in syphilis, an order of magnitude greater than elsewhere in Europe. Outbreaks of plague, cholera, typhus, smallpox and dysentery that accompanied post-war migrations left millions more dead or debilitated. The widespread use of DDT to halt malaria sowed the seeds of silent Spring. All around, natural forces (water courses, lice, rats) were carrying destruction. The 1947 Cairo cholera epidemic became a political flashpoint: did the colonial power deliberately spread rampant disease? That debate marked a beginning of the rhetoric of arming mother nature.

The context of a militarized nature and the language of catastrophism became entangled with the new and emerging idea of the environment. Fear of disease led to fear of nature itself – birds could become carriers of rust spores to ruin crops, and of psittacosis and other diseases that harmed humans. This is a book that focuses most strongly on the United States and, to a lesser extent, its allies in the wars since World War II, including Korea and Vietnam where environmental warfare was prominent. Cold War politics exacerbated the use of sciences to build arsenals of 'total war': the scale of the American program was astonishing: 'by the end of the

1950s, scientists at Fort Detrick had screened some 12,000 chemical compounds'...that might become 'techniques and gadgets to employ in US counterinsurgency operations in Vietnam' (p. 181). It is here we see the emergence of the many new minerals and compounds created by humanity since 1950, the 'man-made substances' that are changing the face of the Earth and leaving the sorts of traces that the stratigraphers might use to signify a new geological epoch.

Hamblin himself aims to unpack the ideas that led to humans coming 'to believe they were capable of changing the natural environment on a large scale' (p. 251). He is interested in the catastrophic results of such science, rather than the political power (or problems) of the rhetoric of catastrophism. It will interest historians of science, of the environment and of war. Its central implication will disturb most readers: if we arm mother nature against others, we imperil our own global nest. The plagues of people will backfire on our species, and could ultimately clear the planet for other more resilient life forms. But Hamblin holds a strong historical voice: he is describing what has happened and its context, not prescribing how we should live now in a world changed by this volatile coalition of science, environment and militarism. The book is compellingly written, critically alert and, despite the 'environmentalism' of the title, far from polemical.

Comments by Dolly Jørgensen, Umeå University

When it came time for me as one of the hosts of the interdisciplinary video series Environmental Humanities Book Chat to pick a book for its second installment, I chose *Arming Mother Nature*.² There were two reasons for this choice. First, it had made the 2013 summer reading list of the prestigious journal *Nature*, which I considered quite a coup for environmental history.³ The listing meant that book would have readership beyond disciplinary borders so discussing its wider significance seemed appropriate. Second, while written by a historian, the book offered a look at the discursive rise of a particular brand of environmentalism, which I thought our ecocriticism colleagues in the Book Chat series could also find valuable.

Hamblin has written the book primarily as a history of science, focusing on the activities of scientists and military organizations that worked on biological, chemical, climatological and geological weapons and how they came to understand the vulnerability of man to large-scale anthropogenic environmental changes. What we see through the course of the book is how the scientists and military personnel began to understand nature as a weapon, a defense mechanism, and a monitoring system. In the first part, Hamblin exposes how Mother Nature could be armed through pathogens and pestilences and biological diversity could be a valuable defense in total war. In the second, nature turns from being armed into a method of monitoring arms. The global environmental monitoring that we take for granted in the 21st century is a Cold War product intended to understand earth dynamics in light of nuclear fall out and atmospheric testing. The goal to manipulate and monitor led to synoptic visions of the environment, of viewing the environment as a whole. In the third section, the doomsday scenarios of environmental warfare get incorporated into the burgeoning environmentalist movement. Hamblin presents an enlightening history about the ways in which environmental warfare permeated military thinking, as well as became the foundation of environmentalist discourse.

In essence, this book is about imagining. The men (and they were almost all men) in Hamblin's story were imagining future wars. These were not wars to be fought in a hundred years or two, but ones to be fought within a few decades. Because of their positions in the military-industrial complex, they were able to bring many of those visions to reality. They could rank pathogens for effectiveness and cost efficiency; they could run computer scenarios on deaths from famine or radiation poisoning. Science fiction was not so distant from science fact. As member of the President's Science Advisory Committee Gordon MacDonald wrote, scientists and the military were "slowly overcoming the gap between fact and fiction regarding manipulations of the earth's physical environment" (quoted in Hamblin, 159-160).

² The EH Book Chat is joint effort of the European Society for Environmental History and the European Association for the Studies Literature, Culture and Environment. The video of the chat is available at <http://eseh.org/eh-book-chat-on-jacob-d-hamblins-arming-mother-nature/>

³ David Katz et al. "Summer books," *Nature* 499 (11 July 2013): 150-153.

Despite this being a story of imagining, Hamblin does not use that word. He does not overtly frame his story as one of conflicting sociotechnical imaginaries about environmental war at play in the US, Russia, or elsewhere. Sheila Jasanoff and Sang-Hyun Kim have usefully defined sociotechnical imaginaries as

“instrumental and futuristic: they project visions of what is good, desirable, and worth attaining for a political community; they articulate feasible futures. Conversely, imaginaries also warn against risks or hazards that might accompany innovation if it is pushed too hard or too fast. Inactivating collective consciousness, imaginaries help create the political will or public resolve to attain them.”⁴

This is precisely what is happening in *Arming Mother Nature*: there are visions being created of feasible, desirable futures while risks and hazards are also articulated. The scientists were continuously swinging back and forth between overselling and underselling their capabilities. They claimed to be close to harnessing environmental warfare, but when they were blamed for it, like the case of the Colorado beetle invasion in eastern Europe in 1949-1950, the scientists and military tended to back down.

What I miss in Hamblin’s book is a more overt foregrounding of this collective imagining. W. Patrick McCray’s *The Visioneers* (2012) is an example of how imagining and envisioning can be centered in a similar story of post-WWII scientists, leading to a history that ties together the scientific visions and popular culture. Hamblin only very briefly mentions the interplay of the military and scientific imaginings with popular culture in the case of *Dr. Strangelove* and the *Star Trek* episode “The Doomsday Machine” from 1967 (154-155), yet so much more could have been made out of the bleeding of scientific ideas into popular culture in magazines, film, and television, such as UK television series *Doomwatch* which ran 1970 to 1972. Much more could also have been made of the discursive use of *bomb* in the phrase *population bomb* and its representations in media. Crossing the lines between the scientists and the public is especially important for Hamblin’s ultimate goal, which is to show the origins of the discourse of “catastrophic environmentalism,” which is the primary mode of talking about the environment in the first two decades of the 21st century. This discourse is not something restricted to the military-scientific sphere, but rather a pervasive way of framing environmental issues. A broadening out of Hamblin’s study into cultural aspects would have served to strengthen the argument about catastrophic environmentalism as a framework.

In spite of not being explicitly about imagining, *Arming Mother Nature* explains much about our collective vision of the environment. Although the book only offers hints about how catastrophic environmentalism grew after Nixon’s presidency, this book has much to offer to readers right now. First, it puts the current propensity for

⁴ Sheila Jasanoff and Sang-Hyun Kim, “Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea,” *Minerva* 47 (2009): 119-146, 123.

environmental catastrophic talk into historical perspective. The language of global crisis and environmental apocalypse has specific roots, and it hasn't necessarily proved the most action-oriented framing. The idea of environmental adaptability, which came along with this thinking, has been one of the go-to reasons to do nothing about climate change. Doomsday talk can also make all actions seem hopeless. As Hamblin points out in the conclusion with reference to the Skeptical Environmentalist, "when every problem is treated as a global crisis, real global crises are easily ignored" (250). Second, it effectively reveals the interweaving of environmental knowledge and the US military in the Cold War era—the military personnel were interested in nature because they saw it as the next military theater and a mode to protect the country. Hamblin's story shows that the military has been keenly aware of environmental change in the past. This is incredibly relevant today. The McKinley amendment to the US defense spending bill, which got tacked on in mid-May 2014 by the House of Representatives, would bar the Department of Defense from taking into account the UN's IPCC report and the *National Climate Assessment* in its planning. Nothing could fly in the face of history more. Environmental scenarios have been at the core of military and scientific imagining of the future. I would recommend all of those who voted in favor of the amendment read *Arming Mother Nature*.

Response by Jacob Darwin Hamblin, Oregon State University

Since creating these roundtables a few years ago, I have been honored to facilitate conversations about recent books on environmental topics, and now I'm thrilled to have *Arming Mother Nature* thrown into the mix. I want to thank Michael Egan for offering to guest-edit, and I also want to formally thank Chris Jones, my co-editor, for recently taking over the job of commissioning new roundtables. Further thanks go to Dolly Jørgensen, Kristine Harper, and Libby Robin for their thoughtful comments on my book. I hope my response can extend the conversation about the themes I raised in it.

With *Arming Mother Nature*, I wanted to explore the origins of catastrophic environmental ideas among those who tried to initiate human tragedies on an enormous scale. That meant exploring the collaboration between scientists and the military, and trying to see what influence their work had on environmental ideas. What I ended up with is not a comprehensive study of environmental warfare, but a book-length essay showing how comprehending human vulnerability in one context (preparing for another total war) had an enormous impact on conversations about it in another (environmental issues). The range of responses to this premise among professional reviewers and casual readers has intrigued me—some take it as highly plausible, even a given; some see it as conspiracy theory; some see it as a reason to deny the reality of climate change, or to interpret my agenda as climate change denial; still others are reflexively opposed to it, offended at the notion of tying environmental science to military aims. I can't address all these reactions here, but I'd like to share my brief thoughts on the book's initial reception, to respond to the roundtable comments, and to mention a few of the many aspects of the story that remain to be studied.

In the past year or so, I have had numerous occasions to smack my head when learning an interesting story that might have been included in the book. I console myself in knowing that some readers may already find the range of weapons systems and scientific disciplines dizzying. Planning for a new total war against the Soviet Union legitimized many different paths for research. As Kristine Harper points out in her comments, it may seem like I consider "any scientific/technological tool that could change the earth on any scale to fit the bill." Especially in the late 1940s and early 1950s, the US kept its options wide open in atomic weaponry, biological warfare, radiological warfare, and later with other kinds of manipulation. What united these was not that they were grim weapon systems, or that they could change the earth, but that they seemed like promising ways to achieve the goal of maximizing civilian death by letting nature do most of the work. If there are readers who want a book solely on weather control, exclusively on bio-weapons, only something novel about climate change, or a monograph focusing on crazy plans to melt the polar ice caps, they will be disappointed. The book is less about the weapons *per se*, and more about what motivated them, and how vulnerability to them shaped the way we think about environmental change.

Shortly after publication, *Arming Mother Nature* sprouted its own legs and began running in directions beyond what I had envisioned. I was surprised by the extent of conspiratorial fascination with odd weapon systems. When the *New York Times* invited me to write an op-ed about the book's themes, I focused on vulnerability and biodiversity, and the piece was called "Ecology Lessons from the Cold War." But *Salon* excerpted a chapter and re-titled it "We Tried to Weaponize the Weather," choosing the part of book discussing some of the stranger ideas about environmental warfare. *Salon* included a graphic of a flying saucer! The excerpt subsequently turned up on conspiracy theory websites along with stories about alien sex, covert ops, and government surveillance. I was asked to be a talking head in an episode of a new SyFy Channel program, so that I could entertain audiences by speculating on what the government was doing today to weaponize the natural environment. Then I was invited to appear on *Ancient Aliens*—so that the show could suggest that perhaps aliens possessed nuclear weapons in bygone days. I passed on these—opportunities?—hoping to focus on the book's genuine aims.

My sincere aim was to rethink the historical context for ideas about large-scale environmental change. I respect existing historical work on activism, the history of conservation, and the rise of the environmental movement. I wanted to add to this robust body of scholarship, because I felt that the history of science, and its deep military context, had not yet been translated substantially into histories of environmentalism. From writing my previous books, I knew that many scientists were influenced by military planning and projections, and were porting questions back and forth between military and environmental arenas. I hoped to explore that further. I was fascinated to read up on ecological vulnerability, for example, reading such classic texts as Charles Elton's *Ecology of Invasions by Animals and Plants*, and thinking of it as an agricultural defense text. There were interesting side-stories, such as the deployment of Oxford ecologists into war zones in Southeast Asia, but what I found most compelling was that a strategy for protecting the homeland—maintaining biodiversity—was an irresistible link between surviving a world war and fortifying the natural environment. On a different subject, I explored climate modeling and military defense, recognizing that they weren't merely analogous but instead were directly tied. I was also drawn, with morbid curiosity, to the myriad ideas to use the hydrogen bomb as a scientific tool, to use it as a trigger for much larger-scale geophysical events, and to imagine the widespread effects of fires and radioactive contamination. These are just a few examples of the paths I took. They illustrated an obvious historiographic point: if we want to understand how humans came to imagine that they could alter the earth in dramatic, irreversible, and unpredictable ways on a massive scale, we should study those people who tried to bring about such catastrophes and plan for them.

Dolly Jørgensen has suggested that my book is about imagining, and I think that she is right. It is fair to wonder why I passed up the opportunity to highlight how these ideas, many of them classified or otherwise internal to governments, were represented publicly or in popular culture. After all, she aptly notes, my book is

ultimately about the rise of a very “pervasive way of framing environmental issues,” and this is not limited to scientists and governments. The Japanese film *Godzilla*, which followed the 1954 Bravo shot and *Lucky Dragon* incident, is a classic example of a cultural response to that sense of vulnerability, and I duly note it in the book. But I attempted no thorough analysis of *Godzilla* or any other work that was inspired by the dangers of this perilous era. Although I do include brief discussion of *Star Trek*, *Dr. Strangelove*, *The Andromeda Strain* and *The Stand*, popular works play a relatively minor role in my book. Instead, I saw myself working from the outside toward the inside, trying to get beyond Strangelovian caricatures to understand what scientific, environmental, and strategic issues the war planners themselves thought they were facing. That said, Jørgensen is right to suggest that the popular perception of these ideas is crucial for assessing catastrophic environmentalism as a frame for the world’s challenges.

Although I agree with Jørgensen’s point about engaging popular culture, the concept of sociotechnical imaginaries, as quoted by her, seems to leave my work out in the cold. These imaginaries “project visions of what is good, desirable, and worth attaining,” leaving negative aspects to be relegated to the unpredictable consequences of moving too fast toward the goal. It is hard to apply this definition to the sciences of manipulating nature to kill civilians. One easily could say that my book is really about widespread death—how to achieve it, and how to avoid it. I think the more positive notion of sociotechnical imaginaries might map onto Patrick McCray’s *The Visioneers* (Jørgensen mentions this), a book that follows people who offered what struck them as ways forward. As I have pointed out to McCray in person, I love that *The Visioneers* appeared less than a year before *Arming Mother Nature*. They make a great pairing because one is yin and the other is yang. In my book, the conversations are quite different—they are visions of harm, along with disagreements about human abilities to achieve that outcome, humans’ capacities for adjustment, and the extent of human vulnerability to changes in their environments. Although scientists of various kinds worked on this research, they rarely offered these as desirable visions.

I confess that, especially in early chapters, I had to ratchet back my own instincts to overdramatize events. This is especially true for the Korean War era, when so many accused the United States of waging biological warfare. My research goal for that material was not to try to take a definitive position on whether they had been used, but to clarify what capabilities the United States had, how experts thought about human vulnerability, and what the policy positions about using the weapons were. Regardless of the Korean War case (details are in the book), it is clear that the time-honored enemies of humans and livestock, such as bubonic plague and various fevers, had places in the US arsenal. Kristine Harper notes that this material is perhaps a bit technical at times, requiring some biological background. *Mea culpa*. Imagine how the high-level military officers and the civilian defense secretary must have felt, none of them trained as science Ph.D.s, yet charged with imagining the relative importance of biological weapons vis-à-vis atomic bombs or conventional weapons. I included a table about the pathogens that the Joint Chiefs of Staff found

most promising. Sometimes it is hard to follow what diseases would be outcomes of a particular pathogen, how it could be “weaponized,” and how many casualties would ensue. It is further complicated, in real life, by the suitability of the natural environment and the existence of differential immunity, given prior exposures in different parts of the world. Adding more complexity, the different branches of the military establishment in the United States had divergent views of how effective these weapons could be. That era is a crucial also because the prospect of an attack without a formal declaration of war seemed to make diseases in crops and livestock a real possibility—and the need for strategies of protection all the more clear.

On weather and climate control, Harper is right to say that most meteorologists were interested in collecting ocean and atmospheric data for the purpose of forecasting weather and sea conditions. I doubt Harper and I have a genuine disagreement here. My own past work on oceanography shows the many reasons why marine scientists wanted to collect this data, and Harper’s work on numerical weather prediction is a crucial source for understanding how prediction methods changed over time. Meteorologists in general were more skeptical about claims of weather control than most (the ambitious rain makers often came from outside the field, which Harper notes), and most of them adamantly rejected the idea that extensive nuclear testing had an influence on the weather. What I found interesting was how much this disciplinary skepticism created (hardened?) attitudes by professional meteorologists about long-term change to the atmosphere induced by humans. Time and again while researching the book, it was the professional meteorologists who dismissed the possibility that humans could be altering the earth in a drastic way, seeing changes in chemical composition as a matter of normal seasonal variation. Many of them would carry their skepticism about human impacts into later controversies, including climate change.

Such skepticism extended to other scientists as well. Although working on weapons of environmental manipulation may have opened up doors to understanding environmental change, it also hardened many scientists’ hearts against the possibility of widespread or long-lasting change—because they had tried to do it and failed, either with actual nuclear tests or simply by gaming out scenarios. Although physicists such as Edward Teller and William Nierenberg were part of the NATO groups that explored these bizarre ideas, that does not mean they advocated their usefulness. For example, it was so difficult to imagine humans being able to effectively manipulate a hurricane, even with several multi-megaton weapons, that it was inconceivable to Teller that human activities could have a discernable long-term impact on earth systems. Humans simply were not capable of generating the kinds of energies that were imparted to the earth daily by the sun. In the case of Teller and likeminded experts, the experience of assessing the “wild cat” ideas helped to turn them into climate skeptics.

I was happy to see Harper point out the need for more transnational approaches in our scholarship. My past work has drawn from UN specialized agencies and national archives primarily in the United States, United Kingdom, and France, and I

encourage multi-archival scholarship. I would like to see the net cast even more widely. Although much of my book is about American plans, there is a great deal in it on research at Porton (in the UK) and British survival plans. I found the latter fascinating because of the major disagreements about food security between the US and UK, such as the ability of deep-sea fish to survive massive radiological contamination. In addition, some of the strangest stories came from the British, who spent years trying to stockpile bull semen effectively for the post-nuclear world. More importantly, my interpretation of international environmental affairs in the 1970s would not have been possible without insights from UK and NATO archives. I agree that we should cross borders when we can, drawing insights from all of the sources available, in all countries possible. Other voices that I included only from secondary sources were from countries such as Brazil, whose diplomats deplored “catastrophic” rhetoric in the early 1970s. I am intrigued by the Bihar example raised in Harper’s comments, and I look forward to reading more about it in her work.

A thorough analysis of the Soviet side of the story, based on primary documents in Russian, continues to elude us. I found myself wishing I had better information from the Soviets or their allies, for example, on the Soviet-bloc boycott of the first United Nations Conference on the Human Environment (Stockholm 1972), and the negotiations behind the ENMOD treaty in the mid-1970s. Another key episode that remains unknown is the use of climate modeling by the USSR in the early 1980s, when Soviet scientists claimed to have independently verified the science of nuclear winter. The documents I used from the CIA, based on its estimate of the computing capacity of the entire USSR, suggested that this was a complete fabrication. I also wondered about the sense of vulnerability in both the USSR and China. I found documents on the NATO side stating that both of these countries were more vulnerable than the US or Europe from the ecological point of view, because of their reliance on a few key crops (this is the familiar criticism of mono-cropping), whereas market economies tended to encourage more varied agricultural systems. But did the Soviets or Chinese feel vulnerable in this way? If so, what did they do about it? Even the CIA believed in the early 1980s that, if anthropogenic climate change were indeed underway, it would be far worse for the communists than for the “free world.” These are just a few examples of how much more research is needed to tell the fullest story.

Finally, I thank Libby Robin for pointing out the importance of catastrophic rhetoric, and she is right to suggest that it often serves political ends. The rhetoric was (and is) ubiquitous, and not just for Cassandra-like texts such as *The Limits to Growth* or *The Population Bomb*. Probably the most influential doomsayer was US President Richard Nixon, who used catastrophic rhetoric to great advantage in the early 1970s. The Nixon White House manipulated key events during the internationalization of the environmental movement, including the 1972 UN Conference on the Human Environment and the creation of the United Nations Environment Programme. NATO representatives secretly debated the mechanism for most effectively controlling the international environmental movement, with the United States

touting “the power of the purse” and others hoping for different kinds of leverage. European desires to fend off demands from the growing ranks of newly independent countries made it seem vital to control the narrative of environmentalism, sustainability, and industrial development, and the Americans attempted to shape the discussion of herbicide use in Vietnam. We still have not yet come to terms with the efforts of the United States and its European allies, using the language of pending environmental catastrophe, to hijack this nascent movement by bankrolling it at the UN.

Arming Mother Nature presents readers with an era when millions of deaths were imagined as a strategic goal, and many scientists collaborated with military partners to understand how to accomplish those deaths. The book also is about those who tried to understand human vulnerability to precisely that kind of conflict, in which huge numbers of people would be susceptible to biological invasions, diseases in crops and animals, food shortages, droughts, fires, changes in weather, gradual shifts in climate, and radiological contamination. Manipulation, monitoring, change, and vulnerability are bywords of *Arming Mother Nature*. The challenge posed by my book is to connect that sense of vulnerability to a pervasive kind of environmental concern—that of catastrophic changes to the earth. Whether I’ve made the case persuasively enough remains to be seen. I welcome further discussion, and I appreciate the effort by my colleagues here to offer critical reflection.

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