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Japan Forum

Fukushima and the Motifs of Nuclear History

Abstract

Nuclear narratives convey responsibility (or lack thereof), and historical understandings are enlisted to stake out defensible positions in times of crisis. As historians, we need to be conscious of the discursive power of the stories we tell and to reflect critically on them. Otherwise we put ourselves in the position of reinforcing past narratives that were contrived in the first place to deflect blame, avoid responsibility, and frustrate accountability. The present essay presents motifs—recurrent themes—that implicitly assign or abrogate responsibility for harm. They are the Risk Society Motif, the Nuclear Watchdog Motif, and the Nuclear Fear Motif. All three reemerged in light of the Fukushima disaster.

“Nature can be cruel. But human beings are brave, resourceful and resilient, as the people affected by the tsunami have shown in the last ten days.”

—Yukiya Amano, director-general of the International Atomic Energy Agency, March 21, 2011¹

The weeks and months that followed the Fukushima nuclear crisis were marked by hasty and opportunistic moves to assign or avoid

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blame for the unfolding disaster. Some saw it as an indictment of the whole industry: American commentators noted the abandonment of the “nuclear Renaissance,” the Germans openly claimed they would avoid a nuclear future as the Greens won unexpected victories across the country, and some French politicians started to rethink their country’s long-standing nuclear commitment. Even the Chinese felt compelled to suspend, temporarily, construction of new nuclear power plants.² Newspapers stated that Japanese prime minister Naoto Kan had planned to go “back to the drawing board” and start focusing on renewable energy.³ The finger-pointing at the height of the Fukushima crisis focused on many targets, including the Japanese prime minister, the Tokyo Electric Power Company (TEPCO) that operates the plants, and the International Atomic Energy Agency (IAEA). The controversial whistle-blower organization WikiLeaks swiftly publicized a 2008 warning from the IAEA stating that all of the Japan’s reactors were vulnerable to earthquakes. The conclusion to be drawn: both the IAEA and Japanese knew yet did nothing.⁴

It may sound pejorative, but finger-pointing is a useful way to understand the significance of Fukushima for historians. Although nuclear power from its inception has been the most highly scrutinized form of energy, it has never had coherent means of accountability. And yet we as historians do give voice to our sense of responsibility for danger or harm in the stories we tell about high-profile events. Nuclear narratives are ultimately stories of responsibility, and those about Fukushima began to cohere immediately following the events. Naoto Kan’s political opponents called for his resignation. American and European nuclear engineers shook their heads at Japan’s “outdated” designs.⁵ To some, TEPCO has become synonymous with irresponsibility, with calls for legal prosecution. It is no accident that the director-general of the IAEA, just ten days after the accident, observed, “Nature can be cruel.” The implicit message was that humans played a negligible role in the disaster. In the same statement, he laid responsibility for safety firmly at the feet of member states, distancing the agency from any hint of blame.⁶

Because nuclear narratives convey responsibility (or lack thereof), we can examine how historical understandings are enlisted to stake out defensible positions in times of crisis. As historians, we are conscious of the discursive power of the stories we tell, and unless we reflect critically on them, we put ourselves in the position of reinforcing past narratives that were contrived in the first place to deflect blame, avoid responsibility, and frustrate accountability. My purpose here is not to criticize historians but to point out some of the ways in which discussions about Fukushima draw from and use themes from past episodes of nuclear history, reinforcing earlier attempts to shape public discussions. The present essay is organized around motifs—recurrent themes—that implicitly assign or abrogate

responsibility for harm. All three reemerged in light of the Fukushima disaster. I refer to them as the Risk Society Motif, the Nuclear Watchdog Motif, and the Nuclear Fear Motif.

The Risk Society Motif

Conversations about Fukushima often pivot on notions of safety and risk, but the meanings of these terms are so malleable that they obscure the interests of those who use them. In March 2011 we began to talk anew about living in a “risk society,” reminiscent of post-Chernobyl discussions. These discussions invoked the work of German sociologist Ulrich Beck, who had helped put the concept of a risk society, or *Risikogesellschaft*, into European political discourse in the late 1980s.⁷ When a journalist from the Japanese newspaper *Asahi Shimbun* interviewed Beck after the Fukushima incident, he noted that “Fukushima is a very symbolic case of the risks of modern times,” namely that we have a system of “organized irresponsibility.”⁸ This view of the risk society is a complaint that we are unwilling to place collective blame or even to account for indirect or long-term harm. It is a plea for greater responsibility. However, it is diametrically opposed to the typical media discussions of risk society, which tend to emphasize that we live in a risky place, that we take a risk every time we drive a car, and that we clearly do and must accept such risks. Both sides of this debate employ the notion of a risk society but draw opposing conclusions. One side says, “We know accidents will happen,” and the other says, “We make things as safe as possible, but there is a chance a freak accident could happen.” One side is frustrated that no one bears responsibility, and the other puts the onus of responsibility on the individual who takes risks every day.

Scholars have taken pains to show that notions of safety and risk are fraught with limitations. On nuclear issues, for example, one can justifiably complain that we focus too much on reactor design safety and not enough on factors beyond the reactor designer’s expertise—ecology, mining, disposal of waste, and other aspects of the nuclear world. And we might overlook the humans working in reactor sites—their decisions, their motivations, and the ways that radiation exposure to them can be vastly understated in official reports.⁹ A number of scholars after Fukushima pointed to Charles Perrow’s 1984 book *Normal Accidents: Living with High-Risk Technologies*, which tried to show how complex systems like nuclear reactors can and will fail.¹⁰ Implicit in these comments are pleas for accountability in an era when predictable mishaps are too easily marveled at as unpredictable perfect storms.

In the weeks following the Fukushima accident, newspapers drew heavily on the notion of the risk society, reflecting a very different framing of it that is captured well in the IAEA fact sheet called “Radiation and Everyday Life.”¹¹ This fact sheet establishes the discourse of

risk explicitly, but its underlying message does the opposite of what Beck and Perrow suggest: rather than work toward greater responsibility, it downplays the significance of damage and thus abrogates responsibility for harm:

The use of radiation and nuclear techniques in medicine, industry, agriculture, energy and other scientific and technological fields has brought tremendous benefits to society. The benefits in medicine for diagnosis and treatment in terms of human lives saved are enormous. Radiation is a key tool in the treatment of certain kinds of cancer. Three out of every four patients hospitalized in the industrial countries benefit from some form of nuclear medicine. The beneficial impacts in other fields are similar.

No human activity or practice is totally devoid of associated risks. Radiation should be viewed from the perspective that the benefit from it to mankind is less harmful than from many other agents.¹²

The word *risk* is a negotiated term, and opposing sides will use it without consensus about its meaning. Nuclear discourse, by incorporating the idea of risk, can relocate decision-making power from the individual to a government without explicitly sounding like disempowerment while seeming to preserve an individual's sense of agency. This long predates Fukushima, Chernobyl, or Three Mile Island. For example, using the language of risk was a key strategy of justification by the U.S. Atomic Energy Commission (AEC) during the fallout controversy of the 1950s. One of the major debating points during the U.S. presidential election of 1956 centered on whether the United States should continue nuclear weapons testing or not. In this case, incumbent President Eisenhower had his scientists, and Democratic hopeful Adlai Stevenson had his. Advocates of nuclear testing were unable to dislodge geneticists from their position that any amount of radiation exposure, no matter how small, would lead to genetic mutations in human offspring. So, instead of contradicting the geneticists' claim, scientists such as Willard Libby (famous for his work on radiocarbon dating) characterized the conflict as one of risk. Both sides used the same data, and both sides were right, according to how they defined risk. The science was the same however you looked at it, but how you looked at it—and how you talked about it—mattered a great deal. Consider the following calculations, based on the discussions of 1956 but rounded for clarity's sake:

Scenario 1: Nuclear testing produces 2 additional birth defects per every 1,000 live births. In a population of 150 million, that amounts to 300,000 birth defects caused by radioactive fallout in every generation in the United States alone.

Scenario 2: Background radiation from natural sources, such as radioactivity from the earth and cosmic rays from outer space, produces 20 birth defects per every 1,000 live births. With nuclear testing, that figure changes only slightly to 22 per 1,000.

Scientists in 1956 could agree that both scenarios provided correct information.¹³ So was one more honest than the other? This depended on one's worldviews, political goals, and sense of responsibility. Willard Libby routinely pointed out that it was far riskier to move to Denver (with increased exposure to cosmic rays, given the high altitude) than it was to be exposed to radioactive fallout. AEC officials believed it important to cast these as small risks, worth taking given the goal of deterring the Soviet Union's aggression.

One might argue that introducing the notion of risk was disingenuous. When confronting statistical projections of expected rates of birth defects, governments are not taking risks but rather calculating extent of harm without taking responsibility for that harm. Policymakers have a different problem than individuals have because they must identify levels of acceptable sacrifice. They expect damage to occur. In the case of fallout, the AEC had the data to predict how many birth defects to expect for any given nuclear test. The only "risk" was whether any given citizen would win that deadly lottery.

To what extent should historians feel obligated to honor the discourse of risk? I confess that I am repelled by it, but this is likely because it was so clearly part of the political toolkit of those wishing to downplay the effects of radiation exposure from nuclear testing in the 1950s, and it remained a habitual defense of radioactive waste disposal in seas and waterways in the 1960s and 1970s (and this is the story with which I am particularly acquainted). I do not suggest that we avoid the word *risk* at all (although I try), but to acknowledge that its contested meaning can be invisible to nonspecialists and to emphasize how it is routinely used to assign or avoid responsibility.

The Watchdog Motif

After the Fukushima accident, IAEA director-general Yukiya Amano traveled home to Japan to meet with senior members of TEPCO, Japan's prime minister, and other senior Japanese political leaders. Afterward, when addressing an emergency meeting of the IAEA board of governors, he could not resist chastising the media for misrepresenting the IAEA:

Since the accident, I have tried to address some widespread misconceptions in the media about the IAEA's role in nuclear safety. These misunderstandings fuelled some criticism of the Agency's response, which was not always justified.

I explained that we are not a “nuclear safety watchdog” and that responsibility for nuclear safety lies with our Member States. The IAEA acts as a hub for international cooperation, helping to establish safety standards and providing expert advice on best practice. But, in contrast to the Agency’s role in nuclear non-proliferation, nuclear safety measures are applied voluntarily by each individual country and our role is supportive.¹⁴

As Amano has repeatedly pointed out, safety is not the IAEA’s responsibility.

Sociologists say that for the sake of simplicity and convenience, scientific ideas get “black boxed,” obscuring the negotiations that are required to produce lasting scientific ideas.¹⁵ We just say “the laws of physics” and dispense with trying to justify them. Similarly, a phrase like “nuclear watchdog” is a shorthand black-boxed representation of history. It bears careful examination because journalists today look to the IAEA for detached, objective analysis of nuclear science. They give the impression that some objective body acts as a responsible caretaker during the global expansion of nuclear power. Doing so ignores a half century of the IAEA’s history.

In many countries, conflict of interest has been at the heart of the crisis of trust on nuclear issues. After World War II, nuclear establishments did everything from licensing, overseeing weapons and electricity, and establishing scientific orthodoxy about the effects of radiation on humans and in the natural environment. In both the United States and United Kingdom, opposition to the nuclear establishments’ self-policing led to their complete reorganization in the 1970s.¹⁶ While the US AEC and UK Atomic Energy Authority had tried to maintain some objectivity—largely by commissioning reports on nuclear safety by outside bodies such as the National Academy of Sciences and Britain’s Medical Research Council—in both countries the conflicts of interest proved too great. In 1974 the AEC was dissolved. Responsibility for promotion of the industry went to what is now the Department of Energy (DOE) while responsibility for regulation went to the Nuclear Regulatory Commission. The UK’s Atomic Energy Authority stayed alive, but production activities moved elsewhere in 1971.

At the international level, it seems as if the separation of salesmanship and oversight has not occurred. But actually, calling the IAEA a watchdog suggests that there is some kind of oversight when there is none. The IAEA has always existed to promote uses of nuclear energy. If it monitors member states’ nuclear programs, it is because the IAEA has not wanted a few bad apples to spoil the whole enterprise. Its only genuine watchdog role has been to keep tabs on nuclear weapons proliferation. In September 2010, IAEA director-general

Yukiya Amano complained that too often his agency is perceived as the nuclear watchdog, when in fact that really is not at the heart of the IAEA's mission. Instead, Amano celebrated the fact that between ten and twenty-five countries would have new nuclear plants by 2030, and part of his job would be to convince banks to be less reluctant to finance them.¹⁷

The IAEA's watchdog status obscures the fact that no one is charged with the responsibility—and certainly no one has adopted it—to ensure safe practices globally. One might say that it is our own illusion. The fact that the IAEA was called the “UN Nuclear Watchdog” by several media outlets right after the Fukushima crisis began is indicative of our own presumption of some kind of watchfulness for a regional catastrophe deriving from an industry that has only national oversight.¹⁸ The watchdog term is anathema to IAEA leaders because it implicitly assigns them a degree of responsibility that they simply do not want.

Where did the watchdog status come from? When law professor Hans Blix took over the agency in 1981, amid the bombing of Iraq's nuclear weapons facility by Israel, the agency began to reflect his interest in monitoring potential weapons programs. His successor, the Egyptian Mohamed El Baradei, took over in 1997 and was deeply enmeshed in the politics of detecting weapons of mass destruction preceding the second Gulf War. ElBaradei and the agency won the Nobel Peace Prize for their nonproliferation efforts, but behind the scenes, American diplomats disliked his attempts to play a mediator role in the Middle East, accusing him of being soft on Iran. WikiLeaks documents suggest that the Americans were much happier with ElBaradei's successor, Japanese diplomat Yukiya Amano, who issued matter-of-fact statements about Iran's failures to comply with the UN. But Amano had hoped also to emphasize the agency's fundamental purpose, namely the promotion of peaceful applications of the atom.¹⁹ This goal enjoys the strongest commitment by the United States. Because the United States needs the IAEA to help enforce the nonproliferation of nuclear weapons, it continues faithfully to espouse the agency's electricity generation goals. Even if no nuclear power plant is ever again built in the United States, Americans will continue to fund the most authoritative and powerful force for the industry's expansion.²⁰

These long-standing goals were unperturbed by the events at Fukushima. As the disaster mounted, and the IAEA upgraded its status from one with only “local consequences” to a “major accident” comparable in magnitude to Chernobyl, Amano undoubtedly sensed the weight of nuclear history descending on Japan. Two atomic bombs in 1945, the first major fallout controversy in 1954 (afflicting Japanese fishermen aboard the *Lucky Dragon*), and now the worst nuclear disaster in decades. It must have been a delicate task,

balancing his agency responsibilities with the expectations of his government, the political pressures from Japanese nuclear industries to downplay the accident, and his own personal feelings as a Japanese citizen. But in the end, he was still the IAEA director-general. Amano has stated confidently that Fukushima will likely slow the expansion of nuclear power, but it will not stop it. Today, the IAEA still has the same outlook: the future is nuclear, and we should set aside our objections.²¹ But the IAEA will remind us that it should not be held responsible for negative outcomes.

The Nuclear Fear Motif

The most prominent and apparently immortal motif of nuclear history is that objections to peaceful applications such as electricity generation are based on irrational emotions and fear of nuclear weapons. German chancellor Angela Merkel was accused of letting her emotions get the better of her when she promised to turn away from nuclear power after the Fukushima disaster. French minister of education Claude Allegre called her irrational and emotional, noting that Europeans should not be so fearful, antiprogressive, and antiscience.²² *The Sydney Morning Herald* published a poll three weeks after the Fukushima crisis began suggesting that 45 percent of respondents believed that fears about nuclear power were irrational. CNN carried an interview with academic psychologists who pointed out the long-standing associations with bombs and other weapons. Many historians also share this view, including Spencer Weart, whose book *Nuclear Fear: A History of Images* is essential reading for all historians of the nuclear era.²³

Grist for this manner of thinking lies in the fact that more people were killed in the tsunami (thousands) than were killed by radiation (so far, none), and yet we pay disproportionate attention to the nuclear side. Some have used this as evidence that irrational fears of all things nuclear have led the crisis to be blown out of proportion.²⁴ Perhaps a different way of looking at it is to see Fukushima as a demonstration of the interconnections between natural disaster and those caused, mitigated, or exacerbated by humans, a theme familiar to environmental historians.²⁵

Irrational and *emotional* are loaded terms, to say the least. For one, these terms have been used routinely as tactics of feminization in conversations about nuclear power—in contrast with the supposedly rational, scientific, objective, and tough-minded advocates of nuclear power. In discussing irrationality surrounding Fukushima and a less serious explosion later in a French facility, one UK *Daily Mail* commentator wrote, “Interestingly, there is a marked sex-difference here—men are far more likely to support nuclear power than women, seeing it as a viable solution to both the energy crisis and global warming.”²⁶ This

gender disparity is actually true, although unrelated to irrationality. Some studies show that it correlates well with values, not emotions: women surveyed tend to be more persuaded by health and safety arguments, whereas men tend to be more swayed by economic ones. An IAEA report on efforts at “gender mainstreaming” of nuclear power noted that women are underrepresented in scientific positions in the nuclear sector, and that women’s attitudes toward nuclear power differ markedly from men’s, on average. “Interestingly,” the report noted, “the higher women’s educational level, the more likely they were to object to the use of nuclear energy while the reverse was true for men.” This particular report casts the difference as one of increased knowledge and divergent priorities.²⁷

Indicators of the nuclear fear motif can usually be found in calls for greater awareness or education about nuclear energy. For example, prior to Fukushima the Nuclear Energy Institute (a policy advocate for the nuclear industry based in the United States) published a report in 2010 attributing the previously mentioned gender disparity not to differences in values or priorities but to differences in energy awareness. It blamed the media for focusing too much on alternative energy sources: “Women historically have softer and more changeable opinion about nuclear energy than men,” the report claimed, making them more susceptible to media influence.²⁸ Plenty of others see objections to nuclear energy as also based on fear. Reflecting on the as yet unsuccessful attempt to establish a national radioactive waste storage facility at Yucca Mountain, the US Congress’s Government Accountability Office stated in 2011 that future efforts should focus on educating the public. It then noted the problem of emotions and irrationality.²⁹

The motif of nuclear fear infantilizes the lay public and encourages a technocratic view of public policy that defers to the experts. It underlines a strong current of technological determinism that writers such as Jacques Ellul and Lewis Mumford identified many decades ago. In the 1950s and 1960s, the alleged solution to dissonance between humans and their technologies was to compel humans to “catch up” or adjust to technological advancement. When UNESCO convened social scientists to address the issue of nuclear fallout, they too decided that atomic energy was much like the problems of automation in industry—humans were behaving emotionally and irrationally by not adjusting to the onward march of technological progress.³⁰

Deployment of the nuclear fear motif tends to cast one side of the debate as the more objective one and the other as easily confused or swayed by politics. In the first decades of nuclear power plants, scientists working within atomic energy establishments routinely pointed out that their position was the scientific and technical one, and that opponents had only irrational and emotional reasons to resist. This view carried them to astounding levels of deafness to others’

objections. When the United States planned dumping operations in the Gulf of Mexico in the early 1960s, people at the AEC were annoyed that Mexican diplomats protested. There was a scientific way and a wrong way, AEC scientists believed. In that case, the State Department intervened and stopped the AEC, for the greater good of a positive relationship with a neighbor. AEC scientists saw this as irrational.³¹

There is no reason for scientists or governments to expect the general public to accept what they say without subjecting it to doubt. Science changes, and so have standards of safety. What began in the 1940s as safe soon transitioned to relatively safe. Then scientists avoided using the word *safe* altogether and adopted one that allowed for American foreign policy goals to override scientific consensus: *permissible*.³² When geneticists convened in the mid-1950s to write the National Academy of Sciences first major study of the biological effects of atomic radiation (the BEAR reports), they debated vigorously behind the scenes about what should go into the calculus of permissible. The need to test weapons to deter the Soviet Union was part of that calculus, and geneticists knew that whatever objective science they set forth would enter directly into the debates over nuclear fallout in the 1950s. Other recommendations from that era were equally tailored to the age: they also assumed that most people were done having children by the age of thirty.³³

After Fukushima, the American Nuclear Society convened several commentators to its blog to answer the question “Why is there Irrational Fear of Radiation?” The typical answer to this loaded question, including one from author Stewart Brand, was that the public is easily confused by the complex nomenclature of the nuclear industry. All of the commentators appeared to agree that the problem lay in “communication of the numbers to a skeptical and fearful public.”³⁴

Conclusion

The narratives of responsibility in nuclear history are not always written at crisis points like Fukushima but at less sensational failures along the way. Plenty of ink has been spilt about the exceptionally costly attempt (to the tune of over \$15 billion) to store radioactive waste at Yucca Mountain, Nevada. Why has it been such a dismal failure? One month after the Fukushima crisis began, the US Congress’s Government Accountability Office relatively quietly named the DOE as the party responsible: the “revolving door” style of leadership, with many changes in high-ranking positions, created inconsistent attitudes about planning and safety. It also blamed the Environmental Protection Agency for taking fourteen years to issue specific safety standards at Yucca Mountain and leaving a wide margin of discretion for scientists and managers to make choices

based on their own views, not at all insulated from political influences.³⁵ Perhaps a worse criticism was the DOE's casual disregard for its own institutional memory, once it started pulling the plug on the project in 2010. As the United States apparently went back to square one after a quarter century of assuming the waste would go ultimately to Nevada, the DOE watched its experienced scientists and administrators walk out the door. As the Government Accountability Office pointed out, DOE officials made no effort to capture this experience, to gain from institutional memory, or as they aptly put it, to learn from the lessons of the past.³⁶

Lessons from the past have already shaped how we discuss Fukushima. But they come in the form of motifs that are deployed time and again. For historians, consciousness of motifs in nuclear narratives serves at least two purposes. The first is to challenge us as scholars to acknowledge how much these motifs influence our own thinking, and the second is to understand how powerful these motifs are as techniques to assign, redirect, or completely abrogate responsibility when things go awry. It is possible to be critical of how we represent nuclear history without being antinuclear. In the realm of scholarship, we might take greater care about our complicity in allowing the media, the nuclear industry, or environmental groups to shape academic discourse. It is troubling to see us accept the notion that people oppose nuclear power principally because of an emotional and irrational fear of nuclear weapons. Equally, we should acknowledge that the ubiquitous presence of risk society discourse has become part of the toolkit of proponents and critics of nuclear power alike. And it makes little sense at all to call the IAEA a watchdog when its principal goal has been to promote nuclear energy and other applications, not to regulate them. It does not claim responsibility for the actions of the entire nuclear industry. No one does. No one ever has.

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Notes

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- 1 Yukiya Amano, "Introductory Statement to Board of Governors," March 21, 2011, accessed December 2, 2011, <http://www.iaea.org/newscenter/statements/2011/amsp2011n007.html>.

- 2 See Kevin Voigt and Irene Chapple, "Fukushima and the 'Nuclear Renaissance' that Wasn't," *CNN World*, April 15, 2011, accessed December 1, 2011, <http://globalpublicsquare.blogs.cnn.com/2011/04/15/fukushima-and-the-nuclear-renaissance-that-wasnt/>. On France, see the collection of articles under the heading "La France doit-elle sortir du nucléaire?" *Le Monde*, March 18, 2011, accessed December 1, 2011, http://www.lemonde.fr/idees/ensemble/2011/03/18/la-france-doit-elle-sortir-du-nucleaire_1494874_3232.html. Although the French media dutifully included fresh debates about the place of nuclear energy in French society, nuclear power already constitutes three quarters of France's power (compared to some 20 percent in the United States and less than 30 percent on average in the European Union), and calls for abandoning it have been relatively muted. Nevertheless, at the time of this writing, the extent of dependence on nuclear power as a source of energy has become a major point of contention in France between incumbent president Nicolas Sarkozy and his socialist opponent François Hollande (the former has suggested that drawing down nuclear commitments would be catastrophic for the French economy, whereas the latter seeks to decrease the proportion of France's nuclear energy and diversify into other forms of energy). For an example of news coverage, see Cecile Brisson, "Sarkozy Clings to Nuclear Energy Amid Protests," *ABC News*, November 25, 2011, accessed November 30, 2011, http://abcnews.go.com/International/wireStory/sarkozy-clings-nuclear-energy-amid-protests-15027290#.Ttcwbk_1tE0.
- 3 Justin McCurry, "Japan Nuclear Power Expansion Plans Abandoned," *The Guardian*, May 11, 2011, accessed November 23, 2011, <http://www.guardian.co.uk/world/2011/may/11/japan-nuclear-power-expansion-plans-abandoned>. What Kan actually said, as historian of Japan Martin Dusenberre immediately pointed out, was that there needed to be a fresh debate—this was a vague pronouncement from Kan, not a disavowal. See Martin Dusenberre, "Is Japan Really Winding Back on Nuclear?" *The Guardian*, May 12, 2011, accessed November 23, 2011, <http://www.guardian.co.uk/commentisfree/2011/may/12/japan-nuclear>. Kan would eventually resign his job under the immense pressure of public criticism about his handling of the crisis.
- 4 "Japan Earthquake: Japan Warned over Nuclear Plants, WikiLeaks Cables Show," *The Telegraph*, March 15, 2011, accessed November 23, 2011, <http://www.telegraph.co.uk/news/worldnews/wikileaks/8384059/Japan-earthquake-Japan-warned-over-nuclear-plants-WikiLeaks-cables-show.html>.
- 5 Engineers such as Robin Grimes, of Imperial College London, emphasized the differences between the Fukushima reactors and "a modern nuclear reactor." Tony Jones, "Grimes: Fukushima Is an Outdated Design," *ABC Lateline*, March 17, 2011, accessed December 1, 2011, <http://www.abc.net.au/lateline/content/2011/s3167108.htm>.
- 6 Yukiya Amano, "Introductory Statement to Board of Governors," March 21, 2011, accessed December 2, 2011, <http://www.iaea.org/newscenter/statements/2011/amsp2011n007.html>.
- 7 Ulrich Beck, *Risk Society: Towards a New Modernity* (London: Sage, 1992).
- 8 Hirohito Ohno, "Interview/Ulrich Beck: System of Organized Irresponsibility behind the Fukushima Crisis," *Asahi Shimbun*, July 6, 2011, accessed October 21, 2011, <http://ajw.asahi.com/article/0311disaster/opinion/AJ201107063167>.

- 9 Hugh Gusterson, "The Human Element," *Bulletin of the Atomic Scientists*, September 1, 2011, accessed November 23, 2011, <http://www.thebulletin.org/web-edition/columnists/hugh-gusterson/the-human-element>. The likely over-exposure of temporary cleanup workers at Fukushima was discussed by Gabrielle Hecht at a symposium on Fukushima at the joint meeting of the History of Science Society, Society for History of Technology, and Society for the Social Studies of Science. A more detailed discussion is in Gabrielle Hecht, "Nuclear Nomads: A Look at the Subcontracted Heroes," *Bulletin of the Atomic Scientists*, January 9, 2012, accessed January 10, 2012, <http://thebulletin.org/web-edition/features/nuclear-nomads-look-the-subcontracted-heroes>.
- 10 Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (New York: Basic Books, 1984). For examples of references to Perrow, in this issue Sara Pritchard discusses how these reactors can be considered envirotechnical systems, with the natural world adding complexity and greater likelihood of serious failures in the system. Also, Hugh Gusterson referenced Perrow and wondered in the *Bulletin of the Atomic Scientists* whether we are hardwired to make the same mistakes time and again. Gusterson in particular appeared frustrated that certain countries such as Turkey, China, and India will probably proceed as if Fukushima had never happened. See Hugh Gusterson, "The Lessons of Fukushima," *Bulletin of the Atomic Scientists*, March 16, 2011, accessed November 23, 2011, <http://www.thebulletin.org/web-edition/columnists/hugh-gusterson/the-lessons-of-fukushima>.
- 11 "Radiation and Everyday Life," accessed November 20, 2011, <http://www.iaea.org/Publications/Factsheets/English/radlife.html>. Examples of articles referencing the fact sheet include Peter Grier, "Fukushima Nuclear Crisis: How Serious Is the Radiation Threat?" *Christian Science Monitor*, March 15, 2011, accessed November 22, 2011, <http://www.csmonitor.com/USA/2011/0315/Fukushima-nuclear-crisis-How-serious-is-the-radiation-threat>.
- 12 "Radiation and Everyday Life," accessed November 20, 2011, <http://www.iaea.org/Publications/Factsheets/English/radlife.html>.
- 13 Jacob Darwin Hamblin, "A Dispassionate and Objective Effort: Negotiating the First Study on the Biological Effects of Atomic Radiation," *Journal of the History of Biology* 40, no. 1 (2007): 147–77.
- 14 Yukiya Amano, "Introductory Statement to Board of Governors," March 21, 2011, accessed November 22, 2011, <http://www.iaea.org/newscenter/statements/2011/amsp2011n007.html>.
- 15 A useful history of the development of such ideas can be found in H. M. Collins, "The Sociology of Scientific Knowledge: Studies of Contemporary Science," *Annual Review of Sociology* 9 (1983): 265–85.
- 16 The crisis of trust is emphasized in J. Samuel Walker, "The Atomic Energy Commission and the Politics of Radiation Protection, 1967–1971," *Isis* 85 (1994): 57–78.
- 17 Sasha Henriques, "More Than a 'Watchdog,'" accessed September 27, 2011, <http://www.iaea.org/newscenter/news/2010/gc54opens.html>.
- 18 One example is Julian Borger, "UN's Nuclear Watchdog IAEA under Fire over Response to Japanese Disaster," *The Guardian*, March 15, 2011, accessed December 5, 2011, <http://www.guardian.co.uk/world/2011/mar/15/nuclear-watchdog-response-japanese-disaster>.

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