Chapter 8

Expanding Notions of Scientific Argument

A Case Study of the Use of Scientific Argument by American Indians

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Scientific arguments—or appeals to the authority of science and/or use of scientific and technical knowledge as evidence in arguments—play an important role in the deliberation of public controversies. This is evident across the many examples of environmental policy discussed in the rhetoric of science literature (e.g., Farrell & Goodnight, 1981; Fisher, 1987; Gross, 1984; Katz & Miller, 1996; Keränen, 2005; Lyne & Howe, 1986; Waddell, 1990). One area of particular interest in this body of literature is the research that has shown that scientific and technical knowledge is often valued over social, political, or pathos-based arguments in public deliberations, which results in a marginalization of these other ways of knowing (e.g., Fisher, 1987; Gross, 1984; Waddell, 1990), and in the preceding chapters of this book. This is notable because controversies over intelligent design, human genomics, and nuclear power often involve politically charged clashes that pit the authority of scientific knowledge against the authority of cultural knowledge, cultural beliefs, and religion and spirituality (see Chapters 1 and 2 in this volume). It is in this vein that this chapter examines the controversy surrounding plans to install a high-level nuclear waste site in the Yucca Mountains in Nevada (U.S. Department of Energy, 2008b).

Although the details of this site will be discussed later in the chapter, it needs to be noted here that in this particular controversy, the Department of Energy (DOE) specified the scientific and technical suitability of the Yucca Mountain site as its only criterion in considering whether or not to proceed, as evidenced in a mandate in the Nuclear Waste Policy Act (NWPA) (Nuclear Waste Policy Act, 2004). As will be argued in this chapter, this specification artificially limited the scope of a controversy that essentially bridges the public and technical spheres of argument (Goodnight, 1982) and invokes ethical, spiritual, political, cultural, and scientific arguments. During the public hearing process, public participants—specifically American Indians—appealed to the authority of science as well as the authority of their own cultural knowledge, including the narrative-based knowledge of oral traditions and religious beliefs.

While arguments based on science are typically privileged in a hierarchy of evidentiary value, the case of the Yucca Mountain high-level nuclear waste site in Nevada provides an informative study of how this dichotomy between science and culture limits our understanding of the rhetorical complexity of public debates of scientific issues. Indeed, this analysis of commentary from public hearings reinforces previous research suggesting that scientific and cultural knowledge should not be treated as mutually exclusive in public policy debates (e.g., Coleman & Dysart, 2007; van Dijck, 2003; Waddell, 1990). It also extends lines of scholarly inquiry that: (a) shift attention from the arguments of scientists to scientific arguments made by the public; (b) reveal the fluidity of boundaries between scientific and non-scientific arguments in public scientific controversies; (c) invite deeper analysis of the role of cultural arguments in environmental decision making; and (d) challenge misconceptions about the relationship between American Indian cultures and science. On this latter point, there is a tendency to both subordinate culture arguments to those of science, and underestimate the scientific literacy of American Indians.

The chapter begins with a discussion of the relationships between science, culture, religion, and American Indians; moves to an examination of the use of science and culture arguments by American Indian participants in the public comment period of the Yucca Mountain site authorization process; and concludes with a discussion of the implications of this study for our understanding of scientific argument within public scientific controversies.

Science, Culture (and Religion)

Friedman, Dunwoody, and Rogers (1986) maintain that the scope of science communication "comprises not only the biological, life and physical sciences but also the social and behavioral sciences and such applied fields as medicine, environmental sciences, technology, and engineering" (p. xv). This broad array of scientific disciplines includes both theoretical and practical fields, with a shared system of knowledge implicitly linking them together.

What further distinguishes science as a public discourse is how it has traditionally been set in opposition to culture (and to religion as a type of cultural argument). The tensions and cohesions between science and religion are a well-documented site of scholarly inquiry (e.g., Condit, 1998; Harris, Parrott, & Dorgan, 2004; Lessl, 1989, 1993, 2003, 2005; Taylor, 1992). As is alluded to above, this antagonistic relationship has been made abundantly clear more recently in public debates about evolution and whether the teaching of intelligent design should be given equal time in public schools (e.g., Condit, 1998; Johnson-Sheehan & Morgan, 2008; Martin, Trammell, Landers, Valois, & Bailey, 2006). Scientist and novelist

C. P. Snow, himself a personification of this tension, famously spoke of the "two cultures" (1993)—expressed as the sciences and humanities—with a vast gulf separating them. Snow's articulation of the competing cultures of science and the humanities implicitly lingers in much current scholarship about public understanding of science and scientific literacy.

The claims that are made in public regarding science controversies generally require some form of legitimization to become more than just groundless claims and opinions. Not surprisingly, science typically provides the grounds on which arguments in these controversies do battle. While science, or the scientific method, can be understood as a means of gaining knowledge about natural phenomena through the systematic testing of hypotheses based on observation, the way science is used in arguments about policy decisions has more to do with the scope of its perceived authority and the way it is practiced than the specific knowledge system it names.

Still, despite the fact that cultural knowledge does not arrive at truth via the scientific method of testing hypotheses, it does offer a means of arriving at truth with its own systems of logic. Culture, according to Philipsen (1997), is a "socially constructed system of symbols, meanings, premises and rules" (p. 125). This broad definition is particularly important for understanding the overlapping of science and culture arguments in public participation of environmental decisions, including the Yucca Mountain nuclear-waste siting decision. First, the definition allows for a broad, nontraditional understanding of culture that can include national, ethnic, academic, organizational, and subcultural designations. Although culture has been traditionally and popularly defined as national (i.e., American culture or Japanese culture), in this iteration culture can describe any number of social groups with shared codes of communication and ways of knowing the world.

The definition also allows for culture, understood as a system of symbols and practices, to condition or otherwise influence the practice of science and the way science is invoked to authorize claims made in defense of itself or in the defense of cultural interests. In other words, as the scholarly literature on culture and science points out, culture subsumes science in that science is (a) a culture unto itself and (b) culturally determined. The articulation of science as a culture of knowledge assumes that science is a "set of cultural activities among others" (van Dijck, 2003, p. 185). What could be called a culture of science has a general but heterogeneous set of symbols, meanings, premises, and rules that guide the practice of science across the different subfields of science such as biology, medicine, or engineering. The scientific method, then, can be understood as science's way of speaking and knowing.

The risk of accepting the science/culture dichotomy, then, is to impose limitations on each discursive field's ability to communicate with legitimacy both within and across themselves. While the public discussion of

climate change and stem-cell research has dealt a blow to the authority of science (see Nisbet, this volume), in environmental public policy decisions the arguments of science enjoy privileged status, resulting in the devaluation of public arguments, cultural arguments, and spiritual arguments. Research on models of public participation in environmental decision making (e.g., public hearings) reveals that scientific argument can actually be used to silence and intimidate members of the public (Depoe & Delicath, 2004; Fiorino, 1990; Fisher, 1987; Katz & Miller, 1996; Kinsella, 2004; Ratliff, 1997). In this way, the culture of science is not only posited against the humanities (as in Snow's articulation) but is also posited against the public culture or cultural rationality. As Coleman and Dysart (2007) note, "The effect of separating scientific rationality from cultural rationality issues forth a sort of cognitive superiority that results in a marginalization of views seen as nonscientific and hence nonrational" (p. 5).

Yet, when we talk about science as a culture, it is important to understand that we are generally talking about Western science. Western science historically has a troubled relationship with marginalized, oppressed, and colonized peoples—in this case American Indians. Western scientific research is embedded within imperialism and colonialism, and can be dehumanizing to indigenous peoples (Deloria, 1997; Smith, 1999). Moreover, despite the complexity of indigenous knowledge of local ecologies and resources, indigenous beliefs and arguments are frequently portrayed and subsequently framed in the media as non-scientific or less important than scientific information. As Coleman and Dysart (2007) further suggest,

> Real-life dramas that invoke scientific rationality and progress and that affect Native American tribes—such as mineral and oil exploration, radioactive dumps, and age-old skeletal remains—relegate Indians to a preserved past in which their values are considered quaint, outmoded and scientifically irrelevant.
>
> (p. 20)

This was the framework that characterized the debate over the Yucca Mountain high-level nuclear waste site; science and scientific argument were valued over other forms of argument, including those that invoked the cultural norms and values of American Indians (Endres, 2005).[1]

Science, Culture, and American Indians

As suggested above, the view that science itself is also a cultural phenomenon has particular resonance for some American Indians and their relationship to Western science (Deloria, 1997; Hodson, 1993; Manzini, 2003). In the vein of scholarship that views science as both culture and cultural product, Manzini (2003) argues that "every culture has its own

science, which can be seen as an indigenous science of that particular cultural group" (p. 193). Similarly, Deloria (1997) maintains that the way in which indigenous people hold traditional knowledge about the world can be understood as an indigenous science. In this relationship between science and culture, culture is defined more traditionally to be a national, ethnic, or racial group whose practices influence the definition of science for that culture. Of course, understanding science as a cultural practice, which is also determined by culture, shows its relevance across national, ethnic, or racial boundaries.

Speaking at a public hearing on the proposed Yucca Mountain nuclear waste site, Edward Smith of the Chemehuevi Southern Paiute said he looked "forward to the day when scientists, engineers, agencies, and policy makers give serious consideration" to the cultural value of Indian lands, rather than simply their "scientific, technological, commercial and economic value" (U.S. Department of Energy, 2001d, p. 29). While it would be accurate to say that this American Indian perspective dichotomizes science and indigenous culture, it does not dismiss the value of science, only the suitability of applying it and the motives for its use in the case of Yucca Mountain. If science is accepted as a cultural phenomenon, Smith's argument calls attention to the clash between two cultures' perceptions of the land and its value.

Another way that science and culture arguments have been applied in public debates involving American Indians is via the default frame of religion and its mutual exclusion with science. Deloria (1997) argues that any challenge to Western science by indigenous people is often perceived to be a religious objection, even though much of American Indian knowledge could also be understood as ecological and not necessarily linked to religious practice. For example, the controversy over the Kennewick Man—remains of a prehistoric man found near Kennewick, Washington in 1996—was primarily framed as a contest between Western science and American Indian religion (Coleman & Dysart, 2007). The controversy focused on whether the U.S. Army Corp of Engineers or area Indian tribes was responsible for the handling of the remains. The frame identified by Coleman and Dysart (2007) suggested that religion and science are mutually exclusive, which is typical of other public scientific controversies.

In his analysis of the debate about creationism versus evolution, Taylor (1992) noted that "while most scientists may not rigidly dichotomize scientific rationality vs. religious irrationality, the rhetorical demarcation in this case [creationism] constructed just such a division" (p. 289). Indeed, in public deliberation about policies that share a border with religion, the media often frames science as the rational choice that should be valued over religious arguments (Coleman & Dysart, 2007). And this framing can actually further entrench science and religion as mutually exclusive, reinforcing the divide between scientists and the public (Taylor, 1992).

However, just as science and cultural knowledge can provide different types of evidence to public debates, science and religious/spiritual knowledge are different ways of knowing that do not have to be in competition. In the context of public deliberation, both scientific and spiritual arguments can provide important challenges to each other. Speaking of the importance of the interplay between scientific and religious arguments, Condit (1998) notes,

> For the good of the community it is desirable for religion to attack science in order to prevent science from becoming the exclusive discourse of the public sphere. For, as many observers have noted, scientific methods are notoriously poor at offering social values. If the only discourse shared within the polity were science, that polity would lack critical ingredients for coexistence and public concordances.
>
> (p. 600)

Healthy public deliberation, then, can include both scientific and religious/spiritual claims, as long as there is an understanding of how each contributes different things to the deliberation. This holds true for all forms of cultural knowledge as well. As an example of a model of deliberation that draws from both scientific and cultural knowledge, Walker and Daniels (2004) offer the notion of civic science that calls for conversation among scientific experts, political experts, and citizen experts. The Yucca Mountain siting decision, which is detailed below, offers a means of further exploring the relationship between science, culture, and religion in public deliberation.

The Yucca Mountain High-Level Nuclear Waste Site

High-level nuclear waste (HLW) is a byproduct of nuclear fuel production or nuclear fuel reprocessing (U.S. Nuclear Regulatory Commission, 2007). High-level waste is the most dangerous of all forms of nuclear waste because it emits harmful radiation for tens of thousands of years (U.S. Department of Energy, 2008b). There are two main sources of high-level nuclear waste in the United States: the commercial nuclear power industry and the federal government (including the Department of Energy and the Department of Defense). As a result of over 60 years of nuclear power and nuclear weapons development in the United States, we are now facing a nuclear waste crisis. According to a 2002 report by former Secretary of Energy Spencer Abraham, "We have a staggering amount of radioactive waste in this country" (Abraham, 2002). By 2035, there will be approximately 119,000 metric tons of high-level nuclear waste (U.S. Department of Energy, 2008a). Through the Nuclear Waste Policy Act (NWPA) Con-

gress vested responsibility for permanent storgage of high-level nuclear waste with the U.S. federal government. The NWPA mandates that the Department of Energy is responsible for researching and recommending a site for permanent geologic storage of high-level nuclear waste. Congress would ultimately decide on the site recommendation made by the Secretary of Energy.

Decisions about where to store nuclear waste and toxic waste are difficult and rife with controversy. The Yucca Mountain high-level nuclear waste repository site is certainly no exception. The controversy over the site began in 1978, when the Department of Energy (DOE) began researching Yucca Mountain as a potential site for an underground geologic storage site for nuclear waste (U.S. Department of Energy, 2008b). In 1984 President Ronald Reagan selected Yucca Mountain in Nevada, the Hanford Complex in Washington, and a location in Deaf Smith County, Texas as the three potential sites for geologic storage of high-level nuclear waste. Congress amended the NWPA in 1987 to direct the DOE's attention to study just one site: Yucca Mountain. In the midst of an ongoing controversy over the site, Congress and President George W. Bush officially authorized the Yucca Mountain site in 2002. Between 2002 and June 2008, the DOE prepared an application for a Nuclear Regulatory Commission (NRC) license for the site. The DOE submitted a license application on June 3, 2008 and the NRC now lists the application as docketed. An interview with an NRC official reveals that the NRC usually takes 3 to 4 years to evaluate an application.[2]

The Yucca Mountain high-level nuclear waste repository site is located in Nye County, Nevada. Yucca Mountain straddles the Nevada Test Site and Nellis Airforce Range and is about 90 miles northwest of Las Vegas. Although the Yucca Mountain site has not yet been granted a license to begin accepting high-level nuclear waste, the underground repository has been constructed. The repository consists of a series of tunnels drilled into the mountain. At present, high-level nuclear waste is currently stored in nuclear fuel rods. For storage at Yucca Mountain, the rods will be encased in casks engineered to prevent leakage and inserted into the tunnels. The capacity of Yucca Mountain is 77,000 metric tons. Although the United States is projected to have 119,000 metric tons by 2035 (as stated above), there are curently no plans for a second high-level waste-storage facility.

While the DOE stands by the safety of the repository (e.g., Abraham, 2002), opponents argue that there are risks of radioactive leaks from the repository that could damage water tables, local ecosystems, and human health (see U.S. Department of Energy, 2001c for access to public comments opposed to the Yucca Mountain site). In addition to these reasons, several American Indian nations also oppose the Yucca Mountain site because Yucca Mountain lies within the traditional boundaries of the Western Shoshone and Southern Paiute nations. Although the United

States claims that the Yucca Mountain nuclear waste site is located on federally controlled land, Western Shoshone and Southern Paiute nations claim treaty-based and spiritual rights to the land. The Western Shoshone argue that the Yucca Mountain site violates the 1863 Ruby Valley Treaty of Peace and Friendship.[3] The Southern Paiutes and others argue that the repository harms their culture and spirituality by using Yucca Mountain to store waste.

As stated above, the NWPA vested responsibility with DOE for recommending a site for permanent geologic storage of high-level nuclear waste. The NWPA outlines a detailed process for site selection including an evaluation of multiple sites, production of an Environmental Impact Statement, several public comment periods, and site characterization research (NWPA, 2004). One formal public comment period concerning the proposed site at Yucca Mountain lasted from May through December in 2001.[4] A total of 5,250 public comments were heard/collected. Statements were heard/collected at 66 public hearings throughout Nevada, delivered to a court reporter at the Yucca Mountain Information Center, and received via email messages or letters sent through U.S. mail to the center. An archive of public comments is available at the Yucca Mountain Information Center and on the Web (U.S. Department of Energy, 2001c). From this corpus of public comments, 52 statements made by 33 self-identified Americans Indians from 26 nations and two American Indian non-profit organizations were identified. Although this may be a small number of comments compared to the total number of public comments, the relative size of American Indian populations is significantly smaller than the overall population of the United States (0.8% of the U.S. population according to the 2000 U.S. Census; U.S. Census Bureau, 2000). Also, many of the 52 comments and statements were issued by American Indian governments that speak for larger numbers of individuals.

Using rhetorical criticism (e.g., Burgchardt, 2005; Foss, 2009; Hart & Daughton, 2005), in this chapter, the scientific arguments used by non-scientist American Indians are described, evaluated, and interpreted. Analysis of these comments reveals that Western Shoshone and Southern Paiute scientific arguments are characterized by two rhetorical strategies: (a) challenging the authority of Western science through invocation of Western Shoshone and Southern Paiute understandings of culture and science; and (b) using arguments based on Western scientific knowledge to contradict the government's evidence in support of the Yucca Mountain site. The remainder of this section evaluates these strategies.

Challenging the Absolute Authority of Western Science

The case study reveals findings consistent with earlier research focusing on the relationship between science and indigenous peoples (Coleman &

Dysart, 2007). In the public comment period, American Indians opposed to the Yucca Mountain project made arguments that challenged the scientific way of thinking about the Yucca Mountain site and offered alternative ways of thinking about Yucca Mountain based on the cultural and spiritual knowledge of the Western Shoshone, Southern Paiute, and others. Interestingly, many comments implicitly accept the legitimacy of science as a culture and practice but challenge its application and authority. For example, Edward Smith of Chemehuevi Southern Paiute nation stated in a public hearing in Las Vegas,

> We have been telling the government about the importance of Yucca Mountain area to our people since 1987. Today I tell you the same thing yet again. Yucca Mountain is sacred to our people. It is part of the lands that our Creator gave to us. It is a powerful place. We have been prevented from using it and caring for it. The government has disturbed the area for half a century.
>
> (U.S. Department of Energy, 2001d, pp. 24–25)

In his statement, Smith positions the spiritual nature of the land as an argument against the Yucca Mountain site. His argument does not directly address the scientific arguments that support the choice of Yucca Mountain as the repository of nuclear waste; instead, it challenges the absolute authority of science to evaluate, legitimate, and approve. This suggests the importance of context, a sort of pragmatic relativism, which can also be seen in Smith's appeal to the sacredness of Yucca Mountain to authorize his claim. Rather than dismissing the legitimacy of science, he says the mountain is sacred to his "people," an appeal to the legitimacy of cultural knowledge and a gesture intended to elicit cultural respect and understanding. Again, this represents a challenge to the hegemony of scientific argument and a call to weigh the merits of culture, as the particular case dictates, rather than dismissing the scientific outright.

While other challenges follow this line of argument, American Indians who issued public comments also invoked the superiority of their traditional spiritual knowledge. They argued not that science does not afford truth or insight—but that it can be misapplied, misunderstood, and used in the service of political interests. To draw again from Smith's comments, it is the government, not scientists or science itself, which has "prevented" his people from "using" and "caring" for the land their "Creator gave to" them. In another example, Calvin Meyers of the Moapa Paiute Nation, commented,

> I have read a long time ago and I believe this, because it came from the medicine man, that before the government or anybody else even messed with the—with radiation, they were told not to bother with it

> because they don't know what to do with it. They don't what it can do to them [sic]. They don't know how to get rid of it.
>
> (U.S. Department of Energy, 2001a, p. 181)

In this statement, Meyers cites a medicine man to argue that humans should have never even started to work with radioactive materials because of the difficulty in disposing of the waste. What is significant here is not the wisdom of pointing out the conundrum of nuclear waste—all sides will freely admit to that—but the source of authority to which the argument appeals. This appeal is to Moapa knowledge and sacred wisdom, invoking a historical narrative pitting science against nature, where science is cast as a tragic outgrowth of human ambition in the modern world. The medicine man's authority thus becomes recognizable to the non-insider as a source of reason and pure objectivity. Again, the implication is that cultural ethics should play a part in judging the suitable parameters of science.

Similarly, Barbara Durham and Bill Helmer (2001), Tribal Administrator and Environmental Director, respectively, for Timbisha Shoshone Tribe, challenge the suitability of the Yucca Mountain site by attacking the judgment of those who practice science irresponsibly. In a letter submitted during the public comment period, they wrote,

> The unresolved dangers of the Yucca Mountain project demand that the DOE listen and respond to the concerns of tribes and others who may know much more than the DOE about 'site suitability.' If the ancestors of the Timbisha Shoshones had left such a poison for future generations we probably would be dead or not able to live here anymore. The ancestors would never do this, and the Timbisha Shoshone Tribe of today will never approve the desecration of this land for future generations.
>
> (p. 10)

This comment, and Meyers' earlier comment, appeals to the wisdom of ancestors, elders, and spiritual leaders that directly challenge the argument made by the DOE that a scientifically and technically suitable storage site can solve the problem of nuclear waste (Abraham, 2002). This strategy also calls into question the technocratic reliance on Western scientific knowledge in American public deliberation.

In similar appeals to American Indian cultural authority, the anthropocentric focus of the DOE's scientific evidence was also called into question. Western Shoshone Carrie Dann stated in a Crescent Valley hearing:

> And I look at all of these things, there's not only going to be suffering from human kind, but suffering from all the animals, the birds. Of

course, the plant life too will suffer, only we can't see them suffer, but they will. They will wilt and they will die.

(U.S. Department of Energy, 2001e, p. 28)

Dann challenges the DOE to consider animal and plant health in addition to human health. Her argument reflects the tendency of some American Indian cultures to value the earth and the symbiotic relationships between all living things (Deloria, 1997; Mander, 1992).[5] Dann's perspective is not merely based on cultural and religious beliefs. Deloria (1997) argues that much indigenous knowledge is based on the oral tradition, which "represented not simply information on ancient events but precise knowledge of birds, animals, plants, geologic features, and religious experiences of a group of people" (p. 36). This argument about the effects on plants and animals by the Yucca Mountain site, therefore, does not include traditional Western "scientific evidence" but it still represents a challenge to the Yucca Mountain site. In that way, it further expands the boundaries of the scientific controversy to include spiritual and cultural concerns.

The above public comments serve to highlight three ways that American Indians used cultural—and by extension spiritual—arguments to challenge the Yucca Mountain site. In these comments we see evidence of (a) spirituality as a competing criterion to science; (b) cultural knowledge as a challenge to the authority of science and responsible practice; and (c) a challenge to the anthropocentrism of Western science. While none of these are traditional scientific arguments, they do engage science. And they engage science in a different way than direct refutation of scientific evidence. These examples demonstrate how cultural and spiritual knowledge can be invoked to dispute scientific knowledge; although in this case, this challenge was not entirely successful. In the Yucca Mountain site authorization decision, the DOE essentially ignored these arguments when it decided to go forward with the Yucca Mountain site (Endres, 2009). The DOE's reluctance to accept cultural and spiritual arguments as relevant contrary evidence is consistent with the dominance of scientific rationality over cultural and spiritual "irrationality" in public deliberation.

Yet, despite their lack of traditional Western scientific evidence, the arguments posed by these non-scientist American Indians presented significant objections and questions that are worthy to consider. Can technology solve the problem of radioactive nuclear waste? Does the focus on Western scientific argument exclude consideration of whether nuclear technologies that emit dangerous levels of radiation for hundreds of thousands of years should be pursued? Should plant and animal life be considered as important as human life? While these questions are beyond the scope of this chapter, they do suggest that multiple forms of knowledge can make public policy deliberation richer and ultimately more complex and inclusive.

Using Scientific Argument

While American Indian arguments in the Yucca Mountain public comment period invoked culture, spirituality, and traditional knowledge as support for opposition to the Yucca Mountain project, American Indian arguments also used traditional Western scientific arguments. As Fabj and Sobnosky (1995) argue, not only are non-scientists capable of engaging in scientific argument but public scientific controversy involves interplay between scientific argument and other forms of argument. Keränen (2005) states, "Participants engage in an argumentative process in which competing perceptions of science forged by scientists, citizens, policy makers, journalists, and others vie for ascendancy and acceptance in ways that reconstitute the borders between the public and the technical" (p. 97). In cases of public scientific controversy, publics can and do use scientific arguments in addition to other forms of argument. This section explores how American Indian participants in the public comment period invoked scientific arguments in their opposition to the Yucca Mountain site.

In their comment letter, Durham and Helmer (2001) from the Timbisha Shoshone Tribe made an argument about the potential for radiation leakage from the Yucca Mountain site. Their letter responds to the DOE's reliance on the Environmental Protection Agency's (EPA) 10,000-year standard for radiation compliance,[6] upon which the models of the radiation leakage from the site were based. They argue that the 10,000-year standard is insufficient and that potential radiation doses need to be monitored for a longer period of time. To support their claim, Durham and Helmer refer to some of the DOE's other studies on Yucca Mountain and studies by scientists. They wrote:

> The 10,000 year regulatory compliance period is insufficient because groundwater contamination from leaked radionuclides is predicted by the DOE to occur after 10,000 years (other scientists have predicted leakage within a thousand years). The predictive models for 10,000 years are extremely abstract and virtually worthless, since they are based on data that is constantly being revised as new data is accumulated.
>
> (2001, p. 3)

This argument challenges the scientific findings of the DOE and the technical radiation standard offered by the EPA. Similarly, Smith (U.S. Department of Energy, 2001d) questions the models that were used to create EPA and NRC standards related to radiation. He argues that models are "based on assumptions, scientific uncertainties, and degrees of uncertainty" (p. 3) Although Durham and Helmer, or Smith did not offer original scientific findings to support their claims, their arguments do reveal a

familiarity with scientific concepts and an ability to critically examine the scientific arguments put forth by the DOE. Unlike the examples in the previous section which challenged the legitimacy of scientific arguments by positing cultural arguments as another form of legitimate argument, these arguments challenge the legitimacy of the Yucca Mountain project by using the DOE's own findings and standards of scientific and technical suitability. After the hearings, the U.S. District of Columbia Court of Appeals ruled that the EPA must change the radiation standard for the Yucca Mountain site (U.S. Environmental Protection Agency, 2008).

In addition to challenges to EPA models and radiation standards, there are also arguments based in geological and hydrological science. In an argument that challenged the geological findings of the DOE, Marlene Begay of the Walker River Paiute stated at a public hearing in Hawthorne, Nevada,

> Yucca Mountain is in a very active earthquake zone with a number of volcanic cinder cones visible a short distance away. The highly fractured and fissured rock allows rain water infiltration at a fast rate, which will corrode waste containers and wash their deadly contents into the ground water, contaminating the drinking water supply for nearby communities. As pointed out to the DOE three years ago by over 200 environmental groups, this fast flow of water should disqualify Yucca Mountain for further consideration, for it violates DOE's own repository citing guidelines.
>
> (U.S. Department of Energy, 2001b, pp. 1–2)

This argument posits that the geological and hydrological features of Yucca Mountain should disqualify it as a site. She argues that the volcanic and seismic features of the mountain will allow water to flow through the mountain quickly and result in radiation contamination. Although Begay does not offer original scientific data to support her claims, she does challenge the DOE's scientific and technical findings related to the Yucca Mountain site. Begay's comment calls into question the legitimacy of the DOE's findings. However, the comment does not call science into question; rather, it implies that competing scientific findings lead to a different conclusion.

The Timbisha Shoshone Tribal Council also objects to the scientific and technical suitability of the Yucca Mountain site. In Resolution 18–2001, the Timbisha Shoshone Tribal Council expresses concern over the potential contamination of groundwater from nuclear waste at Yucca Mountain. The resolution states,

> Whereas the Timbisha Shoshone Tribe will be directly affected by the proposed Yucca Mountain project since the Furnace Creek parcel of

> the Tribe is down-gradient from the groundwater of Yucca Mountain, and the predicted radionuclide leakage from the storage casks will eventually reach the Timbisha Shoshone; and the proposed Yucca Mountain project would adversely affect the future members of the Timbisha Shoshone Tribe as well as all living things at the site vicinity and along the proposed transportation corridors.
>
> (Timbisha Shoshone Tribe, 2001)

The resolution concludes with a recommendation that the Secretary of Energy not authorize the Yucca Mountain site. Like Begay's comment, this comment challenges the suitability of the Yucca Mountain site by claiming that the site will not effectively contain radioactive leakage.

These examples demonstrate that American Indian participants in the public comment period relied on Western scientific arguments to oppose the Yucca Mountain site. The comments by Durham and Helmer, and Smith also contained appeals to non-scientific arguments as evidenced by the examples in the previous section. Moreover, in addition to Begay's arguments about the geological and hydrological features of Yucca Mountain, her comment also draws from cultural beliefs about Yucca Mountain

> According to the Shoshone, Yucca Mountain is not really a mountain. It is a rolling hill. This means that it moves and will continue to move. Putting nuclear waste in the land is polluting it and will kill Mother Earth. We only have one earth, and one water. Everything is related: If we poison earth, then we are poisoning ourselves.
>
> (U.S. Department of Energy, 2001b, p. 1)

Taken together, the two passages from Begay's comment use both Western scientific and cultural or indigenous scientific claims to argue against the Yucca Mountain site. The argument employs concepts from Western geologic science to argue that Yucca Mountain is seismically and volcanically active, but also draws from a cultural knowledge to argue that Yucca Mountain is a rolling hill that will move. Both arguments challenge the suitability of the Yucca Mountain site by arguing that its instability may cause radioactive leakage.

In the above examples, scientific arguments challenge the science used to support the Yucca Mountain site, and non-scientific arguments challenge the reliance on science as the only method to determine the suitability of the Yucca Mountain site. The simultaneous use of both Western scientific and cultural claims provides evidence that scientific arguments are not mutually exclusive with non-scientific cultural or spiritual arguments.

This disputes the idea that American Indians and other indigenous people do not understand Western science or that Western science is

wholly incompatible with indigenous world views. One of the risks of emphasizing the differences in Western science from the science of other cultures (see Deloria, 1997) is that the emphasis may lead some people to the conclusion that indigenous people cannot understand or engage in Western science. This is a problematic assumption that serves to reinforce the marginalization of indigenous knowledge and racist beliefs about American Indian culture and intelligence. That American Indians used Western scientific arguments simultaneously with arguments from traditional knowledge and spirituality reveals that American Indians comprehend and can use Western science when it serves their purposes. This counters the assumption that all arguments made by American Indians are "quaint, outmoded and scientifically irrelevant" (Coleman & Dysart, 2007, p. 20).

This evidence also debunks the notion that Western science and indigenous knowledge, culture, and spirituality are truly mutually exclusive. Although they are different types of arguments, they can be used together to support an overarching argument, in this case opposition of the Yucca Mountain site. That is, while some of those commenting issued statements that focused on indigenous factors, and others issued statements that focused on Western science, both approaches were intended to meet the same end: to stop the waste site. And both were issued by people with a shared culture.

Certainly, there are cases in which indigenous traditional knowledge may contradict Western science (e.g., the origins of American Indian tribes) (Deloria, 1997). However, the cases of contradiction do not invalidate the compatibility of science and culture arguments, but rather suggest that relationships between scientific, cultural, and spiritual arguments are complex and must be examined through particular cases.

It is also important to note that there may be negative consequences of simultaneously issuing both scientific arguments and non-scientific arguments, as was the case in the American Indian participation in the deliberation over Yucca Mountain. There is the possibility that the nature of perceptions and stereotypes about American Indians may result in both arguments being disregarded. Deloria (1997) suggests,

> Regardless of what Indians have said concerning their origins, their migrations, their experiences with birds, animals, lands, waters, mountains, and other peoples, the scientists have maintained a stranglehold on the definitions of what respectable and reliable human experiences are. The Indian explanation is always cast aside as superstition, precluding Indians from having an acceptable status as human beings and reducing them in the eyes of educated people to a pre-human level of ignorance.
>
> (p. 7)

As a result, work still needs to be done to envision public deliberation in a way that acknowledges the contributions of American Indians.

Conclusion

Moving outward from the case study, this chapter explored the complex relationships between scientific, spiritual, and cultural arguments in public deliberation about scientific controversy. The intersection of these types of arguments often occurs in relation to politically and emotionally charged issues. When science enters the realm of public policy deliberation, it stands as one form of evidence among many others. Public scientific controversy involves more than just debates between scientists, it also involves contestation over the role of science in decision making, scientific findings versus local and cultural knowledge, and the relationship between cultural identity/spirituality and science. The study of public scientific controversy is an important area of research in science communication, especially with recent controversies over climate change, stem-cell research, the causes of autism, and intelligent design. This chapter contributes to this much-needed program of research. There are at least four implications of the findings of this case study that call for future research.

First, the findings presented here shift the focus from the arguments of scientists to scientific arguments made by the public. Although this rhetorical analysis examined comments by American Indians, some of these findings can be generalized to other non-scientist members of the public. Science communication—both the rhetoric of science and the public understanding of science—tends to focus on either how scientists communicate with each other or how scientists communicate with the public (often through mediated channels). In both cases, the focus is mainly on how scientists communicate. This chapter calls for a shift in focus to examine how publics communicate about science. By no means should the study of how scientists communicate cease, but the collective body of research in this area will be enhanced with an understanding of how non-scientist publics attempt to make scientific arguments or challenge scientific arguments with other forms of argument. Moreover, a focus on how publics engage with science in public controversy or deliberation is revealing even when not compared to how scientists communicate. This chapter expands our understanding of the relationship of science to other forms of knowledge. Future research in this area could include case studies of different public scientific controversies.

Second, in addition to better understanding how publics engage with science in public deliberation, the current analysis also helps us to understand the interplay between science, culture, and spirituality in public scientific controversy. Instead of reinforcing the polarity of science and culture/spirituality, this case study reveals the messiness of public scientific

controversy in which different perspectives interact. In other words, scientific knowledge is not the only kind of knowledge that is relevant in public controversies. The findings of this study are consistent with scholars like Fischer (2000), Wynne (1996), Kinsella (2004), Walker and Daniels (2004), and others who recognize the importance of local, cultural knowledge as a part of deliberation about scientific policies. Although scientific arguments, religious arguments, and cultural arguments are different types of arguments, they are not incompatible. Moreover, multiple forms of knowledge are crucial to public deliberation. As Fabj and Sobnosky (1995) suggest, "bridges between different discourses on the same issue help to realize the full potential of democratic society" (p. 183). When science enters the realm of public deliberation, it is no longer insulated from interaction with policy concerns. To make just and democratic policies, it is crucial that not only the scientific and technical aspects of a policy are understood, but also the implications for local communities, cultural and spiritual beliefs, and the limitations of making public policy decisions using only science.

Besides this case study, which looked at American Indian scientific, cultural, and spiritual objections to the Yucca Mountain nuclear waste site, there are many other cases worthy of study. Specifically, examination of additional cases can reveal how cultural and spiritual arguments can be defined in multiple ways. For example, in the case of autism research, groups of parents object to child immunization due to its potential correlation with autism. In this case, the parents' arguments are defined as cultural arguments and are contrasted with scientific evidence. In another example, the debate over intelligent design has revealed some interesting dynamics in the interplay between science and spirituality with some scientists, such as Richard Dawkins, defending atheism and other scientists upholding the compatibility of evolution and spiritual beliefs. Further study in this area will help to build our understanding of the interplay and instances of fluidity between science, culture, and spirituality.

Third, this chapter has implications for public participation in environmental decision making. Many environmental communication scholars study the processes of public participation in environmental decision making (e.g., Depoe & Delicath, 2004). As science plays an important role in most environmental policies like siting nuclear waste facilities, it is crucial that how science intermingles or blends with other forms of evidence in public deliberation over scientific policy is understood. As research in public participation has shown, decision making often values scientific and technical arguments over cultural, spiritual, and other forms of proof (Depoe & Delicath, 2004; Katz & Miller, 1996; Waddell, 1990). This chapter not only describes how participants in a decision-making process used scientific argument, but also how they created positions against the Yucca Mountain site through combinations of scientific and

non-scientific cultural and spiritual arguments. While this chapter does not offer conclusions about how to create better models of public participation that recognize the interplay between science, cultural, and spiritual arguments, it does highlight the need for science communication scholars to engage in conversation with environmental communication scholars about the role of science in public participation in environmental decision making.

Finally, because this case study focused on the arguments made by American Indians, this chapter has implications for how the relationship between indigenous knowledge and Western science is understood. It challenges misconceptions about the relationship between American Indian cultures and science. Findings reveal that while stereotypes assume that Western science is incompatible with indigenous science and knowledge, the incompatibility is a social construction that serves to continue the marginalization of indigenous peoples. As this case study shows, it is possible for American Indians to maintain their cultural/spiritual beliefs and use Western science. Although there will be situations when Western science is at odds with indigenous science, this is not always the case. The complexity of indigenous knowledge and the necessity of evaluating American Indian engagement with science must be examined on a case-by-case basis. Thus, researchers interested in the relationship between indigenous knowledge and Western science can contribute to this conversation through examining additional cases of public scientific controversy that overlap with indigenous peoples and their lands.

Notes

1. Although the general term "American Indians" is used here, it is important to recognize that there are over 500 American Indian nations in the United States (Department of the Interior, 2002). Even though some generalizations are made about American Indians as a group, care is taken to distinguish the arguments and beliefs of specific American Indian nations, in this case mostly Western Shoshone and Southern Paiutes.
2. This interview was part of the Nuclear Technology in the Great Basin Oral History Project at the University of Utah.
3. "Treaty between the United States of America and the Western Bands of Shoshone Indians," October 1, 1863, 18 Stat. 689–692.
4. There have been several other public comment periods during the research of the Yucca Mountain site. For example, there was a public comment period associated with the Draft Environmental Impact Statement in 1998.
5. It is important to note that a cultural value does not automatically translate into practice. In other words, this chapter is not meant to romanticize all American Indians as living in harmony with nature. However, many tribes explicitly place value on nature in ways that other cultures do not.
6. The Environmental Protection Agency is responsible for setting radiation standards in relation to protecting the public from radiation exposure from the Yucca Mountain site. In 2001, they set a standard for a 10,000-year compliance

period, meaning that the Yucca Mountain project would have to perform dose projections and protect the public from potential radiation exposure for 10,000 years after accepting waste. In 2004 the U.S. Court of Appeals for the District of Columbia ruled that the 10,000-year standard was inconsistent with the recommendations of the National Academy of Sciences and called for a revised standard. In 2005, the EPA released a new standard that calls for a one-million-year compliance period (U.S. Environmental Protection Agency, 2008).

References

Abraham, S. (2002). *Recommendation by the Secretary of Energy regarding the suitability of the Yucca Mountain site for a repository under the Nuclear Waste Policy Act of 1982.* Washington, DC: U.S. Department of Energy.

Burgchardt, C. R. (2005). *Readings in rhetorical criticism.* State College, PA: Strata Publishing.

Coleman, C., & Dysart, E. V. (2007). Framing of the Kennewick Man against the backdrop of a scientific and cultural controversy. *Science Communication, 27,* 3–26.

Condit, C. M. (1998). The rhetoric of intelligent design: Alternatives for science and religion. *Rhetoric and Public Affairs, 1,* 593–602.

Deloria Jr., V. (1997). *Red earth, white lies: Native Americans and the myth of scientific fact.* Golden, CO: Fulcrum Publishing.

Depoe, S., & Delicath, J. W. (2004). Introduction. In S. Depoe, J. W. Delicath, & M. A. Elsenbeer (Eds.), *Communication and public participation in environmental decision making* (pp. 1–10). Albany, NY: State University of New York Press.

Durham, B., & Helmer, B. (2001). *Letter to the Department of Energy.* Received October 10, 2001, public comment #330036. Retrieved January 20, 2005, from www.ocrwm.doe.gov/documents/sr_comm/sr_pdf/330036.pdf.

Endres, D. (2005). *The guise of deliberation: A rhetorical criticism of arguments in the Yucca Mountain site authorization controversy.* Unpublished doctoral dissertation, University of Washington.

Endres, D. (2009). The rhetoric of nuclear colonialism: Rhetorical exclusion of American Indian arguments in the Yucca Mountain nuclear waste siting decision. *Communication and Critical/Cultural Studies, 6,* 39–60.

Fabj, V., & Sobnosky, M. J. (1995). AIDS activism and the rejuvenation of the public sphere. *Argumentation and Advocacy, 31,* 163–184.

Farrell, T. B., & Goodnight, G. T. (1981). Accidental rhetoric: The root metaphors of Three Mile Island. *Communication Monographs, 48,* 271–301.

Fiorino, D. J. (1990). Citizen participation and environmental risk: A survey of institutional mechanisms. *Science, Technology and Human Values, 15,* 226–243.

Fischer, F. (2000). *Citizens, experts, and the environment: The politics of local knowledge.* Durham, NC: Duke University Press.

Fisher, W. (1987). *Human communication as narration: Toward a philosophy of reason, value, and action.* Columbia, SC: University of South Carolina Press.

Foss, S. K. (2009). *Rhetorical criticism: Exploration and practice* (4th ed.). Long Grove, IL: Waveland Press.

Friedman, S. M., Dunwoody, S., & Rogers, C. L. (1986). Introduction. In S. S. Friedman, S. Dunwoody, & C. L. Rogers (Eds.), *Scientists and journalists: Reporting science as news* (pp. xi–xvii). New York: Free Press.

Goodnight, G. T. (1982). The personal, technical, and public spheres of argument: A speculative inquiry into the act of public deliberation. *Journal of the American Forensics Association, 18*, 214–227.

Goodnight, G. T. (2005). Science and technology controversy: A rationale for inquiry. *Argumentation and Advocacy, 42*, 26–29.

Gross, A. G. (1984). Public debates as failed social dramas: The recombinant DNA controversy. *Quarterly Journal of Speech, 70*, 397–409.

Harris, T. M., Parrott, R., & Dorgan, K. A. (2004). Talking about human genetics within religious frameworks. *Health Communication, 16*, 105–116.

Hart, R. P., & Daughton, S. (2005). Modern rhetorical criticism (3rd ed.). Boston, MA: Allyn and Bacon.

Hodson, D. (1993). In search of a rational for multicultural science education. *Science Education, 77*, 685–711.

Johnson-Sheehan, R., & Morgan, L. (2008). Darwin's dilemma: Science in the public forum. *Journal of Technical Writing and Communication, 38*, 53–73.

Katz, S. B., & Miller, C. R. (1996). The low-level radioactive waste citing controversy in North Carolina: Toward a rhetorical model of risk communication. In C. G. Herndl & S. C. Brown (Eds.), *Green culture: Environmental rhetoric in contemporary America* (pp. 111–140). Madison, WI: University of Wisconsin Press.

Keränen, L. (2005). Mapping misconduct: Demarcating legitimate science from "fraud" in the B-06 lumpectomy controversy. *Argumentation and Advocacy, 42*, 94–113.

Kinsella, W. J. (2004). Public expertise: A foundation for citizen participation in energy and environmental decisions. In S. Depoe, J. W. Delicath, & M. A. Elsenbeer (Eds.), *Communication and public participation in environmental decision making* (pp. 83–98). Albany, NY: State University of New York Press.

Lessl, T. A. (1989). The priestly voice. *Quarterly Journal of Speech, 75*, 183–197.

Lessl, T. A. (1993). Toward a definition of religions communication: Scientific and religious uses of evolution. *Journal of Communication and Religion, 16*, 127–138.

Lessl, T. A. (2003). Scientific rhetoric as religious advocacy: Origins in the public schools. *Journal of Communication and Religion, 26*, 1–27.

Lessl, T. A. (2005). The mythological conditioning of scientific naturalism. *Journal of Communication and Religion, 28*, 23–46.

Lyne, J., & Howe, H. F. (1986). "Punctuated equilibria": Rhetorical dynamics of a scientific controversy. *Quarterly Journal of Speech, 72*, 132–147.

Mander, J. (1992). *In the absence of the sacred: The failure of technology and the survival of the Indian nations*. San Francisco, CA: Sierra Club Books.

Manzini, S. (2003). Effective communication of science in a culturally diverse society. *Science Communication, 25*, 191–197.

Martin, J. D., Trammell, K. D., Landers, D., Valois, J. M., & Bailey, T. (2006). Journalism and the debate over origins: Newspaper coverage of intelligent design. *Journal of Media and Religion, 5*, 49–61.

Nuclear Waste Policy Act: As amended with appropriations acts appended (No. 20585). (2004). Retrieved March 12, 2004, from www.ocrwm.doe.gov/documents/nwpa/css/nwpa_2004.pdf.

Philipsen, G. (1997). A theory of speech codes. In G. Philipsen & T. Albrecht

(Eds.), *Developing theories of communication* (pp. 119–156). Albany, NY: State University of New York Press.

Ratliff, J. N. (1997). The politics of nuclear waste: An analysis of a public hearing on the proposed Yucca Mountain nuclear waste repository. *Communication Studies, 48*, 359–380.

Smith, L. T. (1999). *Decolonizing methodology: Research and indigenous peoples.* London and New York: Zed Books.

Snow, C. P. (1993). *The two cultures.* Cambridge: Cambridge University Press (originally published in 1959).

Taylor, C. A. (1992). Of audience, expertise and authority: The evolving creationism debate. *Quarterly Journal of Speech, 78*, 277–295.

Timbisha Shoshone Tribe. (2001). *Resolution No. 18–2001.* Submitted to the Department of Energy and received on October 24, 2001 (public comment #330095). Retrieved December 30, 2008, from www.ocrwm.doe.gov/documents/sr_comm/sr_pdf/330095.pdf.

U.S. Census Bureau. (2000). *Census 2000.* Retrieved December 30, 2008, from www.census.gov/main/www/cen2000.html.

U.S. Department of Energy. (2001a). *Hearings for site recommendation consideration of the Yucca Mountain site for geologic disposal of spent nuclear fuel and high-level radioactive waste.* Reporter's transcript of proceedings taken on Wednesday, December 12, 2001, at 1 p.m. at Las Vegas, NV, reported by Heidi Konsten, RPR #516382.

U.S. Department of Energy. (2001b). *Public comments on site recommendation for the Yucca Mountain Project.* Reporter's transcript of proceedings taken on Friday, October 12, 2001, at Hawthorne, NV, reported by Nicole M. Rossy, CSR #10698.

U.S. Department of Energy. (2001c). *Site recommendation support documents: Public comments submitted during the public comment period.* Retrieved December 30, 2008, from www.ocrwm.doe.gov/documents/sr_comm/index.htm.

U.S. Department of Energy. (2001d). *U.S. Department of Energy availability session on the possible site recommendation of Yucca Mountain.* Reporter's transcript of proceedings taken on Saturday, September 29, 2001, at 10 a.m.–4 p.m. at Las Vegas Science Center, Las Vegas, NV, reported by Kevin Wm. Daniel, CCR #711.

U.S. Department of Energy. (2001e). *U.S. Department of Energy public hearing on the possible site recommendation of Yucca Mountain.* Reporter's transcript of proceedings taken on Wednesday, October 10, 2001, at 3 p.m. at Town Center, Crescent Valley, NV.

U.S. Department of Energy. (2008a). *How much nuclear waste is in the United States?* Retrieved December 30, 2008, from www.ocrwm.doe.gov/ym_repository/about_project/waste_explained/howmuch.shtml.

U.S. Department of Energy. (2008b). *Yucca Mountain repository.* Retrieved December 22, 2008, from www.ocrwm.doe.gov/ym_repository/index.shtml.

U.S. Department of the Interior: Bureau of Indian Affairs. (2002). National Archives and Records Administration (Federal Register Vol. 67, No. 134). Retrieved December, 22, 2008, from www.census.gov/pubinfo/www/FRN02.pdf.

U.S. Environmental Protection Agency. (2008). *Fact Sheet: Public health and envi-*

ronmental radiation protection standards for Yucca Mountain, Nevada (40 CFR Part 17, final rule. Retrieved December 30, 2008, from www.epa.gov/rpdweb00/yucca/2008factsheet.html.

U.S. Nuclear Regulatory Commission. (2007). *High-level Waste*. Retrieved December 30, 2008, from www.nrc.gov/waste/high-level-waste.html.

van Dijck, J. (2003). After the 'Two Cultures": Toward a "(Multi)cultural" practice of science communication. *Science Communication, 25*, 177–190.

Waddell, C. (1990). The role of *pathos* in the decision-making process: A study in the rhetoric of science policy. *Quarterly Journal of Speech, 76*, 381–400.

Walker, G. B., & Daniels, S. E. (2004). Dialogue and deliberation in environmental conflict: Enacting civic science. In S. L. Seneca (Ed.), *The environmental communication yearbook 1* (pp. 135–152). Mahwah, NJ: Lawrence Erlbaum Associates.

Wynne, B. (1996). May the sheep safely graze? A reflexive view of the expert–lay knowledge divide. In S. Lash, B. Szerszynski, & B. Wynne (Eds.), *Risk, environment and modernity: Towards a new ecology* (pp. 44–83). London: Sage.