

PSYCHOLOGICAL EFFECTS OF TECHNOLOGICAL/HUMAN-CAUSED ENVIRONMENTAL DISASTERS: EXAMINATION OF THE NAVAJO AND URANIUM

Carol A. Markstrom, Ph.D. and Perry H. Charley

Abstract: Disasters can be defined as catastrophic events that challenge the normal range of human coping ability. The technological/human-caused disaster, a classification of interest in this article, is attributable to human error or misjudgment. Lower socioeconomic status and race intersect in the heightened risk for technological/human-caused disasters among people of color. The experience of the Navajo with the uranium industry is argued to specifically be this type of a disaster with associated long-standing psychological impacts. The history of the Navajo with uranium mining and milling is reviewed with a discussion of the arduous efforts for compensation. The psychological impacts of this long-standing disaster among the Navajo are organized around major themes of: (a) human losses and bereavement, (b) environmental losses and contamination, (c) feelings of betrayal by government and mining and milling companies, (d) fears about current and future effects, (e) prolonged duration of psychological effects, (f) anxiety and depression, and (g) complicating factors of poverty and racism. The paper concludes with suggestions for culturally-appropriate education and intervention.

There has been a proliferation of articles about disasters in the psychological and psychiatric literatures in recent years. Less apparent in these literatures is that certain groups are at greater risk for victimization by technological/human-caused disasters. In the intersection of socioeconomic status (SES) and race, people of color are especially vulnerable to contaminating conditions that compromise health and well-being (Bullard, 1993). The term environmental racism is applied to this phenomenon. Long-standing discriminatory practices that have suppressed the power of

marginalized groups in society, limit the ability of these groups to prevent potentially dangerous technological practices from occurring within their domains. The same discriminatory conditions that led to such vulnerability contribute to restricted access to appropriate physical and mental health care to deal with the aftermath of technological/human-caused disasters.

To delve into these issues more fully and to illustrate the effects of a technological/human-caused environmental disaster on a group in society subjected to historical racism, the experience of the Navajo with uranium mining and milling is discussed utilizing existing literature as a basis. According to 2000 Census data, 269,202 individuals identify as solely Navajo (U.S. Department of Commerce, 2002), and approximately two-thirds of that number reside on the Navajo Nation (U.S. Census Bureau, 2000a). The Navajo reservation is located in the Four Corners region of the U.S. and encompasses 24,096 square miles in New Mexico, Arizona, and Utah including off-reservation trust land (U.S. Census Bureau, 2000a).

This article begins with various conceptualizations of disasters with special emphasis on the technological/human-caused classification. The common psychological effects of disasters are briefly reviewed. To fully portray the experience of the Navajo, a summary of the history of uranium mining and milling on and around the Navajo Nation is presented. The strenuous efforts for compensation are reviewed because they have been a major source of stress for families. The nature of this disaster is discussed according to impacts on the way of life and psychological well being of the Navajo people. The article concludes with suggestions for culturally appropriate healing and recovery measures.

Conceptualizations of Disasters

Disasters can be conceptualized on a continuum of deliberateness from "natural" on one end to "purposely perpetuated" on the other end with the "technological/human-caused" classification between the two ends (Green, 1996). A natural disaster occurs outside of the realm of human control, for example, a hurricane or a tornado. A technological or human-caused disaster is attributable to human error or misjudgment—the intent is not to cause disease, death, or disruption of lives. In contrast, a purposely-perpetuated disaster is caused by a perpetrator(s) with the specific intent of human destruction (e.g., September 11 tragedy). The technological/human-caused classification is somewhat problematic because victims may experience a mixture of benefits with adverse side effects. For instance, the introduction of an industry may provide employment and much needed income to depressed local economies, but such advantages are diminished by potentially hazardous working conditions and environmental contamination. This issue certainly pertained to the Navajo in respect to uranium and is discussed more fully in a later section.

Sturgeon (1993) stated that, "the common theme of disasters is that they are so catastrophic and overwhelming that they go beyond anything that individuals involved with normally have to cope with. As a result, their psychological capacity to function is stretched beyond the limits of endurance" (p. 421). What is known about disasters, in general, is that adverse psychological outcomes can be predicted from them (McFarlane, 1995). The most damaging effects of disasters can be the psychological scars of the trauma, most evident in diminished sense of safety and impaired social relations (McFarlane, 1995). Adverse psychological outcomes of disasters include anxiety, depression, somatic complaints, and relationship problems (Green & Lindy, 1994), substance abuse (Fullerton & Ursano, 1997), and negative affect such as increased levels of anger, alienation, mistrust of others, loneliness, and isolation (Jerusalem, Kaniasty, Lehman, Ritter, & Turnbull, 1995).

Posttraumatic stress disorder (PTSD) is a common diagnosis in respect to disasters and frequently occurs in conjunction with other disorders, such as anxiety and depression (Green & Lindy, 1994). Gender differences are apparent with PTSD. Women are more likely to experience anxiety and depression. Alternatively, men are more apt to experience alcohol abuse, physical or somatic complaints, and symptoms of hostility or acting-out (Green, 1996; Green & Lindy, 1994). A threat to one's survival is at the core of PTSD—whether it be a threat to oneself, family, or friends, or home, or even learning about serious injury or harm to a significant other(s) (Fullerton & Ursano, 1997; McCarroll, Ursano, & Fullerton, 1997). According to DSM-IV-TR (American Psychiatric Association, 2000), diagnosis of PTSD is made when there has been: (a) a traumatic event, (b) a re-experience of the event, (c) avoidance of stimuli associated with the trauma, (d) increased arousal, (e) duration of symptoms more than one month, and (f) impairment in social, occupational, or some other form of functioning. The severity, nature, and duration of the disaster or trauma are the best predictors of PTSD. As will be shown, all are relevant to the Navajo in their experience with uranium mining and milling.

Effects of PTSD can be acute or chronic, and chronic effects have been shown to endure for decades. For instance, with respect to the Buffalo Creek dam disaster in West Virginia, Green (1995) found symptoms of PTSD still evident 14 years later and Honig, Grace, Lindy, Newman, and Titchener (1999) reported symptoms of PTSD 20 years later among those who were children and adolescents at the time of the dam break. Many POWs from the Korean conflict were still diagnosed with PTSD after nearly half a century (Page, Engdahl, & Eberly, 1997). Additionally, an association has been found between PTSD and long-term serious physical health outcomes among victims of severe environmental stress (Boscarino, 1997). It has been suggested that with technological/human-caused disasters, some of the survivors may not return to normal levels of psychological functioning for a long period of time or at all (Green, 1996; Green & Lindy, 1994; Honig et al., 1999). Long

duration of psychological effects certainly applied to the case of Navajo victims of the uranium disaster and is one area addressed. Before this and related aspects of the uranium disaster are summarized, the historical context of the uranium industry among the Navajo is reviewed.

Overview of the Navajo and Uranium

History of Mining in Four Corners Area

The escalation of uranium mining during the Cold War in the Four Corners region of the United States was motivated by the need for atomic weaponry (U.S. Department of Energy, 1995). Although the intent was not to disrupt life among the Navajo, other Natives, and non-Natives, this occurred nonetheless. The story begins with the discovery of carnotite deposits in 1918 by John Wade, an Anglo trader from Sweetwater, Arizona (Eichstaedt, 1994). Carnotite is a mineral that contains both uranium and vanadium and is located in the northern and western Carrizo Mountains of the Four Corners area of the Navajo Nation.

In 1992, when Niels Bohr of Denmark received the Nobel Prize for his work in changing the world's picture of the atom, the potential of this massive power was unrealized. In January 1939, Bohr came to the United States with the news that German scientists were experimenting with the properties of the heavy element uranium, believing it retained fissionable properties. Within days, the government confirmed the information and worked to develop nuclear fission and a practical way to produce nuclear power before the Third Reich could do so (Hawkhill Associates, Inc., 1990).

Mining for uranium commenced in 1948 as a result of the Atomic Energy Commission's (AEC) uranium procurement program. Between 1948 and 1966, some 60 properties (at its height, 103 properties) were mined in the Carrizo Mountains (Chenoweth, 1985). Mining activities were begun in several other areas of the Navajo Nation (Chenoweth & Mallen, 1960). To process the ore from these properties, four mills were built on the Navajo Nation (see Table 1 and Figure 1).

Conditions in Mines/Mills

The Office of the Navajo Uranium Workers (T. Martinez, personal communication, August, 2001) maintains data on the number of Navajo people who worked in the uranium industry. Their records registered 2,200 Navajo miners and 400 millers. The actual numbers of Navajo miners and millers may be as high as 3,000 and 1,000, respectively, as estimated in Dawson and Madsen (1995). Work in the underground mines was very hazardous, primitive, and labor intensive (Churchill & LaDuke, 1992; Eichstaedt, 1994).

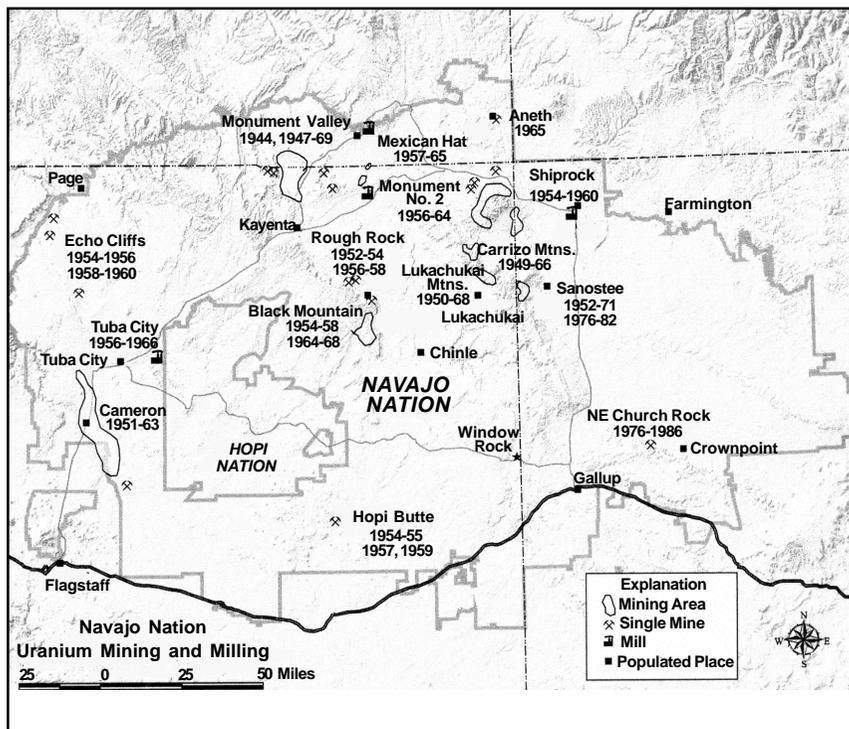
Table 1
Extent of Uranium Mining and Milling on Navajo Nation

Location	Dates	Mines Number of Properties
Carrizo Mountains	1948-1966	103
Lukachukai Mountains	1950-1968	53
Sanostee	1952-1970	16
Monument Valley	1942-1969	37
Black Mesa	1954-1968	15
Cameron	1950-1963	100
Bidahochi	1954-1959	1

Location	Dates	Mills Companies
Tuba City	1956-1966 1962-1966	Rare Metals Corporation of America Rare Metals merged with El Paso Natural Gas
Shiprock	1954-1963 1963-1968	Kerr McGee Oil Industry, Inc. Vanadium Corporation of America (VCA) and Foote Mineral Company (successor to VCA)
Mexican Hat	1957-1963 1963-1965	Texas-Zinc Mineral Corporation Atlas Corporation
Monument Valley	1955-1968	VCA and Foote Mineral Company

Proper protective clothing and safety measures were not provided nor enforced. Ventilation to control fugitive dust and radon progenies were non-existent. It was common practice to force the workers back into the mines immediately after blasting activities, subjecting the Navajo miners to heavy dust, smoke, radon activity, and unstable rocks from the ceilings. Complaints resulted in firing of individuals. Accident rates were high, frequently resulting in loss of hearing, vision, and/or limbs. Miners carried their lunches into the mines and ate in the mines, as well as drank the water that dripped from the walls and ceilings of the underground mines (Eichstaedt, 1994).

Figure 1
Abandoned Uranium Mines Project: Arizona, New Mexico, Utah--Navajo Lands
U.S. Army Corps of Engineers and U.S. Environmental Protection Agency



The following statement from Joe Ray Harvey¹ as quoted in Brugge, Benally, Harrison, Austin-Garrison, and Fasthorse-Begay (1997) illustrated some of these conditions:

When I first began to work, I worked for Kerr-McGee. Yes, it was like that, no air (ventilation); there was a lack of air when we worked. There was just lots of smoke and a powder smell after the blasting... The ventilation tubes did not go into the areas where we worked. (p. 38)

Milling activities were not any different or safer. Millers were subject to radioactive dust from the crushing operations and to sulfuric acids, sodium chlorate, and solvents from the leaching and extraction operations. Personal protective equipment was not used or readily available. The nature of the

conditions are illustrated in the following statements by informants from Dawson and Madsen's (1995) case study of American Indian mill workers:

It was messy and disorganized. It was also very dusty. I had an instant headache while working there. Also much coughing. In the first four years, they didn't provide masks. I breathed much dust and even coughed up the dust. I also had it in my eyes, and it irritated my eyes. I also had sores on my feet. It was hot and I had to wear an acid protector suit. Yellowcake would get into the suit. (p. 23)

The whole building was enclosed. Very stuffy. Can smell the boiling acid and ammonia. We had to handle this stuff (yellowcake) with our bare hands. When I worked in the yellowcake, I only wore a respirator. The dust was there all the time, especially when the yellowcake was being barreled. Now I see those who worked in the nuclear area wear special clothing, but we didn't. (pp. 23-24)

Effects on the Health of Uranium Workers

Uranium workers were exposed to high external radiation, radon gas, and high silica dust containing an underdetermined amount of radiation. RaA and RaC are two energetic alpha emitters of radon gas that interact with and damage body cells. They can be inhaled or transported through water droplets that are ingested. Daughters of radon will decay in the lungs, likewise emitting alpha particles besides gamma and beta. The amount of this dust-borne radioactivity present in mine atmosphere depends on ventilation, air turbulence, and other factors (Eichstaedt, 1994).

The absence of protective measures resulted in high levels of exposure to radioactivity in miners and millers. Summarizing data from the National Institute of Occupational Safety and Health (NIOSH), Eichstaedt (1994) reported that uranium miners were five times more likely to develop lung cancer than the general population. Indeed, more than 75% cases of lung cancer among Navajo males were found in the miners (Gottlieb & Husen, 1982), and Navajo people have a low incidence of smoking (Dawson, Madsen, & Spykerman, 1997; Gilliland, Hunt, Pardia, & Key, 2000; Mulloy, James, Mohs, & Kornfeld, 2001). In summarizing several studies, Mulloy et al. (2001) concluded that, "exposure to dust, gases, exhaust, and fumes can result in nonmalignant or malignant respiratory disease in underground miners" (p. 306). In addition to lung cancer, other respiratory diseases included silicosis, pulmonary fibrosis, emphysema, obstructive lung disease, silico-tuberculosis, and pneumoconiosis (Mulloy et al., 2001).

At the onset of uranium mining in the 1940s, many of the hazardous human consequences of uranium were known, but the tendency of the U.S. government was to minimize the relevance of the European studies to mining in the U.S. (Robinson, 1998). Further, no government agency assumed responsibility to establish and enforce mine safety regulations (U.S. Department of Energy, 1995). In August, 1949, the Public Health Service (PHS), under the U.S. Surgeon General, undertook the first study of miners and made a fateful decision. It was determined that individual miners would not be told of potential hazards from radiation in the mines for fear of causing alarm (U.S. Department of Energy, 1995). Instead of warning the miners, an exculpatory "study" of radiation effects on uranium miners was undertaken in which causal relations were confirmed between cumulative airborne radiation exposure and risk of respiratory cancer. Eventually these findings contributed to the development of protective legislation for miners and millers (PL-91-596, PL-91-173, and PL-95-164) (Lundin, Wagner, Hyg, & Archer, 1971; National Institute of Occupational Safety and Health, 1987). However, for the many Navajo people previously involved in the uranium industry, these protections came too late. The U.S. government had a trust obligation (Snyder Act of 1921) to Native Americans that included relief of stress and conservation of health. These basic principals were violated through the failure to inform Navajo and other American Indians of the hazardous working conditions in uranium mines and mills.

Legal Efforts for Compensation

In the early 1960s, efforts were initiated from Red Valley and Cove, Arizona to obtain compensation for families of deceased uranium miners who had died of lung cancer and other respiratory diseases. The first attempt to compensate uranium miners was in 1973, by the late Senator Joseph M. Montoya (D., NM) (Eichstaedt, 1994). For the next twenty years, until October 1990, numerous efforts were taken by congressional leaders to enact legislation to compensate uranium miners, millers, and surviving family members. In September 1979, Stewart L. Udall, former Secretary of the Interior and a former Arizona Congressman (D.), filed 185 claims against the U.S. government. Udall's lawsuit started a long legal battle through the courts.

A key factor of the government's counterargument was that the government was exempt from blame because it had exercised its "discretionary function" according to the Federal Torts Claims Act. The discretionary function used by the government allowed it to make certain decisions to carry out programs despite possible health risks and consequences. In the appeals process, the courts chose to interpret the exception for the benefit of the government (Eichstaedt, 1994). During its October, 1987 term, the U.S. Supreme Court upheld the earlier lower courts'

decision on behalf of the government, but added that remedy was warranted and that Congress was the appropriate source.

With this, efforts for compensation were renewed. After three more years of congressional hearings and the initiation of several additional legislative bills, on October 15, 1990, President George Bush signed into law H.R.2372, entitled the Radiation Exposure Compensation Act of 1990 (RECA), Public Law 101-426. Shortly after its passage, claimants realized that RECA had some serious flaws. The RECA administrator, the U.S. Department of Justice, refused to recognize traditional customs that may not have been recorded on state records, such as validation of marriages, use of ceremonial tobacco, use of original documents to support work history and medical conditions, and similar requirements. These shortcomings eventually led to RECA's revision in 2000. After another setback, due to bankrupt RECA funds and subsequent issuance of IOUs by the Federal Government, in July 2001 the U.S. Senate approved a spending bill that included \$84 million to pay the IOUs and President George W. Bush's signature followed. Further amendments occurred November 2, 2002 with President Bush's signing of the Justice Department's FY2002 Authorization bill. Prior to this amendment, uranium miners were required to prove exposure to at least 40 working levels (WLs) of radiation, while uranium millers and ore transporters were required to demonstrate employment in a mill or as an ore transporter for one full year. With the amendment, uranium miners can qualify for benefits by meeting either the 40 WL exposure standard or the one-year employment standard. The road to compensation continues to be rocky for many claimants, however. The U.S. General Accounting Office reported on April 15, 2003 that the RECA program is expected to run short of funding during the years 2003 through 2007 due to an increase in the number of claimants in the wake of revisions to RECA. Delays in compensation are anticipated. The uranium issue continues to be at the forefront of consciousness among Navajos. Grassroots groups are sending a message of *leetso dóodá* (no uranium mining in Navajo Country), and are actively engaged in initiatives to educate and inform the public, as well as lobby at Navajo Nation, state, and federal levels of government.

Psychological Consequences of Uranium Disaster

Due to the unintentional, but damaging environmental and health impacts of uranium mining and milling among the Navajo people, we classify it as a technological/human-caused environmental disaster. The psychological impacts of this kind of disaster can be more serious than natural disasters (Green, 1996). Natural disasters are clearly evident to all people and, in response, an "altruistic or therapeutic community" emerges to help cope with the aftermath (Jerusalem et al., 1995). Such a benefit was not available to the Navajo. The following themes of the uranium disaster give insight to the psychological repercussions: (a) human losses and bereavement, (b)

environmental losses and contamination, (c) feelings of betrayal by government and mining and milling companies, (d) fear about current and future effects, (e) prolonged duration of psychological effects, (f) anxiety and depression, and (g) psychological impacts and exacerbating conditions of poverty and minority status.

Human Losses and Bereavement

Mortality risk of Navajo uranium miners was examined according to vital statistics from the years 1960 to 1990 (Roscoe, Deddens, Salvan, & Schnorr, 1995). In examination of data from 303 of 757 miners that had died, elevated risk of mortality due to uranium-linked diseases of lung cancer, pneumoconiosis, and other respiratory diseases was reported. The loss of life among the Navajo had a profound impact as illustrated in the following quote by Joe Ray Harvey as he speaks of the Cove Community's shared experience of grief (Brugge et al., 1997):

There is a general sickness today, with all people. There are no elderly men in Cove because they were mostly miners and have died, but there are many widows. No men! People are still suffering today, especially the widows. (p. 54)

Loss of a family member, while stressful and emotionally painful, is a normal experience. However, when loss is compounded by exacerbating circumstances of disasters, bereavement can become traumatic. Trauma and loss are treated as two separate entities, but certainly can overlap in cases of disaster and form traumatic bereavement (Raphael & Martinek, 1997). Not only must individuals deal with the trauma, but also are engaged in the grieving process. Hence, traumatic bereavement is characterized by an ongoing preoccupation with the traumatic experience accompanied by an inability to progress through the grief process (Raphael & Martinek, 1997). The risk for traumatic bereavement among victims of the uranium disaster may be intensified by: (a) the degree of suffering of the ill family member, (b) the premature nature of the death, (c) the knowledge that the death was due to preventable, human-caused circumstances, (d) the reluctance of any social entity to take responsibility for the disaster, (e) the number of other people in the community affected by uranium mining/milling, and (f) the reduction in household income due to illness or death of the breadwinner.

Environmental Losses and Contamination

Environmental losses are called secondary losses, because they are widespread and affect all members of the community, whether or not they worked in the uranium mines and mills. Such secondary losses increase the number of victims of disasters and deplete much needed coping resources

and social support (Jerusalem et al., 1995). The hundreds of abandoned uranium mines and four inactive uranium mills on the Navajo Nation evidence the gravity of the environmental devastation. These sites continue to degrade the local environment, contaminating soil, plant life, and water, as well as the livestock that depend on clean food and water sources. Radioactive mine waste and protore were left to cause further dispersion of contaminants. In 1989 and 1990, the Navajo Abandoned Mine Lands (AML) Reclamation Department documented and prioritized 1,150 abandoned and un-reclaimed uranium mines according to their degree of physical and radiological hazards.

For the Navajo, their lifestyles, traditions, and cultural practices demand a positive interaction with the forces of nature. That is, to be in harmony and balance with one's self and with nature. In this sense, a primary goal of the Navajo is to "walk in harmony" (hózhó násháádóó). This critical tie with the environment was severely disrupted from the advent of past mining practices. For instance, areas once used to gather herbs for ceremonial and medicinal properties were impacted. Areas considered sacred and linked to explicit oral traditions became desecrated from contamination.

The Navajo peoples' spiritual tie to the land overlaps with basic subsistence functions. The land provides water and vegetation for animals, and humans consume the animals, vegetation, and water. The pattern is apparent—environmental contamination has multiple routes to enter into the biological realms of humans. The Navajo expressed concerns on all of these accounts (Woody, Jack, & Bizahaloni, 1981). Consider the following observations by impacted Navajo informants (Brugge et al., 1997):

Anna Aloysious: To this day low radiation is spreading its disease among us. They had piled up uranium ore beside the road that they never took care of completely when they left. They really did nothing in that way. They thought of us Navajos as nothing. That's how I think about it and it really hurts my heart and mind. (p. 28)

Dan N. Benally: It is true that waste was dumped off the hillsides and the water carried it into the main washes. Meat from these animals is consumed, and contamination continues to affect humans. Forty-three of the people I worked with have died now. Some time ago, I counted this. There are just a few of us still around. (p. 26)

Physical contamination also occurred through the use of open mines for livestock pens and shelter. Radioactive stones and protore obtained from abandoned mines were used for construction of homes and other domestic purposes. A recent U.S. EPA survey of water quality on unregulated water sources used for livestock and domestic usage indicated anomalous

contamination from arsenic, lead, and total uranium. Of great concern was the 1979 flashflood from the rupture of the United Nuclear Corporations (UNC) Church Rock, NM dam that sent radioactive water from a tailings pond down the Rio Puerco. The most severely affected were 1,700 people, mostly Navajo. Children were playing in the contaminated water and, later, only a small segment of the population was tested for thorium, a major contaminant from the spill (Woody et al., 1981). This incident was the largest nuclear accident in the United States, but certainly not as well publicized as the Three Mile Island incident (Grinde & Johansen, 1995).

The psychological impacts associated with environmental losses can be significant. For instance, it was noted that subsequent to the Exxon Valdez oil spill, Native people had higher rates of major depression, generalized anxiety, and PTSD than non-Native people (Manson, 1997). Native people subsisted on game, fish, plants, and berries that were destroyed or damaged by the spill. Similarly, the Navajo are afraid of what effects may occur from the water they drink and the animals they consume. As summarized in Woody et al. (1981):

The residents (of the Church Rock community) accused the companies of dwelling in 'money, money, money' while they live in fear and are faced with questions. Where to get the next water? How to get it? Where to graze the sheep? Whether their children should work for the company? Whether they are breathing radiation and who to ask for help? (pp. 82-83)

In short, lifestyles have changed due to fears of the radiation effects in farming and ranching, and it has been necessary to move herds to less desirable grazing locations.

Feelings of Betrayal By Government and Mining and Milling Companies

In addition to significant and multiple losses experienced by the Navajo impacted by the uranium disaster, feelings of betrayal occurred because it was known that the adverse impacts were human-caused and preventable. As stated by Jerusalem et al. (1995), "community stressors are rarely caused by the very individuals who are forced to cope with them" (p. 117). Certainly there were employment and income benefits of uranium mining and milling for the Navajo Nation. However, workers were not informed of the potential for loss of life and environmental contamination. Dawson (1992) reported that a feeling of being betrayed by their employers was a common response by Navajo informants. Woody et al. (1981) stated that people perceived they had been cheated, but did not know where to go for assistance. Negative affect can be intensified by the knowledge that a disaster could have been

prevented (Sturgeon, 1993). The following comments from Brugge et al. (1997) are revealing:

Mary Frank: They did not say it was harmful, they probably kept it a secret from us. Anglos kept that secret—with this I think. I am very concerned because I was left alone. (p. 46)

Frank Floyd: Are we disposable to the government? These are some of our thoughts this uranium brings out to the front... (p. 8)

Helen Johnson: The real sad thing about it was that they were never straight about what the hell this radiation was or would do to the health of these innocent people. White men (U.S. Government and mining companies) are not honest people. ... In the treaty of 1868 it mentioned that the Federal Government would protect the health of the Navajo people. Yet they didn't do so... (p. 36)

Betrayal also can be related to the lack of compensation from the companies and government, as described earlier and illustrated in this comment:

Paul Nakaidenae: All should be compensated, I think. We really suffered, so why is it that miners file claims and get no compensation? They have children who all are in need. (p. 27)

Fear About Current and Future Effects

There are some commonalities between the Chernobyl nuclear disaster and the uranium disaster. For victims of the Chernobyl disaster, there were three major concerns (Giel, 1998): (a) the effects of current radiation on health and whether or not current health problems were linked to the radioactivity in the environment, (b) the impact of radioactivity on the health of children, and (c) safety with respect to collecting plants in the forests, working with the land, and general food safety. In addition to current concerns of the Navajo about safety in air, water, soil, and livestock, there is anxiety about the uncertainty of and anticipation of health effects on oneself and family. The following quotes reflect these concerns (Brugge et al., 1997):

Greg Lapahe: Today our health is in jeopardy. My children are like that. They are experiencing difficulties health wise and are suffering. So, something called tumors are affecting them. Where are the diseases coming from? Uranium is the only culprit. (p. 20)

Minnie Tsoosie: Three of my daughters are affected. They've been told that their uterus was affected. Two had their uterus removed. The other, they are still tracking her illness and she said the doctors are trying to blame the uranium. She was asked if her father worked in the uranium mines. (p. 50)

People's fear for their offspring may not be unfounded. A study conducted among the mining population in the Shiprock, New Mexico area demonstrated trends that lend limited support for the hypothesis of adverse genetic outcomes from radiation exposure (Shields, Wiese, Skipper, Charley, & Benally, 1992). Recent efforts have been initiated through the Saccomanno Research Institute (Grand Junction), Diné College (Shiprock Campus), the University of New Mexico Cancer Research Center, and Lovelace Research Center to conduct a more detailed DNA damage-ecological risk assessment. It is expected that what the Navajo people have feared will be empirically supported, that is, chromosomal-genetic damages have resulted from prolonged exposure to the uranium environmental hazards.

Prolonged Duration of Psychological Effects

The duration of the effects of the uranium disaster is significant because concern about the working conditions in the uranium mines were voiced as early as 1949 and the first cases of lung cancer were reported in the 1960s (Eichstaedt, 1994). In our estimation, there are four factors that keep the uranium disaster at the forefront for the Navajo people. First, efforts to obtain compensation by miners and millers and their families have been long-standing. Second, the environmental contamination and clean-up efforts have been seemingly endless with no assurance of resolution in the near future. Third, there is a great deal of uncertainty and ambiguity surrounding common concerns for the health and well being of the dependents of mine and mill workers. Fourth, there are recent efforts to resume uranium mining on Navajo trust land. Current technology and extraction methods are safer than in earlier days of uranium mining. However, based on past experiences, some people are alarmed by this prospect.

In short, the tragic aspects of this disaster have endured for four decades and have served to keep the issue alive in the hearts and minds of the Navajo. The continual reminders may serve to increase arousal and

diminish the potential for recovery. The fact that psychological disorders, such as PTSD, can endure for decades becomes especially meaningful in light of the set of circumstances just described.

Anxiety and Depression

Clearly, the uranium disaster heightened a state of transition already present in the lives of the Navajo due to broader influences from the U.S. culture that influenced changing lifestyles and values. The impacts from uranium mining and milling brought additional stress due to many of the factors previously described. Lifestyles were disrupted due to illness, loss of the primary income earner in the family, and environmental contamination that changed traditional styles of living. Changes increase stress that can lead to heightened risk for psychological disorders. However, the psychological impact of the uranium disaster has not been widely addressed in research or intervention. Of available reports, qualitative methodology was used that relied on self-report data obtained through interviews. Woody et al. (1981) examined two Navajo communities impacted by uranium mining. All respondents acknowledged deep psychological stress and despair due to trauma from the changes in their lives subsequent to their experiences with uranium. Anxiety was readily apparent throughout the comments made by respondents, and the authors' speculated that this anxiety contributed to a higher degree of alcoholism on the reservation. The most prevalent theme of Woody et al. (1981), as summarized in the following quote, was that stress was induced from change due to exposure to uranium:

The Navajo people are not opposed to change. However, there is often great stress related to change, especially when the people feel things have 'gotten out of control' and that they do not have control over their destiny. This seems to be the current situation in the communities on which this study was based. (p. 124)

In more recent work conducted by Dawson and Madsen (1995) among American Indian (including Navajo) uranium mill-workers, 39 of 81 respondents reported anxiety, depression, or both. These emotional responses were attributed to their own health problems, the health of other mill-workers, and the death of other mill-workers due to exposure to uranium.

Exacerbating Conditions: Poverty and Racism

It is imperative to recognize that the disastrous effects of uranium mining and milling are among many stressors experienced by the Navajo. When victims of technological/human caused disasters are already marginalized due to poverty and/or racism, the impacts are compounded.

Choney, Berryhill-Paapke, and Robbins (1995) observed that embedded in the American Psychiatric Association's description of PTSD is the consideration of threat to personal integrity. Certainly, insult to personal integrity of American Indians occurred through forced acculturation, racism, and discrimination. These and other experiences of persons from colonized groups are part of the ongoing process of historical trauma and result in a spiritual injury called "the soul wound" (Duran, Duran, & Brave Heart, 1998). Manson (1997) cited the greater experience of trauma by ethnically diverse persons, and attributed this occurrence to greater stress. In particular, the complex relationship between SES, ethnicity, PTSD, and substance abuse give some indication why some groups more than others have adverse outcomes from trauma (Manson, 1997). Poverty and discrimination due to ethnic minority status are ongoing stressors that become aggravated with additional trauma. In short, PTSD and substance abuse may not be linked to one single trigger, but are confounded through multiple stressors.

Poverty is the single most debilitating mental and physical health factor affecting individuals of any racial group, and its undesirable outcomes are well-documented in the literature (e.g., Dadds, 1995; McLoyd, 1998; Routh, 1994). In the U.S., disparities in SES according to race are readily apparent (Huston, 1994; McLoyd, 1998; Taylor, 1997), and the low SES of the Navajo is documented in various indices. According to the U.S. Census Bureau (2000b), 40.8% of families with related children under the age of 18 lived below the poverty line compared to 13.6% for the nation (U.S. Census Bureau, 2000c). The Navajo median household income was \$21,136 compared to the U.S. average of \$41,994 (U.S. Census Bureau, 2000b, 2000c, respectively). Associated with lower income, is the high unemployment rate of 58% among the Navajo, according to the Bureau of Indian Affairs (BIA) (1997) Labor Force Report of Navajo people living on or around the reservation and considered part of the BIA Indian Service Population.

In addition to the stress associated with lower SES, the experience of racism due to inequality and restricted access to resources is a further aggravation that can lead to adverse health outcomes for ethnically diverse persons (Clark, Anderson, Clark, & Williams, 1999). Clark et al. (1999) argued that both psychological and physiological reactions to racism can lead to various adverse health outcomes, such as depression and susceptibility to physical illness.

As noted earlier, environmental racism is evident and, at a global level, traditional societies and third world countries have been more greatly affected by environmental disasters (deVries, 1995). In the U.S., there is evidence of greater risk of exposure to environmental toxins for ethnically diverse populations (Pellizzari, Perritt, & Clayton, 1999; Pirkle et al., 1998; Weintraub, 1997) and for those of lower SES (Bellinger & Matthews, 1998; Brody et al., 1994; Schmidt, 1999). More specific to the Navajo and other Native nations, Churchill and LaDuke (1992) used the term "radioactive colonialism" in reference to a new form of North American colonialism directed

toward technologically-oriented resource extraction on Indian reservations. The stimulus for this practice is the disproportionately higher amounts of uranium, oil, gas, coal, and important minerals that are located on reservations. The irony is that these lands were not known to be resource-rich at the time reservation lands were allotted to tribes. Indeed, in many cases, seemingly the least inhabitable lands were designated for reservations.

Culturally-Appropriate Intervention

We have described the specific dynamics of a technological/human-caused disaster as it psychologically impacted the Navajo. The more pressing needs of the uranium disaster, namely, environmental cleanup and compensation, have played roles in psychological healing and recovery. However, more directed efforts toward emotional recovery are required. Three aspects of psychological intervention are addressed: (a) the role of education, (b) Diné (Navajo) conceptions of uranium, and (c) culturally-specific forms of healing.

Education to Promote Understanding and Reduce Stress

Increased stress and other consequences of the uranium disaster reverberate through multiple levels of the individual, family, community, and environment. Jerusalem et al. (1995) offered a classification system for assessing community stress according to the degree of community awareness. Currently among the Navajo there is a high degree of community awareness concerning the impact of uranium mining along with community efforts to cope with the problem and its aftermath, especially with respect to the treatment of environmental contamination and compensation issues. Contamination has been, and continues to be, addressed by many organizations, such as the U.S. EPA, Navajo EPA, Navajo AML Reclamation, U.S. Army Corps of Engineers, U.S. Geological Survey, and U.S. Department of Energy.

The Uranium Education Program (UEP) at Diné College, supported by funding from the National Institute of Environmental Health Sciences and other agencies, has maintained a mission to inform people about and protect people from the risk and contamination still present in the environment. Efforts of the UEP have included: (a) helping teachers develop curricula on the subject; (b) developing and distributing educational materials on environmental impacts, including water safety; (c) holding public meetings at local chapter houses to inform and educate members of the Navajo Nation; (d) pursuing community-based risk assessments [DNA damage studies] and ecological risk assessments; (e) assisting U.S. EPA and Navajo EPA with issues of contaminated structures built with radioactive waste material from the nearby abandoned uranium mines; and (f) participating in activities related to abandoned mill sites and attempts to clean-up ground water contamination.

In considering education and intervention with any cultural group, language issues must be addressed. There has not been a Navajo vocabulary for terms such as uranium and radiological effects. For instance, at the time of the disastrous Church Rock, New Mexico dam break, many Navajo victims did not have a clear understanding of what occurred or of the possible dangers. Language barriers contributed to the lack of accurate information (Woody et al., 1981). More recently, the Uranium Education Program developed a Navajo-English glossary to describe the uranium phenomenon. Such an effort is essential to educate Navajo speakers on uranium (leetso) and how to protect oneself from radioactivity (bideezla'na'alkidgo).

Through proper education, unfounded fears can be dispelled and anxiety levels will subsequently be lowered. Yet, appropriate cautions for safety must be maintained. Education can be a tool in emotional recovery and healing efforts. As part of education and intervention, it is essential to understand the Diné conception of uranium. Specifically, the cultural meaning of a traumatic event may be the most critical aspect determining the impact of a disaster (McFarlane, 1995).

Diné Conception of Uranium

According to Navajo traditional teacher Frank Morgan (2001), the subject of uranium should be approached with an understanding of its place in the natural order and the properties it possesses. Uranium is a heavy yellow metal and has been regarded as the antithesis to the sacred corn pollen that is used to bless the lives of Navajo. The following oral interpretation of this distinction by an informant of Eichstaedt (1994) is quite revealing:

In one of the stories the Navajos tell about their origin, the Dineh (the people) emerged from the third world into the fourth and present world and were given a choice. They were told to choose between two yellow powders. One was yellow dust from the rocks, and the other was corn pollen. The Dineh chose corn pollen, and the gods nodded in assent. They also issued a warning. Having chosen the corn pollen, the Navajos were to leave the yellow dust in the ground. If it was ever removed, it would bring evil. (p. 47)

The Navajo view the *earth* according to four related elements of atmosphere, land, water, and sunlight/fire (Woody et al., 1981). The *earth* is viewed as the female counterpart of the male *sky*, and their relationship is reflected in the sphere of human existence. An ultimate goal of the Navajo is for balance and harmony between humans and nature (Csordas, 1999; Eichstaedt, 1994; Woody et al., 1981). Mining is regarded as a disruption in the balance of *earth* and *sky* and is disrespectful to the *earth* (Eichstaedt,

1994). It is believed that such a disturbance is the source of much stress experienced by the Navajo people that ultimately led to disease, death, and upheaval in their lives (Eichstaedt, 1994; Morgan, 2001; Woody et al., 1981). The fears and anxiety people hold in response to the uranium disaster are sometimes linked to their knowledge of the disruption of the *earth's* elements that are reflected in atmospheric conditions, such as contamination spread through the blowing wind (Woody et al., 1981). Sadly, some of the Navajo elders blamed themselves for disruption of earth and atmosphere by permitting the uranium mining to occur (Woody et al., 1981).

Culturally-Specific Forms of Healing

...counseling helped me to express a lot of my feelings, a lot of the grief that I was going through, and that is one of the reasons why I stress that a lot of counseling is needed in these areas.... the victims, I and others, are suffering out there. (p. 40)

The preceding quote by Kathlene Tsosie-Blackie (Brugge et al., 1997) illustrates the suffering of Navajo victims of the uranium disaster as well as a perceived need for intervention. It was observed by McFarlane (1995) that the cultural ascription of meaning to a disaster may be the strongest predictor of impact. It may follow, then, that the most effective coping strategies for dealing with disasters are culturally-specific. However, the risk for societies in transition is that, due to acculturation, traditional strategies for coping with trauma are lost (Chemtob, 1996). The extent to which this issue has influenced Navajo coping with the uranium disaster is unknown. What is known, however, is that the Navajo continue to maintain a regard for the sacred nature of the environment (Griffin-Pierce, 2000) and link their own psychological well being to environmental stability. Hence, the role of environmental restoration in psychological healing should not be underestimated.

Of paramount importance is to approach psychological healing from the impact of the uranium disaster with sensitivity. Communication patterns and various taboos of the Navajo play roles in discussions about death and in the expression of emotions. Cooper (1998) identified communication ethics of the Navajo according to respect, balance, containment, moderation, and reverence. There is great respect for thought and speech processes—responsibility and accountability are implicit in communication. Language is not to be wasted and, when something is spoken, it is regarded as important and meaningful. Pauses and silence in communication are comfortably permitted to allow the speaker the necessary time to prepare their thoughts. Containment, then, becomes a primary tenet of communication of Navajo communication because one does not share everything they know and they

think carefully before speaking their thoughts. A listener is never certain if the speaker has shared all they know or think on a topic.

Moderation and balance also are central principles of Navajo communication, as well as behavior. Hence, speech patterns are not excessive or sensational. The inhibition of strong emotion may lead to unwillingness to discuss the death of a loved one or of one's emotional distress. This is an additional factor that may contribute to the duration of psychological effects from the uranium disaster. Humor is acceptable and can be used to relieve tension and heaviness. Eye contact is avoided to not invade the privacy of others, and is not an evasive strategy.

Of all Navajo taboos, the one most relevant to the uranium disaster is to not speak about death or someone who has died because, by talking of the deceased, their ghost may be called and bring harm to the speaker (Kluckhohn & Leighton, 1948). Of interest, is that in its effort to be more culturally sensitive, the American Psychiatric Association (2000) now recognizes "ghost sickness" in its glossary of culture-bound syndromes. One may feel they are ill because of this ailment, which requires a traditional remedy.

A holistic view of healing dominates the belief system of many Navajo. The interaction between the four domains of spiritual, psychological, emotional, and physical existence are recognized, and harmony between these domains is desired. The spiritual domain permeates all facets of life and needs to be implicit in intervention efforts. Nonetheless, within-group diversity exists among the Navajo, and various belief systems operate in their lives. Csordas (1999) addressed three forms of spiritual or faith-based healing currently practiced among the Navajo: Traditional, Native American Church, and Christianity. All three forms are regarded as resources to the Navajo, and share a common goal that the individual acquire understanding of the philosophy that underlies the cause-and-effect nature of disease and healing. The healer must talk to the patient to facilitate such understanding. Explanations for the causes of illness may not follow western prescriptions of pathology and treatment, but are significant within the Navajo system of beliefs. A further commonality in the three forms of spiritual-based healing is the maintenance of a holistic view of interaction between spiritual and religious beliefs and other domains of existence (Griffin-Pierce, 2000).

The only Navajo indigenous form of healing is embedded in traditional beliefs. The person who adheres to the traditional belief system may have a better response when such a healer is involved (Choney et al., 1995; Manson, 1997). The ultimate goal in this healing is to restore a state of harmony, or *hózhó*, that was upset by violations of the natural order (e.g., mining). Identifying the nature of the obstacle in the patient's life is of prime importance. In delineating Witherspoon's (1997) distinction between blessing, curing, and purifying rituals used by Navajo, Cooper (1998) observed that cures serve to bring harmony between the patient and his or her environment (broadly defined) and bring healing in mental, physical, and environmental

domains. Cures rely on both thought and speech (including singing), which are thought to have powerful capacities for restoration (Cooper, 1998). In the process of healing, a diagnostician, also known as a hand trembler or crystal gazer, ascertains the nature of the illness and recommends a route for recovery. A singer will conduct a ceremony using chants and prayers to restore the patient to *hózhó*. Healing ceremonies may be several days in length and require elaborate rituals, such as sand paintings, singing, or chanting, and the use of holy objects (Connors & Donellan, 1998).

A second form of healing practiced among contemporary Navajo is the Native American Church, a pan-Indian movement that originated among Plains Indians around the turn of the previous century. The use of sacramental peyote and the sweat lodge are key tools in this approach. A philosophy of self-esteem predominates as the patient connects to the sacred through the use of peyote (Csordas, 1999). Christian faith healing represents the third form of healing and is found in both Protestant and Catholic faiths. In this approach the issue is one of moral identity and is based on a therapeutic principle of conversion. A unique form of Navajo Christianity has emerged led by Navajo pastors of independent congregations. Navajo people may overlap in their use of these three healing resources, especially the traditional practices and the Native American Church, but all three forms of healing are tools in emotional recovery.

Summary

In this article a specific technological/human-caused environmental disaster was detailed according to its history and the inter-related environmental and psychological impacts on the Navajo people. An attempt was made to understand this occurrence in light of Navajo culture and beliefs. While the experience of the Navajo with uranium was highlighted, the approach taken in this paper can be generalized to other groups in society. For example, chemical dumping and subsequent soil and water contamination has affected the traditional hunting, fishing, and agricultural ways of life of the Akwesasne Mohawks in both Canada and the U.S. (Grinde & Johansen, 1995). There is concern for health and way of life of the Inuit due to contamination of fish and marine life in the no longer pristine arctic. Psychological disorders are more common when people face significant changes in lifestyles and experience diminished feelings of safety and security. How people interpret the unsolicited changes are best understood in the complex of cultural beliefs, values, and practices. As well, steps for healing and recovery reside within these same cultural principles.

Carol A. Markstrom, Ph.D.
Division of Family and Consumer Services
West Virginia University
Morgantown, WV 26506-6124
Email: cmarkstr@wvu.edu

Mr. Perry H. Charley
Director
Uranium Education Program
Diné College, Navajo Nation
Shiprock, NM 87420
Email: phcharley@dinecollege.edu

References

- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (DSM-IV-TR)*. Washington, DC: Author.
- Bellinger, D. C., & Matthews, J. A. (1998). Social and economic dimensions of environmental policy: Lead poisoning as a case study. *Perspectives in Biology and Medicine*, 41, 307-326.
- Boscarino, J. A. (1997). Diseases among men 20 years after exposure to severe stress: Implications for clinical research and medical care. *Journal of Psychosomatic Medicine*, 59, 605-614.
- Brody, D. J., Pirkle, J. L., Dramer, R. A., Flagal, K. M., Matte, T. D., Gunter, E. W., & Paschal, D. C. (1994). Blood lead levels in the U.S. population. Phase I of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991). *Journal of the American Medical Association*, 272, 277-283.
- Brugge, D., Benally, T., Harrison, P., Austin-Garrison, M., & Fasthorse-Begay, L. (1997). *Memories come to us in the rain and the wind: Oral histories and photographs of Navajo uranium miners and their families*. Boston, MA: Tufts University School of Medicine.
- Bullard, R. D. (1993). Anatomy of environmental racism and the environmental justice movement. In R. D. Bullard (Ed.), *Confronting environmental racism: Voices from the grassroots* (pp. 15-39). Boston, MA: South End Press.
- Bureau of Indian Affairs. (1997). *Indian service population and labor force estimates report, 1997*. Washington, DC: Author.
- Chemtob, C. M. (1996). Posttraumatic stress disorder, trauma, and culture. In F. L. Mak & C. C. Nadelson (Eds.), *International review of psychiatry* (Vol. 2, pp. 257-292). Washington, DC: American Psychiatric Press, Inc.
- Chenoweth, W. L. (1985). *Historical review of uranium-vanadium production in the northern and western Carrizo Mountains, Apache County, Arizona* (Open File Report 85-13). Tucson, AZ: Arizona Bureau of Geology and Mineral Technology.
- Chenoweth, W., & Malan, R. C. (1960). *Uranium deposits of northeast Arizona*. United States Atomic Energy Commission.

- Choney, S. K., Berryhill-Paapke, E., & Robbins, R. R. (1995). The acculturation of American Indians: Developing frameworks for research and practice. In J. G. Ponterotto, J. M. Casas, L. A. Suzuki, & C. M. Alexander (Eds.), *Handbook of multicultural counseling* (pp. 73-92). Thousand Oaks, CA: Sage.
- Churchill, W., & LaDuke, W. (1992). Native North America: The political economy of radioactive colonialism. In M. A. Jaimes (Ed.), *The state of Native America: Genocide, colonization, and resistance* (pp. 241-266). Boston: South End Press.
- Clark, R., Anderson, N. B., Clark, V. R., & Williams, D. R. (1999). Racism as a stressor for African Americans: A biopsychosocial model. *American Psychologist, 54*, 805-816.
- Connors, J. L., & Donellan, A. M. (1998). Walk in beauty: Western perspectives on disability and Navajo family/culture resilience. In H. I. McCubbin, E. A. Thompson, A. I. Thompson, & J. E. Fromer (Eds.), *Resiliency in Native American and immigrant families* (pp. 159-182). Thousand Oaks, CA: Sage.
- Cooper, T. W. (1998). *A time before deception: Truth in communication, culture, and ethics*. Santa Fe, NM: Clear Light Publishers.
- Csordas, T. J. (1999). Ritual healing and the politics of identity in contemporary Navajo society. *American Ethnologist, 26*, 3-23.
- Dadds, M. R. (1995). Families, children, and the development of dysfunction. *Developmental Clinical Psychology and Psychiatry, 32*, 42-47.
- Dawson, S. E. (1992). Navajo uranium workers and the effects of occupational illnesses: A case study. *Human Organization, 51*, 389-397.
- Dawson, S. E., & Madsen, G. E. (1995). American Indian uranium mill workers: A study of the perceived effects of occupational exposure. *Journal of Health & Social Policy, 7*, 19-31.
- Dawson, S. E., Madsen, G. E., & Spykerman, B. R. (1997). Public health issues concerning American Indian and non-Indian uranium mill workers. *Journal of Health and Social Policy, 8*, 41-56.
- deVries, M. W. (1995). Culture, community, and catastrophe: Issues in understanding communities under difficult conditions. In S. E. Hobfoll & M. W. deVries (Eds.), *Extreme stress and communities: Impact and intervention* (pp. 375-393). The Netherlands: Kluwer Academic Publishers.
- Duran, B., Duran, E., & Brave Heart, M. Y. H. (1998). Native Americans and the trauma of history. In R. Thornton (Ed.), *Studying Native America: Problems and prospects* (pp. 60-76). Madison: The University of Wisconsin Press.
- Eichstaedt, P. H. (1994). *If you poison us: Uranium and Native Americans*. Santa Fe, NM: Red Crane Books.

- Fullerton, C. S., & Ursano, R. J. (1997). The other side of chaos: Understanding the patterns of posttraumatic responses. In C. S. Fullerton & R. J. Ursano (Eds.), *Posttraumatic stress disorder: Acute and long-term responses to trauma and disaster* (pp. 3-18). Washington, DC: American Psychiatric Press.
- Giel, R. (1998). Natural and human-made disasters. In B. P. Dohrenwend (Ed.), *Adversity, stress, and psychopathology* (pp. 66-76). Oxford, NY: Oxford University Press.
- Gilliland, F. D., Hunt, W. C., Pardilla, M., & Key, C. R. (2000). Uranium mining and lung cancer among Navajo men in New Mexico and Arizona, 1969-1993. *Journal of Occupational and Environmental Medicine, 42*, 278-283.
- Gottlieb, L. S., & Husen, L. A. (1982). Lung cancer among Navajo uranium miners. *Chest, 81*, 449-452.
- Green, B. L. (1995). Long-term consequences of disasters. In S. E. Hobfoll & M. W. deVries (Eds.), *Extreme stress and communities: Impact and intervention* (pp. 307-324). The Netherlands: Kluwer Academic Publishers.
- Green, B. L. (1996). Traumatic stress and disaster: Mental health effects and factors influencing adaptation. In F. L. Mak & C. C. Nadelson (Eds.), *International review of psychiatry* (Vol. 2, pp. 177-210). Washington, DC: American Psychiatric Press, Inc.
- Green, B. L., & Lindy, J. D. (1994). Post-traumatic stress disorder in victims of disasters. *Journal of Psychiatric Clinics of North America, 17*, 301-309.
- Griffin-Pierce, T. (2000). The continuous renewal of sacred relations: Navajo religion. In L. E. Sullivan (Ed.), *Native religions and cultures of North America: Anthropology of the sacred* (pp. 121-141). New York: Continuum.
- Grinde, D. A., & Johansen, B. E. (1995). *Ecocide of Native America*. Santa Fe, NM: Clear Light Publishers.
- Hawkhill Associates, Inc. (Producers). (1990). *Nuclear Power* [Video Documentary]. (Available from Hawkhill Associates, 125 E. Gilman Street, Madison, WI 53703).
- Honig, R. G., Grace, M. C., Lindy, J. D., Newman, C. J., & Titchener, J. L. (1999). Assessing the long-term effects of disasters occurring during childhood and adolescence. In M. Sugar (Ed.), *Trauma and adolescence* (pp. 203-224). Madison, CT: International Universities Press, Inc.
- Huston, A. C. (1994). Children in poverty: Designing research to affect policy. In N. G. Thomas (Ed.), *Social policy report, Society for Research in Child Development*. MI: University of Michigan.
- Jerusalem, M., Kaniasty, K., Lehman, D. R., Ritter, C., & Turnbull, G. J. (1995). Individual and community stress: Integration of approaches at different levels. In S. E. Hobfoll & M. W. deVries (Eds.), *Extreme stress and communities: Impact and intervention* (pp. 105-129). The Netherlands: Kluwer Academic Publisher.

- Kluckhohn, C., & Leighton, D. (1948). *The Navajo*. Cambridge, MA: Harvard University Press.
- Lundin, F. E., Wagner, J. K., Hyg, S. D., & Archer, V. E. (1971). *Radon daughter and respiratory cancer quantitative and qualitative aspects: A report from the epidemiological study of United States uranium miners*. Washington, DC: NIOSH.
- Manson, S. M. (1997). Cross-cultural and multiethnic assessment of trauma. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD* (pp. 239-266). New York, NY: The Guilford Press.
- McCarroll, J. E., Ursano, R. J., & Fullerton, C. S. (1997). Exposure to traumatic death in disaster and war. In C. S. Fullerton & R. J. Ursano (Eds.), *Posttraumatic stress disorder: Acute and long-term responses to trauma and disaster* (pp. 37-58). Washington, DC: American Psychiatric Press, Inc.
- McFarlane, A. C. (1995). Stress and disaster. In S. E. Hobfoll & M. W. deVries (Eds.), *Extreme stress and communities: Impact and intervention* (pp. 247-265). The Netherlands: Kluwer Academic Publishers.
- McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist*, *52*, 185-204.
- Morgan, F. (2001, July). *Cultural perspectives on radiation: With harmony they were placed*. Workshop presented at "Creation of the Natural Order": 2001 Teacher's Seminar, Uranium Education Program, Diné College, Navajo Nation.
- Mulloy, K. B., James, D. S., Mohs, K., & Kornfeld, M. (2001). Lung cancer in a nonsmoking underground uranium miner. *Environmental Health Perspectives*, *109*, 305-309.
- National Institute of Occupational Safety and Health. (1987). *A recommended standard for occupational exposure to radon progeny in underground mines* (DHHS Publication No. 88-101). Washington, DC: U.S. Government Printing Office.
- Page, W. F., Engdahl, B. E., & Eberly, R. E. (1997). Persistence of PTSD in former prisoners of war. In C. S. Fullerton & R. J. Ursano (Eds.), *Posttraumatic stress disorder: Acute and long-term responses to trauma and disaster* (pp. 147-158). Washington, DC: American Psychiatric Press, Inc.
- Pellizzari, E. D., Perritt, R. L., & Clayton, C. A. (1999). National human exposure assessment survey (NHESAS): Exploratory survey of exposure among population subgroups in EPA region V. *Journal of Exposure Analysis and Environmental Epidemiology*, *9*, 49-55.
- Pirkle, J. L., Kaufmann, R. B., Brody, D. J., Hickman, T., Gunter, E. W., & Paschal, D. C. (1998). Exposure of the U.S. population to lead, 1991-1994. *Environmental Health Perspectives*, *106*, 745-750.

- Raphael, B., & Martinek, N. (1997). Assessing traumatic bereavement and posttraumatic stress disorder. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD* (pp. 373-395). New York, NY: The Guilford Press.
- Robinson, W. P. (1998). *More than radon in the uranium dust*. Albuquerque: Southwest Research and Information Center.
- Roscoe, R. J., Deddens, J. A., Salvan, A., & Schnorr, T. M. (1995). Mortality among Navajo uranium miners. *American Journal of Public Health, 85*, 535-540.
- Routh, D. K. (Ed.). (1994). The Impact of poverty on children, youth, and families (Special Issue). *Journal of Clinical Child Psychology, 23*.
- Schmidt, C. W. (1999). Poisoning young minds. *Environmental Health Perspectives, 107*, A302-307.
- Shields, L. M., Wiese, W. H., Skipper, B. J., Charley, B., & Benally, L. (1992). Navajo birth outcomes in the Shiprock uranium mining area. *Health Physics, 63*, 542-551.
- Sturgeon, D. (1993). Posttraumatic stress disorder. In S. C. Standord & P. Salmon (Eds.), *Stress from synapse to syndrome* (pp. 421-432). London: Academic Press.
- Taylor, R. D. (1997). The effect of economic and social stressors on parenting and adolescent adjustment in African-American families. In R. W. Taylor & M. C. Wang (Eds.), *Social and emotional adjustment and family relations in ethnic minority families* (pp. 35-52). New Jersey: Lawrence Erlbaum Associates, Inc.
- U.S. Census Bureau. (2000a). *GCT-PHI. Population, housing units, area, and density: 2000. data set: Census 2000 summary file 1 (SF 1) 100-percent data. Geographic area: United States—American Indian and Alaska Native area, and Alaska Native regional corporation*. Available from the U.S. Census Bureau at: <http://factfinder.census.gov>
- U.S. Census Bureau. (2000b). *Table DP-1. Profile of general demographic characteristics: 2000. Geographic area: Navajo Nation reservation and off-reservation trust land, AZ-NM-UT*. Available from the U.S. Census Bureau at: <http://censtats.census.gov>
- U.S. Census Bureau. (2000c). *Table DP-1. Profile of general demographic characteristics: 2000. Geographic area: United States*. Available from the U.S. Census Bureau at: <http://censtats.census.gov>
- U.S. Department of Commerce. (2002). *The American Indian and Alaska Native population: 2000*. Washington, DC: U.S. Census Bureau.
- U.S. Department of Energy. (1995). *Final report of the advisory committee on human radiation experiments*. Washington, DC: U.S. Government Printing Office.

- Weintraub, M. (1997). Racism and lead poisoning. *American Journal of Public Health, 87*, 1871.
- Witherspoon, G. (1977). *Language and art in the Navajo universe*. Ann Arbor, MI: University of Michigan Press.
- Woody, R. L., Jack, B., & Bizahaloni, V. (1981). *Social impact of the uranium industry on two Navajo communities*. Tsale, AZ: Navajo Community College.

Author's Note

Dedicated to the memory of Elouise R. "Wee-Zee" Charley. March 18, 1973 – December 19, 1997.

Footnote

¹Brugge et al. (1997) specified that in reproducing from *Memories Come To Us in the Rain and the Wind* credit be given to the Navajo Uranium Miner Oral History and Photography Project and to the interviewees.