HALF-LIVES AND HALF-TRUTHS

Confronting the Radioactive Legacies of the Cold War

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Half-Lives, Half-Truths, and Other Radioactive Legacies of the Cold War

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Half-Lives and Half-Truths: Confronting the Radioactive Legacies of the Cold War examines some of the events and consequences of what many call the first nuclear age—the age when uranium was exploited, refined, enriched, and used to end a world war and fight a cold war. It is a book written by anthropologists who study the culture and history of science, document the environmental health problems that are the legacy of the Cold War–era nuclear war machine, and assist communities in their struggles to secure information, accountability, and meaningful remedy. In essays addressing the US and former Soviet nuclear war machines, contributors outline some of the human and environmental impacts of preparing for nuclear war and the related problems created by the heavy hand of the security state. Contributors also explore the dynamic tensions that structure human response to such problematic radioactive realities: How do people come to terms with their past, and the current and future risks from this past, and find ways to carry on? What strategies are employed to cope? What efforts are taken to secure meaningful remedy? What actions do people—survivors, families, communities, scientists, advocates, organizations, and governments—take to ensure never again?

The essays and case studies explore the biases and political constraints intrinsic to atomic energy research on behalf of the security state, and the radioactive legacy of the Cold War in the United States and its former territories of Alaska and the Marshall

Islands, and in the former Soviet Union. While these historical and ethnographic analyses of human response to the radioactive legacies of the Cold War–nuclear war machine reflect specific contexts within time and space, collectively they support a number of generalized observations that are relevant to current events.

First, and foremost, for the communities that hosted the nuclear war machine—uranium mines, mills, and enrichment plants; weapons production facilities; military "proving" grounds; battlefields; and nuclear waste dumps—the "cold" war was truly hot, generating acute and lasting radiogenic assaults on the environment and human health.

Second, actions taken in the name of national security have profoundly shaped both the biophysical nature and sociocultural identity of host communities, creating what might be best termed radiogenic communities. A radiogenic community is produced by the process of radioactive decay: its members are people whose lives have been profoundly affected and altered by a hazardous, invisible threat, where the fear of nuclear contamination and the personal health and intergenerational effects from exposure color all aspects of social, cultural, economic, and psychological well-being. Some radiogenic communities are the end result of a geographic location (downwind from or adjacent to mines, mills, nuclear weapons tests, battlefields, or military training grounds). Others are formed by occupational exposure as a soldier, scientist, miner, or other worker. For far too many people whose identities have been shaped by radiogenic community membership, the "half-life" nature of radioactive decay has resulted in compromised "half-lives," where people struggle with the degenerative conditions associated with their exposure. They struggle with the pain and suffering associated with miscarriages and the birth of congenitally deformed children, the difficulties of raising physically disabled children and caring for increasingly feeble elderly, the fear of and anxiety over additional exposures, the fear of and anxiety over intergenerational and other unknown effects of radiation, and the psychosocial humiliation, marginalization, and stigmatization experienced by the population as a whole as a result of nuclear victimization.

Third, the ability of radiogenic communities to understand, confront, and address environmental health problems is strongly linked to and constrained by their relative status in society. This inequity, in turn, influences access to information and relative power in decision-making processes. Given this sociocultural dynamic, when governments are forced to confront and remedy the messes they have made, their institutionalized responses (for example, biomedical research, biomedical and social welfare entitlement programs) reflect the biases, power struggles, and schisms in society (cf. Liebow, this volume; Petryna 2002).

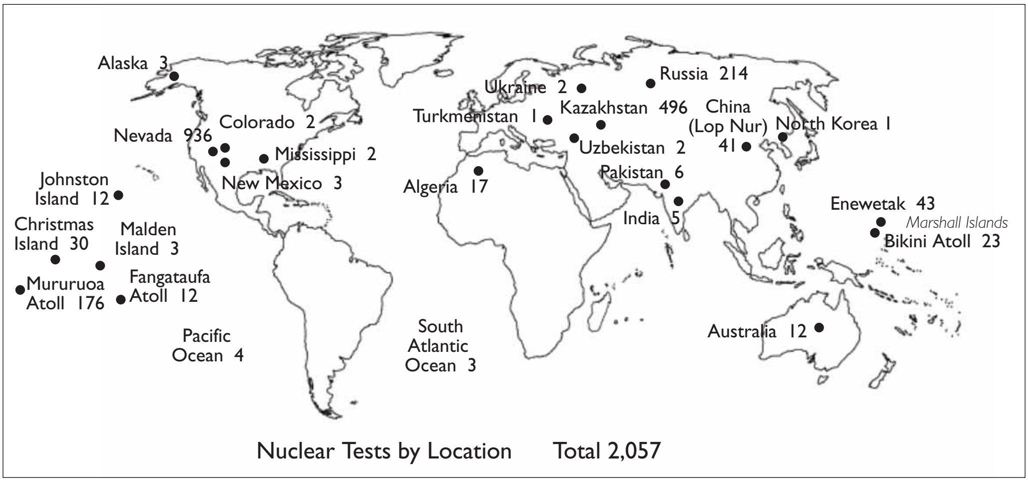
And finally, the heavy hand of the Cold War security state demanded—through cultural and political means—control over systems that produced and disseminated information. Control over science and the dissemination of scientific findings allowed the systematic use of half-truths to pacify public concerns while expanding the nuclear war machine.

One of those half-truths is the popular misconception that the Cold War enterprise of building bigger and better vehicles to deliver an ever-growing number of stronger, dirtier, and deadlier bombs prevented nuclear war. From a human–environmental point of view, nuclear war began with the first use of radiogenic materials for military purposes, and the assault on the world's environment and its peoples has continued ever since.

Germany, France, the Soviet Union, Great Britain, the United States, and Japan all established research programs to develop military applications for uranium, including the possibility of an atom bomb (Preston 2006). The first known use of uranium on the battlefield occurred in 1943, when munitions minister Albert Speer addressed a shortage of wolframite with the order to use Germany's stockpiled supply of uranium, some 1,200 metric tons, to produce fuel cores for solid-core ammunition (Speer 1971:304). By this point in the war, Germany was unable to sustain its atomic weapons research program and ended up using its stockpile of uranium as presumably an inadvertent, rather than overt, radiogenic weapon. In the same year, 1943, the United States established a radiological warfare unit to explore the use of dirty bombs (mixing radioactive material with explosives, creating a "terrain contaminant"), develop uranium as a gas warfare instrument, and conduct field trials to ensure

> that the United States should be ready to use radioactive weapons in case the enemy started it first.… The material would be ground into particles of microscopic size and would be distributed in the form of a dust or smoke or dissolved in liquid, by ground-fired projectiles, land vehicles, airplanes, or aerial bombs. Areas so contaminated by radioactive dusts and smokes would be dangerous as long as a high enough concentration of material could be maintained. In these forms, the materials take on the characteristics of a quickly dissipating gas and it is improbable that heavy concentrations could be maintained for more than a few minutes' time over a given area. However, they can be stirred up as a fine dust from the terrain by winds, movement of vehicles or troops, etc., and would remain a potential hazard for a long time. These materials may also be so disposed as to be taken into the body by ingestion instead of inhalation. Reservoirs or wells would be contaminated or food poisoned with an effect similar to that resulting from inhalation of dust or smoke. Four days' production could contaminate a million gallons of water to an extent that a quart drunk in one day would probably result in complete incapacitation or death in about a month's time. (Conant et al. 1943:2)

Atomic warfare began with the US decision to test and use untried devices. Although Hiroshima and Nagasaki were the first cities to suffer the effects of atomic war, conditions of full-fledged nuclear war were experienced by the many unfortunates who lived downwind from the world's proving grounds. Proving grounds for the United States included Trinity Site in New Mexico; Nagasaki and Hiroshima, Japan; Bikini and Enewetak atolls, Marshall Islands; the Christmas Islands, Kiribati; Johnston Island; Amchitka Island in the Aleutians; the South Pacific and Atlantic



Map 1.1. The world's nuclear proving grounds. Credit: School for Advanced Research Press

oceans; Nellis Air Force Base, Fallon, and Central Valley, Nevada; Alamogordo, Carlsbad, and Farmington, New Mexico; Grand Valley and Rifle, Colorado; and Hattiesburg, Mississippi. Most US lower-yield atmospheric tests and nearly all US underground tests were conducted at the Nevada Proving Ground. The majority of US high-yield atmospheric tests were conducted in the Marshall Islands. Great Britain conducted weapons tests with support and assistance from the United States at sites in the Montebello Islands, Emu Field, Maralinga, and Woomera in Australia; Christmas Island; and Malden Island, Kiribati. The former Soviet Union tested military weapons and industrial applications at numerous sites throughout Siberia (especially Novaya Zemlya Island) and Kazakhstan (especially at Semipalatinsk), as well as at sites in the Ukraine, Uzbekistan, and Turkmenistan. France detonated atmospheric weapons at Reggan and Ekker in Algeria and atmospheric and subsurface weapons in the Tuamotu atolls of Mururoa and Fangatau, French Polynesia. Beginning in 1964, China tested weapons at the Lop Nur site in the Xinjiang Uygur Autonomous Region of northwestern China, where it conducted the world's last atmospheric test in 1980 and its last underground test in 1996. South Africa and Israel conducted joint tests at Prince Edward Island in the Indian Ocean. India detonated its first "peaceful nuclear explosion" in 1974 and conducted five nuclear weapons tests in May 1998 at its Pokharan underground facility in the Rajastan Desert. In 1998 Pakistan tested nuclear weapons in the Chagai Hills of Baluchistan. And in October 2006, North Korea conducted a successful underground nuclear weapons test in the northeastern part of the country, near the Chinese border (Bennett et al. 2000; CNS 2002; Federation of American Scientists 2002; Nuclear Weapons Archive 2006). (See map 1.1.)

The nations of the world have exploded some 504 nuclear weapons in the atmosphere at thirteen primary sites, releasing numerous radioisotopes and dangerous heavy metals (Simon et al. 2006). These tests produced local fallout (the deposition of heavy particles, especially relatively short-lived highly radioactive elements); tropospheric fallout (finer particles that enter the lower part of the earth's atmosphere, spread across the latitude with the atmospheric winds, and over the next month or so fall to earth via rain, snow, and wind); and stratospheric fallout (extremely fine particles blasted into the higher reaches of the atmosphere that encircle the globe for many years after an explosion). The amount and characteristics of fallout varied according to meteorological conditions and the heights of bursts, yields, half-life (the time it takes a substance to decay by half), and the volatilities of the elements used in fission or activation or as tracers (which create a signature in the fallout cloud and a track of the extent and deposition rates from a particular test) (cf. Beck and Bennett 2002; Warner and Kirchmann 2000).

Examples of fallout from weapons tests in 1958 illustrate the varied effects. One hydrogen bomb tested by the United States in 1958, the 3.8-megaton Shot Orange in the Hardtack series, was detonated over Johnston Island. The weapon reached the stratospheric height of 141,000 feet and created an electromagnetic pulse that destroyed an area of ionized air high above the earth used to reflect radio signals. Radio communication capability was lost for two hours in Hawaii and nine hours in Australia. Tungsten-185 and rhodium-102 (tracers added to the bomb casing to allow tracking of fallout debris) were recorded by monitoring stations around the world, indicating that materials in the stratosphere produced an even deposition of fallout between the northern and southern hemispheres. Three years later, fallout from this blast was still being recorded, with the highest concentrations over polar regions. In another 1958 test conducted by the United States (Argus I, II, and III), 1- to 2-kiloton bombs were detonated 300 miles above the South Atlantic. This series generated a 60-mile-thick blanket of beta particles that completely encircled the earth for days (Miller 1986:307–08).

The radioactive legacy of the Cold War is not limited to hazardous debris from atmospheric tests. Subsurface tests also generated atmospheric fallout. For example, the 1961 Project Gnome, first of the tests inspired by Edward Teller's belief in the peaceful uses of nuclear weapons, involved detonating a 3-kiloton device inside a salt dome some 31 miles southeast of Carlsbad, New Mexico. The goal of this test was to create a sealed, molten mound that would generate a cheap source of heat. The detonation produced a wide, deep cavity, with heat and debris escaping in the form of a large radioactive cloud that moved northeast toward the city of Carlsbad, depositing an intense fallout of iodine-131 before moving on to the Texas Panhandle, eastern Kansas, and southwestern Nebraska (Miller 1986:312–13). Declassified radiochemical data from US underground nuclear tests indicate that subsurface testing generated some forty-three long-lived radionuclides and that more than one-quarter of the tests occurred within 100 meters of the groundwater table (Smith et al. 2003).

In an atomic detonation, uranium atoms are transformed through fission. One of the radioactive isotopes formed is krypton-90, a very hot isotope that almost immediately deteriorates, changing into rubidium-90 with a half-life of 4.28 minutes.

Rubidium-90 decays into strontium-90, an element in global fallout that presents a great threat to human health. In humans, strontium-90 behaves chemically like calcium and easily finds its way to bones, teeth, and even arterial plaque, emitting beta radiation throughout its half-life of 28.9 years. Strontium-90 can be absorbed by eating food, drinking water, or breathing. It is also bioaccumulative, meaning it is easily incorporated into the environment, and concentrations increase as one moves up the food chain. The derivative element of strontium-90 is yttrium-90, which decays after some 64 hours into the nonradioactive zirconium-90. When absorbed in humans, strontium-90 and its energetic daughter, yttrium-90, can generate bone deformities, bone tumors, and cancers of the blood-cell-forming organs. Irradiation of the bone marrow also impairs the immune system (Argonne National Laboratory 2005; Miller 1986:202–03). Another element in global fallout that presents a serious health threat to humans is cesium-137. Cesium-137 emits beta particles and relatively strong gamma radiation in its decay to barium-137, a short-lived decay product that in turn decays to a nonradioactive form of barium. The half-life of cesium-137 is 30.17 years, and because of the chemical nature of cesium, it moves easily through the environment at increasingly concentrated levels. Upon entering the human body, cesium-137 can produce acute and chronic health effects, including cancer. Iodine-131, a highly active isotope with an eight-day half-life that is quickly absorbed in the human body, is one of the elements of greatest concern in local fallout. Iodine-131 accumulates in the thyroid. Acute exposure causes thyroid disease and tumors. Long-term exposure to lower levels of iodine-131 causes thyroid cancer (IPPNW–IEER 1991; Makhijani, Hu, and Yih 1995).

Fallout is by no means the only Cold War legacy troubling host communities. Uranium mining, enrichment, and weapons manufacturing have also left their distinct radiogenic footprints on the planet, with heavy health consequences experienced by host communities. Because the health effect from past exposure can include degenerative conditions that emerge only after the passage of many years, exposures fifty years ago still have health implications today, and the health implications of Cold War–era testing will continue into the future (DHHS 2005; Simon et al. 2006).

Who are these radiogenic communities living adjacent to and downwind from the Cold War nuclear complex? Typically, they are the marginal and powerless groups in society: indigenous peoples and other social or political minorities. A 1997 review of the social impacts of uranium mining by the Swedish parliament found that some 70 percent of the world's mines were located in lands inhabited by indigenous peoples (Göes et al. 1997). For the majority of atmospheric tests conducted by the United States, the Soviet Union, China, France, and Great Britain, ground zero was the ancestral homeland for indigenous peoples, tribal groups, and other ethnic minorities. Thus examining the impacts of nuclear weapons production and testing means considering the disproportionate experience of the Dene of Canada; Navajo Diné; Marshallese; Aleut, Iñupiat, and other Alaska Natives; Nez Percé, Umatilla, Yakama, Western Shoshone, Lakota, Pueblo, and other North American tribes; Namibian Bushmen; Australian aboriginal groups; Kazakhstanis; and Tatars and Bashkirs, to name just a

Figure 1.1. Office of Civil Defense Mobilization exhibit at a civil defense fair, circa 1960. The Executive Office of the President established the Office of Civil Defense Mobilization (1958–61), which became the Office of Civil Defense (1961–72) under the Department of the Army. Civil defense programs were largely meant to pacify public concerns over nuclear weapons tests. Officials used fallout shelter displays at county fairs, posters, and other materials to promote products and actions that citizens might take to "protect yourself from radioactive fallout." Credit: National Archives. ARC identifier: 542102

few of the indigenous, ethnic, and other minority groups who have hosted the nuclear war machine. The disproportionate burden borne by these groups is no accident. Their selective victimization occurs because they live in relatively isolated lands and occupy the bottom strata of society. Their social status is rationalized and reinforced by cultural notions as well as political and economic relationships and histories (Johnston 1994:11–12).

The security state and its control over science represented the primary mechanism used to shape and deliver the calculated half-truths that sustained Cold War nuclear militarism. For those who worked to build and expand the nuclear war machine, scientific agendas were shaped according to military needs and findings directed toward the classified, rather than broader scientific, community. Controlling information meant the government was able to convince the public of the relatively minimal threat posed by atmospheric tests.

In the United States, a key mechanism used to shape public knowledge and opinion was the formal inclusion of a public relations plan as a component of the technical plan for every weapons test. As noted by Lawrence Livermore Laboratory historian Barton Hacker:

> AEC [Atomic Energy Commission] officials in general, headquarters staff members in particular, mostly preferred to reassure rather than inform. Convinced that trying to explain risks so small would simply confuse people and might cause panic, they feared jeopardizing the testing vital to American security. Their policy prevailed. A formal public relations plan became as much a part of every test as the technical operations plan. Carefully crafted press releases never to my knowledge lied, though they sometimes erred. Yet, by the same token, they rarely if ever revealed all. Choices about which truths to tell, which to omit, could routinely veil the larger implications of a situation. (Hacker 1994:69)

A comment by AEC director Willard Libby, in a 1956 *US News and World Report* article exploring whether fallout from atmospheric weapons tests represented a significant public health threat, illustrates Hacker's observation. Libby comments, "The world is radioactive. It always has been and always will be. Its natural radioactivities evidently are not dangerous and we can conclude from this fact that contamination from atomic bombs small in magnitude or even of the same order of magnitude as these natural radiations is not likely to be at all dangerous" (Miller 1986:199). While Libby's platitudes in this popular-press article articulate the informed opinions of a scientist who was not particularly alarmed by increased levels of strontium-90 in the atmosphere, Libby's classified opinions reflect deep and serious concern. In 1953, under contract to the AEC and the air force, the Rand Corporation convened a review of Project Gabriel, first initiated in 1949 to determine the impact of nuclear weapons on local populations (Rand Corporation 1953). Libby directed this study, and the "resulting report concluded that strontium 90 (Sr-90) was the most dangerous long-term, global radioactive product of bomb testing and that a global study of strontium 90 fallout was needed" (ACHRE 1995:637). A subsequent study (Project Sunshine) tested for strontium-90 levels in the human body using bone samples and teeth harvested from stillborn babies and deceased people between the ages of one and thirty. Samples were harvested from bodies throughout the world (see the ACHRE discussion of "body snatching," 1995:640). Findings from these studies eventually led to the ban on the atmospheric testing of nuclear weapons adopted by the United Nations in 1963.

The tensions between the political agenda of Cold War nuclear militarism and the scientific study of its devastating effects on humans and their environment not only resulted in overt efforts to keep information from the public (and therefore to deceive and lie to the public), but also generated biases that skewed scientific research from inception to conclusions. The AEC essentially funded a program of research supporting preconceived conclusions: a ban on atomic weapons tests is not needed because such tests pose no danger to humanity; humans evolved in a world where radiation from the sun and naturally occurring elements was present, and radiation at some levels is natural and beneficial; radiation exposure from weapons use has no significant mutagenic, intergenerational effect; any adverse heath effect of radiation exposure is the occasional and accidental result of high levels of exposure; and any resulting adverse heath effect from radiation exposure is limited to the individual, not his or her offspring. When scientists produced data that differed from the official government stance on radiation effects, studies were often censored, researchers were discredited, and research funding was withdrawn (cf. Chomsky et al. 1997; Deepe Keever 2004; Hacker 1994; Hefner and Gourley 1995; Price, this volume).

With the fall of the Soviet Union, the dismantling of the Cold War–era nuclear war machine, and the 1990s change in political administrations in the United States, a brief window of government transparency was opened. From declassified studies on uranium miners we have learned that there is a linear relationship between uranium miners' cumulative exposure levels and lung cancer. Cancer-causing radon gases, released as uranium decays, are more efficient at causing cancer at lower exposure levels than at higher exposure levels. And there is a significant latency period: some twenty years may pass between initial exposure and the health outcome. Exposure can also generate or exacerbate nonmalignant respiratory problems, including pneumoconiosis, tuberculosis, emphysema, chronic obstructive respiratory disease, chronic renal disease, heart disease, miscarriage, cleft palate, and other birth defects (cf. Archer et al. 2004; Gilliland et al. 2000; Johnston, Dawson, and Madsen, this volume; Samet 1991; Shields et al. 1992).

Declassified studies of the Marshallese and their acute exposure to Bravo fallout in 1954 documented an array of immediate effects including beta burns, loss of hair, depressed red cell and leukocyte counts, flulike symptoms, nausea, fingernail discoloration, radioactivity in the urine, and changes at the cellular level in blood and bone marrow (Cronkite et al. 1954). Long-term studies documented immune-deficiency diseases, metabolic disorders (diabetes), growth impairment in children, cancers, leukemia, premature aging (dental decay, cataracts, degenerative osteoarthritis), and a host of reproductive problems including miscarriages, congenital birth defects, and sterility. The long-term studies also confirmed what other classified research suggested: that radioiodine-131 adheres to and accumulates in the thyroid, stimulating the production of benign and cancerous nodules and interfering with the production of hormones, leaving children and pregnant women especially vulnerable. Thyroid cancer and other radiogenic changes occur not only in people exposed to an acute level of ionizing radiation but also in those who were born or moved into contaminated areas long after the initial blast and fallout had occurred (Barker, this volume; Conard 1975; Goldman et al. 2004; Sutow et al. 1965).

The controversial contention that exposure to even the smallest dose of low-level ionizing radiation can produce health risks (Gofman 1990) was explored by the National Academy of Sciences' Board on Radiation Effects ResearchBiological Effects of Ionizing Radiation (BEIR) VII Committee. The BEIR VII Committee concluded that there is no threshold of exposure below which low levels of ionizing radiation can be demonstrated to be harmless (National Academy of Sciences 2005). Health risks, as defined by the development of solid cancers in organs, rise proportionately with exposure to ionizing radiation: as overall life exposure increases, so does the risk. While the risk of inducing solid cancers from low-dose exposures is thought to be small, other degenerative health effects have been demonstrated. And there is a differential risk for women compared to men, and a differential risk for children. Thus radiation in the first year of life for boys produces three to four times the cancer risk as does exposure between the ages of twenty and fifty, and female infants have almost double the risk of male infants (National Academy of Sciences 2005; Simon et al. 2006). Furthermore, findings from a recent study of childhood cancers and strontium-90 in baby teeth demonstrate that the greatest per-dose risks for the very young are at the lowest doses (Mangano 2006). And there is compelling evidence of mutagenic damage from exposure to fallout emerging from intergenerational research in the former Soviet Union. For example, a study of three generations of families living near the test site in Kazakhstan demonstrated genetic mutation in the germline (the sequence of cells with genetic material that can be passed along to children). Exposed people had eight times the risk of mutation in the inherited genes than did rural families outside the fallout zone. Their children had five times the risk (Dubrova et al. 2002).

What have we done with this knowledge? In the United States significant effort was taken in the 1990s to evaluate the extent of radiogenic contamination associated with Manhattan Project research and nuclear weapons development and testing. Evaluations were part of a broader effort to implement remedial programs, such as the US Department of Energy's Long-term Stewardship Program. Assessment studies guided efforts to clean up the environment by removing stored radioactive waste, soils, metal, construction debris, and other contaminated materials, and by binding materials to contain and inhibit the movement of radioisotopes through the environment and the food chain. Significant effort was also taken to assess historic and current exposures and related health risks experienced by Manhattan Project and Cold War nuclear facility workers and residents (Liebow, this volume; Probst and McGovern 1998; Satterfield and Levin, this volume). And Congress passed legislation designed to compensate downwinders, workers, and veterans for health problems resulting from Cold War radiation exposure (see Barker, Boutté, and Dawson and Madsen, all this volume).

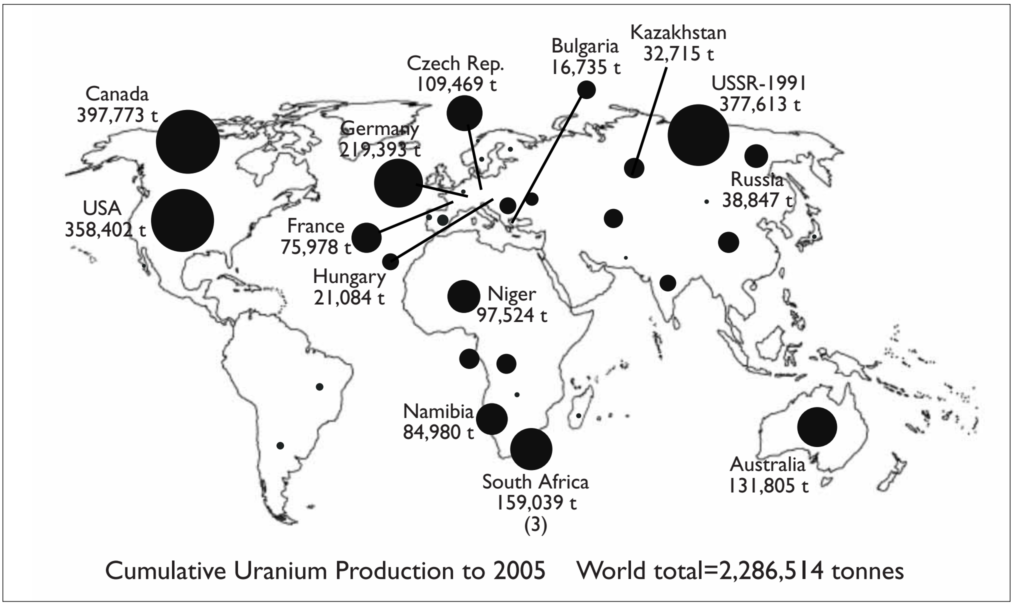
At the same time, while some scientists were occupied with assessment of the environmental health threats of Cold War nuclear weapons production and testing sites, and were developing plans and approaches to clean up the environment, reduce public health risks, and provide some sort of remedy for those who developed cancers from prior exposures, others were involved in actions that created new nuclear hot spots. A new generation of radiogenic weapons—depleted-uranium-tipped missiles, bullets, and shielding—has found its way into the battlefield. Depleted uranium (DU) weaponry was used in the 1991 Gulf War, the 1994–95 war in Bosnia, the 1999 war in Kosovo, the 2002 invasion of Afghanistan, and the war in Iraq that began in 2003. DU is also being introduced into the soil, watershed, and food chain in sites around the world by war games and other training exercises conducted by the United States and by the twenty-nine countries that have purchased DU weaponry from the United States. Depleted uranium is a human-made radioactive heavy metal derived from uranium ore; it is a by-product of enrichment. Recent calculations suggest that it has 75 percent of the radioactivity found in natural uranium and a half-life measured in billions of years. The rationale for widespread use of DU relies heavily upon the controversial belief that low-level exposure produces no significant harm to humans or their offspring. However, recent reviews of animal studies and human epidemiological data support the contention that DU is a teratogen: parental exposure can result in offspring with birth defects (Hindin et al. 2005. See also Baverstock 2005; United Nations Environment Program 2003; World Health Organization 2001; WISE 2006a).

In the first years of the twenty-first century, the meaning of security has been redefined from the previous focus on human security as implemented via the human rights framework to the current focus on political and economic security as imposed and reinforced by a military framework. The many calls for a reduction of warheads and a comprehensive ban on all nuclear weapons, so common in the 1990s, have largely been silenced, and some nations again threaten to adopt policies of nuclear preemptive strikes. In March 2005, the United States revised *The Doctrine for Joint Nuclear Operations*, stating its intent to use nuclear weapons against an adversary "using or intending to use WMD against the United States" (Joint Chiefs of Staff 2005:III–2).

Economic priorities have also shifted as larger portions of the world's national budgets are now earmarked to cover military research, weapons development, expansion of armed forces, the costs of engagement, and the costs of developing new sources of energy. One measure of the economic impact of these shifts can be seen in the changing value of uranium oxide, which sold in December 2000 for US$7 per pound and six years later sells for US$60 per pound and is expected to continue its rise, prompting exploration and new mining worldwide. While half of the world's production in 2005 came from Canada and Australia, the escalating value of uranium ore has prompted expansion or recommissioning of existing mining and contracts for new ventures in the United States, Guatemala, Argentina, India, Armenia, the Czech Republic, Slovakia, Finland, Russia, Kazakhstan, Kyrgyzstan, Mongolia, Uzbekistan, Pakistan, Saudi Arabia, Niger, Namibia, Malawi, Zambia, and South Africa (WISE 2006b). (See map 1.2.) Uranium mining has become big business, providing the fuel for a new generation of nuclear power plants and a reinvigorated weapons industry.

These political and economic shifts reflect fundamental transformations in the social meaning of government and the prioritization of its actions. Where the state once served as the institutional mechanism that secured the fundamental rights of its citizens to life and livelihood, it now functions to protect the individual right to power and profit.

For many of us who lived through the Cold War years, there is a strong sense of déjà vu—that we have stepped back in time to a world where governmental policies and actions prioritize "security interests" over the fundamental rights of people and



Map 1.2. Cumulative uranium production around the world up to 2005. Credit: World Information Service on Energy (WISE), uranium maps, http://wise-uranium.org/umaps.html. Map adapted by School for Advanced Research Press.

their environment. Thus a collective sense of urgency has fueled efforts to produce this book. Military concerns and the prioritization of funding again dominate the scientific agenda. Nations are seeking more and newer nuclear weapons. And radiogenic elements are increasingly dispersed through military testing and battlefield engagements around the world. The nuclear war machine has shifted into higher gear, and those of us who have spent much of our lives studying the political forces and human consequences of Cold War nuclear militarism fear that the lessons of the past are no longer recognized or considered relevant. It is in this climate, in these dangerous times, that we offer this collection of essays and their varied cautionary tales.

Confronting the Radioactive Legacies of the Cold War

Understanding and utilizing the lessons of the past requires free access to information and transparent decision-making processes. The window of transparency opened by declassification orders in the 1990s allowed public access to documents that confirmed the worst fears about how a government takes evil action to ensure a political good. A flood of documents from the Soviet Union and the United States provided material evidence of how the Cold War was fought: with military and economic actions that involved horrific abuses of fundamental human rights. Declassification and public scrutiny of historic injustices provided an opportunity to come to terms with the past, and in doing so to take honest and significant effort toward making amends. The

United States acknowledged culpability for some of the consequential damages of Cold War actions, issuing apologies to human radiation subjects (ACHRE 1995), as well as to nations whose governments had been destabilized and toppled through covert US action, as in President Clinton's apology to Guatemala (Gibney and Warner 2000). In 2001 the Russian Duma adopted a law with social guarantees for citizens affected by radiation from nuclear weapons tests within Russia, as well as outside it (BBC Monitoring Service 2001).

At the most fundamental of levels, the struggle to address the radioactive legacy of the Cold War has been a struggle over who has the right and power to shape, access, and use information. People seek access to information that depicts "the whole truth" about the nuclear war machine and its human health effects. And governments seek to control or remove from public access such information. They do so because this information demonstrates past harm and present or future risk, and thus demonstrates liability and supports demands for accountability. As detailed in the following chapters, the struggle to address the radioactive legacy of the Cold War calls into question the nature of science, the ethical dimensions of scientific research, and the political use of science. In so doing, the struggle has at times produced social movements that threaten to transform the balance of power in society.

Chapter 2, "'more like us than mice': Radiation Experiments with Indigenous Peoples," gives a historical overview of Cold War science that specifically conducted research with discrete biological populations, especially indigenous and other place-based peoples, to understand radiation, manage exposure, and reduce risks. Beginning in the late 1940s, the United States funded research that tracked fallout in the environment, food chain, and people. Beginning in the early 1950s, it funded studies that attempted to identify the human effects of exposure to naturally occurring sources of radiation and studies that documented the immediate and long-term effect of exposure to "environmental sources"—classified code for radioactive fallout from atmospheric weapons tests. Early genetic studies using fruit flies, corn, and mice were followed by human population studies involving groups who had experienced acute radiation exposure during nuclear weapons tests. Both the United States and the Soviet Union conducted such research, though the chapter presented here focuses on the US research experience. Research discussed here includes the targeted and opportunistic use of indigenous peoples in the Marshall Islands, Arctic, and Andes, whose participation typically occurred without meaningful informed consent. These people were selected as human subjects because they were heavily exposed to fallout, lived in areas with high levels of naturally occurring radiation, or were considered to be unexposed and thus could serve as a control group. Selected study populations all lived on traditional lands, depended upon the local environs for food, and lived in tightly defined social groups. The science was designed to produce findings in support of the military and its capacity to fight and win a nuclear war.

Cold War scientific research was, of course, conducted by an array of people, with an array of motivations and sensibilities, altruistic and otherwise. In chapter 3, "Earle

Reynolds: Scientist, Citizen, and Cold War Dissident," David Price examines the experience of an Atomic Bomb Casualty Commission (ABCC) scientist whose research findings demonstrated the harmful effects of fallout on Japanese atomic bomb survivors. Because these findings ran counter to US public policy, his work was censored. Using archival documents and records released by the Department of Energy, the Federal Bureau of Investigation, and the Central Intelligence Agency under the Freedom of Information Act, Price depicts Earle Reynolds's transition from physical anthropologist working with children who survived the bombing of Hiroshima and Nagasaki to devoted activist risking his life opposing US development of the hydrogen bomb. Reynolds's research, and the censorship of his research findings, changed his political orientation and led him to protest the development of weapons of mass destruction. As Reynolds obstructed nuclear weapons tests and spoke out in public settings on the dangers of these weapons, the FBI and other intelligence agencies increased their surveillance of him and actively hindered his work. While many elements of Reynolds's life were extraordinary, Price makes the point that the basic problems Earle Reynolds faced in trying to reconcile the interests of his employer and those of the population he studied were similar to many essential dilemmas faced by academics and scientists working in today's national security state.

A very different story of scientific research and political advocacy is presented in chapter 4, "There Are No Peripheries to Humanity: Northern Alaska Nuclear Dumping and the Iñupiat's Search for Redress," by Edith Turner. This reprint of a 1997 journal article explores the meaning of anthropological fieldwork and the evolving role of the author as she worked with a northern Alaskan Iñupiat community whose water, soil, and food were contaminated by radioactive soils imported from Nevada by the AEC. The consequential damages of unwittingly hosting a nuclear dump site are detailed, as is the anthropologist's efforts to facilitate and support the Iñupiat in their struggle for meaningful remedy. The article is reprinted here, juxtaposed with the Earle Reynolds story, for a number of reasons. Turner's work with the Iñupiat began in 1987, some three decades after Reynolds did his research in Japan, and this essay paints the picture of life in very different political times. Turner's ability to document health conditions, communicate findings from her work, challenge the federal government to acknowledge culpability, and see an eventual acknowledgment of harm and efforts to make amends stands in sharp contrast to Earle Reynolds's experience. It is important to note that her work illustrates some of the many ways in which anthropology changed in the years following World War II, the Korean War, and the Vietnam War. As an ABCC scientist, Earle Reynolds studied human subjects. The implied power relationship between scientist and subject, as well as the unquestioned support of a military research program, was not unusual for the time. Edith Turner, on the other hand, saw her role in the community evolve from that of the traditional anthropologist conducting fieldwork, with the goal of producing new intellectual insights on human behavior, to that of a proactive scholar–adviser–advocate who works for and with her host community.

In chapter 5, "Uranium Mining and Milling: Navajo Experiences in the American Southwest," by Barbara Rose Johnston, Susan Dawson, and Gary Madsen, we move the focus of this book back to the nuclear war machine, examining the context and times in which uranium was mined and processed to fuel the early Cold War buildup of nuclear weapons in the United States. This chapter places specific focus on the impact of uranium mining as experienced by the primary host community: the Navajo Nation. We examine the role of the AEC in structuring the uranium mining industry, noting its complete disregard for the occupational health and safety of Navajo miners, millworkers, and the broader residential community. We explore some of the consequential damages of this environmental racism for worker and community health. We argue that the US federal government fundamentally abused its trustee responsibilities to exploit uranium resources. And we describe recent Navajo Nation efforts to identify and remediate environmental health hazards.

The consequential damages of mining and processing uranium are explored in greater detail in chapter 6, "Uranium Mine Workers, Atomic Downwinders, and the Radiation Exposure Compensation Act (RECA): The Nuclear Legacy," by Susan Dawson and Gary Madsen. This chapter presents the broader history of uranium production and atmospheric testing in the United States and their devastating environmental and health impacts on workers and communities in the American Southwest, with a critical look at government efforts to protect the health of workers and residential communities. Reviewing findings from fifteen years of fieldwork, the authors demonstrate that a significant time lag occurred between government studies confirming significant health risks in 1951 and the implementation of basic occupational health and safety regulations in 1971. Workers developed lung cancer and other radiogenic illnesses—and these problems were predicted and studied by government scientists—yet for many years, workers were not informed of their illnesses or treated. The authors also summarize some of the actions taken by community residents to mobilize and seek redress. And they critically explore the federal response: the Radiation Exposure Compensation Act, passed in 1990 and amended in 2000. Dawson and Madsen conclude with a cautionary discussion of US government attempts to expand the nuclear industry and resume nuclear testing—actions that require renewed mining and milling of uranium and may result in the recurrence of problems that impacted Colorado Plateau residents in the past.

Moving from uranium mining and milling to an examination of community legacy issues associated with nuclear weapons production, Edward Liebow, in chapter 7, "Hanford, Tribal Risks, and Public Health in an Era of Forced Federalism," considers some of the problems associated with uranium enrichment facilities. Attention in this chapter is placed on the Native tribes who live around and downstream from the Hanford enrichment facility in southeastern Washington—that segment of the surrounding community that is most closely tied to the land and the local food chain and thus receives a greater degree of exposure to radioactive contamination. Liebow reviews the history of medical research meant to address questions posed by residents:

To what extent were the Native peoples of the Columbia Plateau exposed to different doses of Hanford radiation than their non-Indian counterparts in the general population? And which of the public health problems evident in Indian Country today can be attributed to Hanford's radiation releases? To ask these questions, and to participate in the various studies and political processes initiated by the federal government, Liebow notes that Hanford's tribal neighbors had to organize, develop technical capacities, and compete with states for scarce federal public health resources. Critically assessing flaws in the resulting scientific studies, and situating the science within the broader sociopolitical context, Liebow allows the reader to see the institutional landscape of tribal involvement in Hanford health studies, the roles of several anthropologists, and the problematic aspects of state-tribal relations. The chapter concludes by raising serious questions concerning prospects for public health, pointing toward the need to develop studies and environmental health policies that treat actual conditions rather than look for illusive proof of direct causality.

A parallel study of the efficacy and inhibiting factors in federal response to contamination and the health risks posed by uranium enrichment facilities is presented by Theresa Satterfield and Joshua Levin in chapter 8, "From Cold War Complex to Nature Preserve: Diagnosing the Breakdown of a Multi-Stakeholder Decision Process and Its Consequences for Rocky Flats." Satterfield and Levin take a focused look at the processes of risk communication and public involvement in decisions about contamination cleanup at the Rocky Flats Environment Technology Site, where the detonating devices for hydrogen bombs were produced from 1952 to 1989. They report on a political process that incorporated "best practice" public participation models that are increasingly used to define and shape environmental remediation. In this case, risk and science communication efforts at Rocky Flats were successful to the extent that much of the "involved" public achieved an impressive level of technical sophistication. However, this scientific literacy did not lead to a reduction of conflict about the risks posed by residual contaminants at the site. Instead, improved public understanding of the risk estimates and the attributes of radiation hazards occurred in a context of increased conflict: participants, with a greater knowledge of the technical issues, were unable to manage the tradeoffs underpinning core cleanup decisions, and this situation led to a crisis in public confidence in the environmental remediation process. The authors argue that the processes that bring about informed public involvement in decision making are laudable, but in the long run, they will likely fail if the overriding goal of regulators is to simply educate and convince the public that already-made decisions are in their best interest. Satterfield and Levin conclude with a "lessons learned" discussion, proposing an alternative model to explain the dynamics of risk communication and public involvement in the cleanup of contaminated sites.

Chapter 9, "Health Assessment Downwind: Past Abuses Shadow Future Indicators," by Marie Boutté, presents findings from a community health assessment pilot project that gathered baseline health data in rural Nevada during 2000–01 as part of the state's oversight of the proposed permanent, national repository for high level nuclear waste at Yucca Mountain. The community selected was on a likely transportation route for high-level nuclear waste and was also downwind from the Nevada test site. For years, this community was exposed to nuclear radiation from both atmospheric and underground weapons tests. Boutté outlines the history of exposure and community perceptions of injustice and describes how this history and sense of injustice led community members to challenge the federal government to define and assess their health. Cultural notions of identity, governance, and personal versus governmental responsibilities are identified as key variables influencing community perception of environmental risk, awareness of the relationships between exposure and health, and interest in or ability to pursue compensatory claims under RECA.

In chapter 10, our focus moves from downwinders in Nevada to the acutely and chronically exposed communities in and downwind from the US Pacific proving grounds. In "From Analysis to Action: Efforts to Address the Nuclear Legacy in the Marshall Islands," Holly Barker explores health effects from radiation exposure, noting that Marshallese women suffer from a multitude of birth anomalies and that linguistic evidence demonstrates that these health problems did not occur prior to nuclear weapons testing. Barker's use of participatory ethnography has helped refine Marshallese people's firsthand understanding of the devastating health and environmental impacts of the testing program and has allowed them to identify their own meaningful strategies and priorities in adjusting to the sociocultural upheaval caused by exile from a contaminated homeland. Thus, as with many of the case studies in this volume, Barker explores radioactive legacy issues from a community perspective. In describing how she works with affected communities, she demonstrates the role of the engaged anthropologist as adviser and advocate—that is, empowering people to address problems in meaningful and locally appropriate ways.

Very different issues, actions, and observations are offered by Paula Garb, who writes about her work with ethnic Russian, Bashkir, and Tatar communities exposed to radiation from nuclear weapons facilities in the Chelyabinsk region of Russia. In chapter 11, "Russia's Radiation Victims of Cold War Weapons Production Surviving in a Culture of Secrecy and Denial," Garb outlines the divergent perceptions of ordinary citizens living near the former Soviet Union's largest uranium enrichment facilities: how their health and lifestyles were affected by the exposure, who they blame, and what strategies they have devised to ameliorate the problems and to preserve their cultures in contaminated environments. Material presented in this chapter is derived from a multiyear study involving in-depth interviews of the victims, survey data on the local population, and newspaper articles.

Chapter 12, "Unraveling the Secrets of the Past: Contested Versions of Nuclear Testing in the Soviet Republic of Kazakhstan," by Cynthia Werner and Kathleen Purvis-Roberts, provides an overview of Soviet nuclear weapons testing in Kazakhstan, focusing on resident populations and the consequential damages of Cold War secrecy associated with the test site. Emphasis is placed on Kazakhstani citizens' descriptions of their experiences—that is, what people were and were not told about the "military tests"; how some individuals were forced to stay behind during evacuations; how those who tried to challenge the government were silenced; how radiation-related illnesses were systematically underreported; and how doctors prevented parents from seeing stillborn children. Content is based on an interdisciplinary multiyear study employing a variety of methods to determine how different groups (villagers-victims, doctors, and nuclear scientists) understand the risk and health impacts of radiation. The methods included risk-perception surveys, focus group interviews, ethnographic interviews, and textual analysis of newspaper accounts, in addition to an analysis of environmental data and health statistics.

The conclusion to this collection, Laura Nader and Hugh Gusterson's "Nuclear Legacies: Arrogance, Secrecy, Ignorance, Lies, Silence, Suffering, Action," offers critical commentary on these essays and case studies. Nader and Gusterson note that anthropologists, like other scientists, have a mixed history with regard to their role in Cold War militarism. This history includes failure to demand a public accounting of the true costs of nuclear weapons testing, as well as occasional overt involvement in research that sustained nuclear militarism. Observing the transformations in anthropology and other sciences, from "passive inhalation of the official point of view to a more muscular interrogation of received wisdom," Nader and Gusterson consider the contributions in this book to be evidence of a growing trend to resituate science within civil society. Given the strength of the military-industrial-academic complex, this is by no means an easy task. Nader and Gusterson note that today, once again, "science is saturated with politics"; "the atomic energy cover-up continues, and victims and their families have had to work hard to get accurate information about what was done to them and even harder to get any kind of remedy." They suggest that one of the collective lessons emerging from this book is that accountability is intrinsically linked to transparency—both in terms of access to information and the broader structure of government. Demands and struggles to secure accountability require a reshaping of the values and priorities of government, and it is only through such processes that opportunities for truly democratic form and practice emerge.

At one level, these essays offer a sampling of Cold War radioactive legacy issues, with snapshot descriptions of people, events, problems, and responses from the varied perspective of the anthropologist as participant, observer, analyst, or advocate. Yet while chapters vary in their focus on people, place, and time, all essays demonstrate the complex nature of the problems and the politics involving radiogenic contamination. They illustrate how actions taken in the name of national security have profoundly shaped sociocultural identity and fundamentally transformed the biophysical nature of communities.

I end this introductory chapter with a final note to the reader. As you read the following pages, do so with this thought in mind: In this world, where conflict and violence are increasingly the norm, now more than ever we need to listen to and learn from the experiences of those who understand what it is to host the nuclear war machine and survive nuclear war.

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