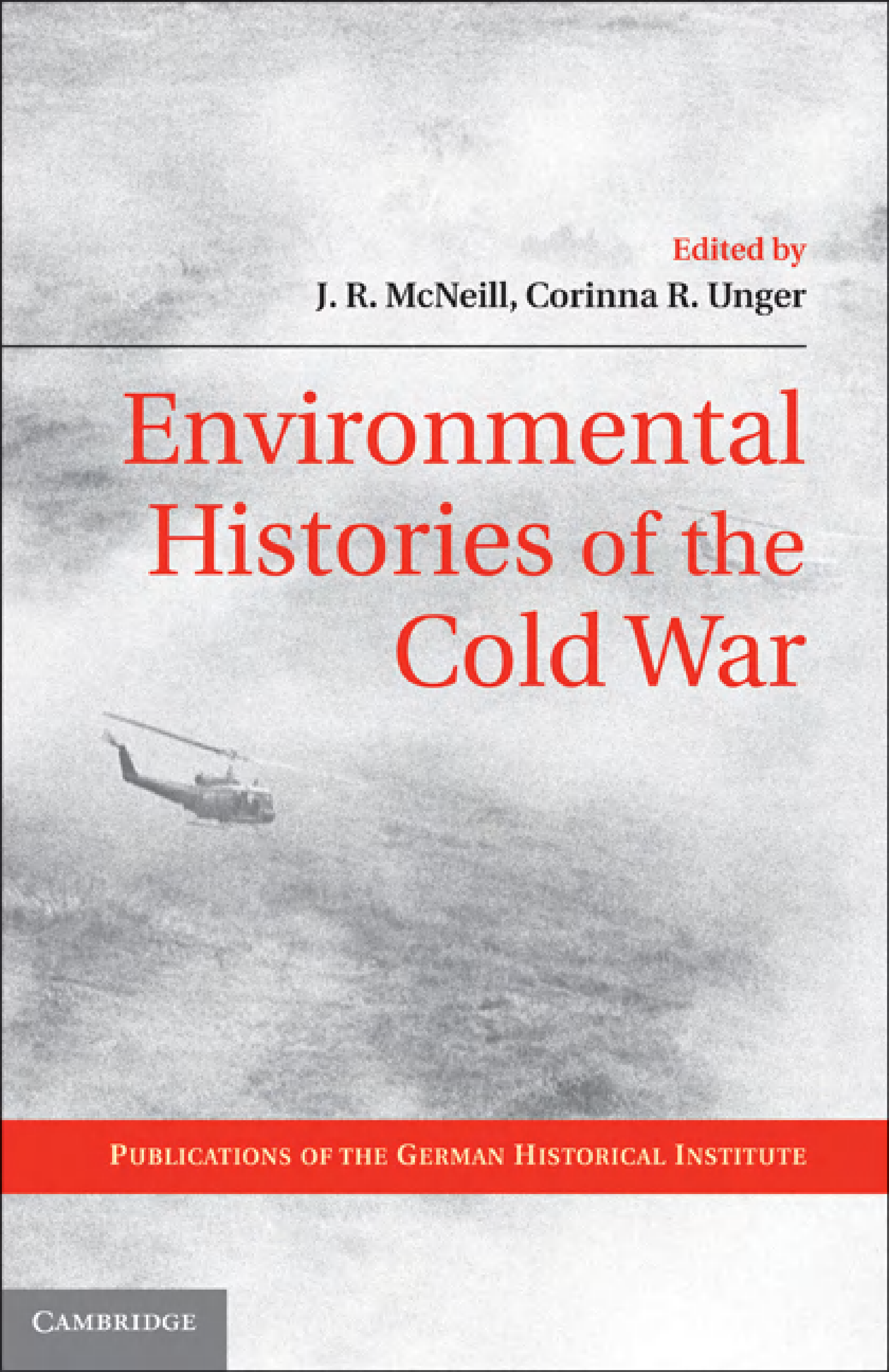

Edited by

J. R. McNeill, Corinna R. Unger

Environmental Histories of the Cold War

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Environmental Histories of the Cold War

Environmental Histories of the Cold War explores the links between the Cold War and the global environment, ranging from the environmental impacts of nuclear weapons testing to the political repercussions of environmentalism. Environmental change accelerated sharply during the Cold War years, and so did environmentalism as both a popular movement and a scientific preoccupation. Most Cold War history entirely overlooks this rise of environmentalism and the crescendo of environmental change. However, these historical subjects not only were simultaneous but also were linked together in ways both straightforward and surprising. The contributors to this book present these connected issues as a global phenomenon, with chapters concerning China, the Soviet Union, Europe, North America, Oceania, and elsewhere. The role of experts as agents and advocates of using the environment as a weapon in the Cold War or, in contrast, of preventing environmental damage resulting from Cold War politics is also given broad attention.

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Contents

List of Figures

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INTRODUCTION

The Big Picture

J. R. McNEILL AND CORINNA R. UNGER

CONTEXT

For those too young to have learned, or old enough to have forgotten, the Cold War was nasty, brutish, and long.[1] Historians disagree vehemently about its origins, about both who was responsible and when it began. But it was under way by 1947 at the latest, driven partly by conflicting ideologies among the victorious allies in World War II, partly by conflicting economic and political interests, and partly by a host of lesser considerations, including personalities, misunderstandings, and much else.

The Cold War fault lines derived from World War II. Its main theaters, Europe and East Asia, were the main theaters of World War II. On one side stood the Soviet Union of Joseph Stalin and the East European countries the Red Army had liberated (or conquered) in 1944–5 in the savage war with Germany. On the other side stood the United States and Britain, supported by dozens of allied countries, notably those liberated and occupied by Anglo-American forces in the last months of World War II. In East Asia, the defeat of Japan left a divided China, which embarked on a civil war between Communists, often but not always supported by Stalin, and nationalists, often but not unconditionally supported by the United States.

From 1948 to 1962, the Cold War featured a series of crises that threatened to convert it into World War III. The biggest shift in the balance of power came in 1949, when the Chinese communists under Mao Zedong's leadership won the civil war and drove the nationalists to the island of

1 A handy primer is David S. Painter, *The Cold War: An International History* (London, 1999). Readers familiar with the outlines of the Cold War may skip down a few paragraphs.

This book arose from a conference sponsored by the German Historical Institute in Washington, D.C. We wish to thank Christof Mauch, former director of the institute, for supporting the conference from the outset, and David Lazar of the institute for his sharp eye and firm hand in helping shepherd this volume into print.

Taiwan, and when the Soviet Union successfully exploded its first nuclear weapon. A full-fledged war in Korea (1950–3), uprisings among Soviet satellites in Eastern Europe (1953, 1956), and crises in Berlin (1958, 1961) and Egypt (1956) kept the great powers on edge and motivated dizzying arms races. The most dangerous moment of all came in 1962, when the United States persuaded the Soviets to withdraw missiles from Cuba, which had recently become a Soviet client state.

Meanwhile, the decolonization of the British, French, Dutch, and Portuguese empires in Africa and Asia enlarged the scope of the Cold War. Not only the United States and the Soviet Union but also China wished to secure allies and resources in the new countries. The United States gradually waded deeper and deeper into a conflict in Vietnam, trying to forestall communist expansion there. By the late 1960s, Vietnam had become a divisive and expensive problem for the United States, and escape from Vietnam seemed to require some relaxation of tensions with either the Soviet Union or China, or with both. Better relations with the United States, awkward as that might be in ideological terms, held a strong attraction for the two communist powers because they had had a falling out that led to border clashes in 1969. The Soviet invasion of its insubordinate satellite Czechoslovakia in 1968 further divided the communist camp. Thus, the table was set for negotiations and détente. The failure of the Soviet Union and China to maintain their alliance was another major shift in the balance of power during the Cold War.

The relaxation of tensions did not last long. A Middle East war in 1973 and the Soviet invasion of Afghanistan in 1979 ignited a new phase of intensified conflict and arms buildups. After Mao's death in 1976, China stayed mainly on the sidelines. The Soviet Union could not carry the burden, as its economy had proved far less flexible and productive than that of the capitalist world by the 1970s. By the late 1980s, under Mikhail Gorbachev, it gambled on desperate efforts to revitalize economy and society. The Soviets lost the resolve to clamp down on restive Eastern European populations, and in 1988–9, Eastern Europe – peacefully – escaped Soviet control. The Cold War was over, although the Soviet Union limped on until 1991.

By conventional reckoning, then, the Cold War lasted from the middle of the 1940s until 1991, pitting the material, cultural, psychological, and other resources of the United States and its allies against the Soviet Union and its bloc. The Cold War included shooting wars, often but not always fought by proxy forces, notably in Korea, Vietnam, Afghanistan, and southern Africa. It featured fluctuating tension and anxiety, which at many moments seemed likely to boil over into an atomic Armageddon. It incorporated almost the entire world, directly or indirectly, and was bound up with the politics of nationalism and decolonization. There is much to reckon with within the conventional reckoning.

That reckoning still does not acknowledge that the Cold War was fought on Earth in the biosphere with repercussions that will last for perhaps a hundred thousand years. In some respects, the Cold War enlarged the human experience of the biosphere by encouraging research and explorations in previously neglected nooks and crannies, such as the polar regions, the ocean floors, and the upper atmosphere. The Cold War helped alter the human appreciation of the biosphere, spurring grand ambitions such as changing the direction of ocean currents and altering weather patterns. The stakes seemed so high to those in the corridors of Cold War power that drastic interventions in the workings of the biosphere were easily justified if they promised some advantage in the mortal struggle with the enemy. In countless ways, the Cold War altered the biosphere itself. This book explores those linkages between the Cold War on the one hand and the environment, environmental change, and human knowledge of the environment on the other. It seeks to bring together the concerns of environmental history and Cold War history.

Historians of the Cold War have kept themselves busy for about sixty years, chronicling and analyzing various aspects of the struggle. The occasional opening of a new archive or the release of a new set of documents has invited periodic revisions of reigning interpretations. So, unlike the Peloponnesian War or even World War I, about which no new documents are likely to challenge prevailing wisdom, Cold War historiography chases a moving target, repositioning and remaking itself at a rapid clip, like the study of human evolution (constantly revised by new archeological finds and genomic evidence) and cosmology (revised by new snippets of data from the far corners of the universe). Historians of the Cold War, despite their unflagging industry, their relentless curiosity, and their plentiful numbers, have not given much attention to the relationships between their chosen subject and its earthly context. Like those in the corridors of power whom they have so carefully studied, they have been too busy with more conventional matters.[2]

2 See, e.g., the three recent general treatments by leading Cold War historians: Odd Arne Westad, *The Global Cold War* (Cambridge, U.K., 2005); John Lewis Gaddis, *The Cold War* (New York, 2006); and Melvyn Leffler, *For the Soul of Mankind: The United States, the Soviet Union and the Cold War* (New York, 2007). None of these works considers environmental issues or contexts. A notable exception is Jeffrey A. Engel, ed., *Local Consequences of the Global Cold War* (Washington, D.C., and Stanford, Calif., 2007). Historians of war, for their part, have long been interested in environmental factors that might affect campaigns and battles or, in an older tradition, the character of peoples. But environmental

In the latter years of the Cold War, the historical profession developed a new wrinkle, environmental history. Although it has many roots and precursors, as a self-conscious enterprise, environmental history dates to the 1970s. It is concerned with relations between human society and the rest of nature. These can take any number of forms, such as human alteration of the environment, writing and thinking about the environment, and policies and politics concerning the environment. Environmental historians have probed several aspects of this relationship, from bodies and disease to industrial metabolism and environmental protest movements. But, by and large, they have been reluctant to consider the significance of war.[3]

At first glance, this is strange indeed. War has long been one of the classic subjects for historians. Even in the past forty years, when historians have stampeded in new directions, such as social and cultural history, most still attribute great importance to big wars and routinely use them in their periodizations. And there is good reason for this: wars, at least big ones, are important in the evolution of societies. Conceivably, the sort of historian attracted to consideration of the environment is normally repelled by attention to warfare. Or, perhaps, it is merely that environmental historians thus far have been too busy with other matters and have not yet gotten around to focusing their lenses on war. In any case, environmental historians and historians of war have almost completely ignored one another's work until very recently.

Stranger still is that Cold War historians and environmental historians have studiously ignored one another's work. The majority of inquiry in environmental history concerns the post-1945 world. Just as the Cold War played out against a backdrop of the changing biosphere, every environmental issue between 1945 and 1991 took place in an evolving geopolitical context dominated by the Cold War. Yet the two historiographies have been like two ships passing in the night, dimly conscious of one other but unable or unwilling to engage each other.[4] In this book, we aim to shine a

change and the possible impacts of war on the environment have yet to spark much interest among military historians. This stands in sharp contrast to the outlook of military planners today, many of whom have developed a keen interest in environmental change, especially climate change, which they foresee as possibly affecting their craft in fundamental ways.

3 There are some exceptions, such as Richard P. Tucker and Edmund Russell, eds., *Natural Enemy, Natural Ally: Towards an Environmental History of Warfare* (Corvallis, Ore., 2004); J. R. McNeill, "Woods and Warfare in World History," *Environmental History* 9 (2004): 388–410; Berthold Meyer, ed., *Umweltzerstörung: Kriegsfolge und Kriegsursache* (Frankfurt, 1992); and Charles E. Closman, ed., *War and the Environment: Military Destruction in the Modern Age* (College Station, Tex., 2009). For readers of Finnish, there is also Simo Laakkonen and Timo Vuorisalo, eds., *Sodan ekologia: Nykyaisen sodankäynnin ympäristöhistoriaa* (Helsinki, 2007), concerning recent warfare.

4 The chief exception to this general statement is the awareness in the historiography of the rise of modern environmentalism of the significance of anxieties arising from nuclear fallout.

searchlight through the fog, making it easier for those on one ship to take account of those on the other.

CONNECTIONS

Countless connections exist between the Cold War and the concerns of environmental history. This book explores a few but by no means all of them. Here are some reflections on some of the relevant themes – some represented, some not – in the chapters that follow.

The Environmental Effects of Proxy Wars

Greg Bankoff's chapter on Asian fauna in the Cold War, and especially in the hot wars of Korea, Vietnam, and Afghanistan, provides a glimpse into a fascinating and large subject. Proxy wars took place outside of Asia, too, of course, in Angola; Mozambique; Central America; and, in some people's estimation, in the Middle East. These were often guerilla conflicts, fought in remote rural landscapes by poor and hungry people. The destruction of crops, trees, animals, water supplies, and so forth – environmental warfare – had a strong logic where those resources were so desperately needed and where moral strictures against punishing civilian bystanders scarcely applied. The wars in southern Africa (c. 1960–90), where the Americans and the Soviets supported rivals seeking to supplant Portuguese colonial rule, serve as a fine example. The fragility of ecosystems, especially in semiarid areas of Angola and Mozambique, made ecological damage hard to repair, and the poverty of the affected populations made environmental warfare an especially effective political tool.[5]

The Vietnam War is the best-studied war from the ecological perspective, mainly because of the moral objections to the Americans' use of chemical defoliants such as Agent Orange. David Zierler's chapter explains some sides of that important issue. Other aspects of the environmental effects of combat, and of political struggle, in Vietnam have rewarded investigation.[6] Other Cold War theaters, from Central America to the Horn of Africa, deserve detailed attention, too.[7]

5 Emmanuel Kreike, "War and the Environmental Effects of Displacement in Southern Africa (1970s–1990s)," in *African Environment and Development*, ed. W. G. Moseley and B. I. Logan (London, 2003), 89–110.

6 David Biggs, "Managing a Rebel Landscape: Conservation, Pioneers and the Revolutionary Past in the U Minh Forest, Vietnam," *Environmental History* 10 (2005): 448–76.

7 On Central America, there is Daniel Faber, *Environment under Fire: Imperialism and the Ecological Crisis in Central America* (New York, 1992), but it is thinly researched.

Agriculture and the Green Revolution

The Cold War was a contest for the hearts and minds of millions around the world, but it could not have been won without successfully filling stomachs. Claims for the moral or practical superiority of communism or capitalism would ring hollow unless people were adequately fed. In the Soviet Union, this presented an acute problem in the aftermath of World War II because food production lagged well behind requirements. Famine stalked the land in 1946; Nikita Khrushchev's memoirs mention cannibalism in the Ukraine. Stalin, no friend of the peasant, responded with various efforts to squeeze more grain from the countryside and, in 1948, a comprehensive plan for the transformation of nature. The plan's central goal was to make the Soviet land more productive, to feed the population, and to allow grain exports that could serve political ends (during the 1946 famine, the Soviet Union exported grain to France in hopes of influencing election results). The plan had not progressed very far by the time of Stalin's death in 1953. Khrushchev, eager to distance himself from Stalin, followed with the Virgin Lands Campaign, which involved plowing up huge areas of steppe grassland in Kazakhstan and eastern Siberia and sowing them with wheat.

American authorities, meanwhile, were increasingly concerned about the problem of hunger, which, they feared, could threaten political stability and open the door to communist agitation, especially in Latin America and Asia. After flirting with ideas of land reform, they responded with a technical solution known as the green revolution. This was an agricultural modernization package of high-yield cereals (initially wheat and rice, carefully bred to carry a heavy, grain-packed head on a short stalk), combined with chemical fertilizer, pesticides, and usually new machinery and irrigation. As a production strategy, it worked: wheat and rice yields doubled and tripled where the new crop varieties flourished (e.g., Mexico and India).[8] The Chinese, too, pursued scientific crop breeding, but they also followed the Soviet strategy of plowing up semiarid grasslands for cultivation.

Both of these responses to the threat of hunger, intensification and extensification of agriculture, brought pronounced ecological effects. The green revolution loosed new chemicals on agroecosystems and the waters that drained them. Its machinery led to soil compaction and its irrigation to waterlogging and, in places, to salinization. Plowing up grasslands invited wind erosion and the rapid drawdown of soil nutrients. Hundreds of millions

8 A forthcoming book by Nick Cullather, *Parable of Seeds: The United States and the Green Revolution in Asia*, will illuminate the role of the green revolution in U.S. Cold War strategy.

of hectares of Earth's surface were fundamentally altered by agricultural initiatives spurred by the Cold War.[9]

Cold War Infrastructure

In Richard Tucker's chapter, the connections between Cold War geopolitical agendas and the spate of dam building around the world are laid bare. Dams had both practical and symbolic value in the Cold War struggle, as did other forms of large-scale infrastructure, such as roads and railroads. Like dams, such infrastructure was built for a host of reasons, not all of which involved the Cold War. But, as with dams, Cold War anxieties helped shape projects such as the U.S. interstate highway system and the Soviet Baikal-Amur Mainline (BAM) railroad.

In 1956, after years of political wrangling, the U.S. Congress succumbed to pressure from President Dwight Eisenhower and passed what is commonly known as the National Interstate and Defense Highways Act. Ike wanted a highway system that would stand the country in good stead in the event of war, that would allow rapid evacuation of major cities in the case of nuclear attack, and that would speed men and materiel to ports should conventional war break out. Its roadbeds, tunnels, and bridges were built to accommodate military vehicles. Its network served all of the roughly four hundred military bases in the (then) forty-eight states.

The Soviet leadership also had military priorities in mind when making transport-investment decisions during the Cold War. In contrast to the United States, however, the Soviet Union neglected roads and instead gave priority to railroads. One example is the long-delayed completion of the BAM line first begun in the 1930s but left languishing until geopolitical events in the 1960s – the Sino-Soviet border clashes and the Vietnam War – gave routes to the Soviet Far East and Pacific ports a new importance in the Kremlin's strategic thinking. The sole existing transport line linking the Russian heartland with Vladivostok was the old Trans-Siberian Railroad, which lay close to the Chinese border. The BAM line, well back from the border, offered welcome insurance against either Chinese incursion or American missiles or bombers.

These roads and railroads, like all transport infrastructure, helped redefine patterns of land use. They influenced settlement, the location of businesses,

9 John H. Perkins, *Geopolitics and the Green Revolution* (New York, 1997); Zhores Medvedev, *Soviet Agriculture* (New York, 1987); Nick Cullather, "Miracles of Modernization: The Green Revolution and the Apotheosis of Technology," *Diplomatic History* 28 (2004): 227–54; Martin McCauley, *Khrushchev and the Development of Soviet Agriculture: The Virgin Lands Programme, 1953–1964* (London, 1976).

and the economics of resource extraction. Logging, mining, and farming became practical in places previously inaccessible. The interstate highways also inhibited terrestrial wildlife migrations – as dams did aquatic wildlife.

Military Bases

The Cold War was a global struggle, especially after the Soviet Union made a commitment in the 1960s to foster communist revolution wherever circumstances seemed promising.[10] This meant that both the Americans and the Soviets built networks of military bases to house their forces, partly to keep local governments and populations loyal (or at least compliant) and partly to be prepared should a real war break out. By the mid-1960s, the United States had some 375 overseas bases. Sometimes these were sprawling establishments, as in the case of the Panama Canal Zone or Subic Bay in the Philippines. Normally, the bases were free from local laws and at least partially insulated from local pressures. This meant that military authorities could often use the environment of the military bases as they saw fit, with little or no restraint. They could, for example, dump millions of tons of toxic chemicals – mainly in fuel, lubricants, and ammunition – on soils and in waters without regard to the consequences. The pollution record of the Soviet military in Eastern Europe and the Baltic in this respect is especially egregious, an indication of the frictions felt between Soviet occupying forces and the unwelcoming populations. As the Soviet forces withdrew after 1989, they sometimes willfully polluted the bases they were turning over to Eastern Europeans. The Americans' slow withdrawal from the Panama Canal Zone after 1977 seems honorable in comparison – but only in comparison. Thus, the networks of bases were archipelagoes not merely of environmental nonchalance but sometimes of deliberate despoliation as well.[11]

Nuclear Weaponry

Far in the future, when none but the most encyclopedically informed historians has heard of the Cold War, the legacy of radioactive contamination from nuclear weapons programs will still haunt the biosphere. Most of the

10 See Vladislav Zubok, *A Failed Empire: The Soviet Union in the Cold War from Stalin to Gorbachev* (Chapel Hill, N.C., 2007), on Soviet adventures around the world.

11 Henri Myrttinen, *Base Conversion in East and Central Europe, 1989–2003* (Bonn, 2003), 12–13; José Carcione, Henryk Marcak, Geza Seriani, and Giorgio Padoan, "GPR Modeling Study in a Contaminated Area of Krzywa Air Base (Poland)," *Geophysics* 63 (2000): 521–5; Joseph Gerson and Bruce Birchard, eds., *The Sun Never Sets: Confronting the Network of Foreign U.S. Military Bases* (Boston, 1991).

environmental effects listed above were the result of Cold War conduct that was driven only in part by Cold War political agendas. In the case of nuclear weapons, although the United States first developed them in World War II, their mass production and frequent testing was explicitly a result of Cold War anxieties. The production, testing, and even decommissioning of nuclear weapons all made lasting messes. Paul Josephson's chapter gives a sense of the casual attitude toward nature and the anxious attitude toward security that characterized the Soviet nuclear weapons program. Mark Merlin and Ricardo Gonzalez's chapter illustrates some of the effects of American, British, and French nuclear testing in the Pacific. No one knows just what the environmental effects of Chinese testing at Lop Nor might be, as China maintains a thicker veil of secrecy around its nuclear weapons program than anyone else does. But whether in the Soviet Arctic, the atolls of Micronesia, the Xinjiang Uyghur Autonomous Region of China, or anywhere else, the radiation resulting from nuclear weapons production, testing, and (careless) disposal will be with our descendants, and indeed with all life forms, for tens of thousands of years to come. Historians will have to be at their best to explain to future generations how the pressures of the Cold War led responsible officials to make the choices that they did.[12]

Military-Industrial Complexes

At the end of his presidency, Eisenhower warned the U.S. public against the power of what he dubbed "the military-industrial complex." It was not a new threat. Britain and Germany had their own versions of military-industrial complexes in the nineteenth century, and every major combatant in the world wars either had one or had to build one. But in the course of the Cold War, the United States and the Soviet Union took the military-industrial complex to another level. According to some estimates, military goods accounted for 25–40 percent of all industrial production in the Soviet Union. In all Cold War powers, industries deemed vital to military preparedness were given tax breaks and subsidies, and afforded levels of secrecy unavailable to others. Military industries enjoyed privileged access to raw materials, particularly in the Soviet Union, and special powers in labor

12 Michele Gerber, *On the Home Front: The Cold War Legacy of the Hanford Nuclear Site* (Lincoln, Neb., 1992); Stephen I. Schwartz, ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons* (Washington, D.C., 1998); Arjun Makhjani, Howard Hu, and Katherine Yih, eds., *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects* (Cambridge, Mass., 1995); Nikolai Egorov, Vladimir Novikov, Frank Parker, and Victor Popov, eds., *The Radiation Legacy of the Soviet Nuclear Complex* (London, 2000); V. I. Bulatov, *Rossia: Ekologiia i armiia* (Novosibirsk, 1999), 41–53.

relations, including, in the Soviet case, the provision of free gulag labor. Wherever possible, and in the Soviet Union this meant everywhere, they were exempt from pressures and laws to contain pollution. In the United States during the Cold War, environmental regulation more or less stopped at the doorstep of military industries, especially before the mid-1970s. As for the Chinese, after the Sino-Soviet split, they felt anxious about attack from both the Soviet Union and the United States, and consequently built a brand new military-industrial complex deep in the interior, mainly in Sichuan Province, polluting broad swaths of countryside that had formerly breathed easily.[13]

Military-industrial complexes reached beyond the borders of the leading geopolitical powers to a much greater extent during the Cold War than they had in earlier epochs. Strategic ores such as uranium, manganese, cobalt, and nickel meant a great deal to the Cold War powers, so they tried hard to maximize and monopolize production wherever they could. The United States tried to persuade its firms to mine strategic ores in places where the prospects for profits were usually insufficient to tempt businesspeople, such as in central and southern Africa. The Soviet Union tried to get as much ore, especially uranium, out of Eastern Europe as fast as possible, leaving a radioactive mess in the former East Germany and Czechoslovakia. Thanks to the pressures of the Cold War, mining operations took place around the world that otherwise would not have. And, of course, they had a range of environmental consequences, from the in-filling of streams and rivers to the creation of mountains of slag.

Respites for Nature

One of the more cheerful aspects of the relationship between the Cold War and the environment is the creation of de facto nature preserves in restricted military areas. Simply by preventing quotidian economic activity, restricted areas sometimes preserved ecosystems and species that would otherwise likely have disappeared. In some cases, decommissioned bases or artillery ranges have been converted to formal nature preserves, as with some of the former Soviet bases in Eastern Europe, the former U.S. Navy gunnery range at Culebra (an island off of Puerto Rico), and the former nuclear arsenal at Rocky Flats, Colorado (an official wildlife refuge since 2005).

Perhaps the best example, and a direct result of the Cold War, is the demilitarized zone (DMZ) spanning the waist of the Korean peninsula. Off-limits

13 Judith Shapiro, *Mao's War against Nature* (New York, 2001).

to civilian activity since the armistice of 1953, the DMZ is the final active front of the Cold War and today is the most heavily militarized border region in the world. The rest of Korea is densely populated and thoroughly used for economic purposes, but not the DMZ. As a result, over the past half century, the DMZ has become a wildlife preserve where species absent elsewhere can still be found, as Greg Bankoff shows in his essay. It is a way station for migratory birds, including some very rare species of cranes that are culturally prized in East Asia but nonetheless threatened with extinction. The DMZ is only about 2.5 miles wide and 155 miles long, but it includes wetlands, grasslands, and mountain ecosystems – a good transect of Korea's natural biomes. Most of it was farmed or logged or otherwise used before the Korean War, but in half a century of enforced neglect, the ecosystems have shown resilience and have reminded Koreans of what their peninsula once looked like.[14]

Cold War Environmentalism

Modern environmentalism has many parents and grandparents, but it is, among other things, a child of the Cold War. Perhaps the most direct connection is in the overlap between antinuclear and environmental protests. This was most pronounced in Europe, probably in West Germany and Britain above all, where several communities objected to the placement of American nuclear warheads in their vicinity. Often, the same people took part in both the antinuclear and the environmental movements.[15] Fears of radiation poisoning and nuclear-winter scenarios helped tilt popular culture in the direction of ecological thinking. The former also affected the conduct of politics and diplomacy in the case of the Partial Test Ban Treaty of 1963, as discussed in Toshihiro Higuchi's chapter. In the United States, the environmental movement of the 1960s and 1970s often appealed to the same segments of society that objected to the Vietnam War and viewed Cold War militarism with suspicion. Other segments of the population, more committed to vigorous prosecution of the Cold War, often viewed environmentalism with equal suspicion and, in extreme cases, viewed environmentalists as treasonous stooges of the Soviet enemy.

14 Ke Chung Kim, "Preserving Biodiversity in Korea's Demilitarized Zone," *Science* 278 (1997): 242–3; Kwi-Gon Kim and Dong-Gil Cho, "Status and Ecological Resource Value of the Republic of Korea's De-militarized Zone," *Landscape and Ecological Engineering* 1 (2005): 3–15.

15 Sandra Chaney, "For Nation and Prosperity, Health and a Green Environment: Protecting Nature in West Germany, 1945–1970," *Nature in German History*, ed. Christof Mauch (New York, 2004), 93–118; Jens Ivo Engels, *Naturpolitik in der Bundesrepublik: Ideenwelt und politische Verhaltensstile in Naturschutz und Umweltbewegung 1950–1980* (Paderborn, 2006), 322–76.

In the Soviet Union and several of its Eastern European satellites, environmentalism eventually served as one of the few – sometimes the only – permissible form of critique of the state and the Communist Party. When environmentalism began to gather momentum in the West, those in the Kremlin and their apparatchiks elsewhere initially welcomed it, seizing the opportunity to portray environmental degradation, pollution in particular, as characteristic of capitalism in its decadence. Some imaginative Polish theorists even briefly advanced the position that pollution was impossible under socialism. This was conspicuously at odds with visible (and smellable) fact, and gradually a critique emerged of communist regimes' failure to protect nature and human health adequately. Although those who made such views public were sometimes suppressed, as often as not, the authorities tolerated environmentalism within certain limits. As a result, it attracted adherents who could find no other way (that would not result in a spell in prison or worse) to express their frustrations and resentments toward the state. These movements peaked in the 1980s and played a modest role in shaking the foundations of the Eastern European satellites. In the Soviet Union itself, the political space accorded to environmentalism and its influence on high politics was smaller.[16]

Something similar could be observed in the People's Republic of China, according to Bao Maohong's account in this volume of Chinese environmental policies. After years of sacrificing environmental interests to forced industrialization, economic considerations of the costs of environmental destruction and growing international pressure helped develop a sensitivity toward environmental degradation. Environmental critique in Cold War China carried considerable risks to those who engaged in it, but it was safer than almost any other form of criticism of the state or Communist Party.

Environmentalism and Diplomacy

By the late 1960s, environmentalism had gained such importance in the West that it became part of international politics and was instrumentalized as a foreign policy tool. Many politicians became persuaded by the need for détente, and environmental issues, less contentious matters such as arms control, promised to help bridge the divide between East and West. International organizations such as the United Nations and the Conference on Security and Cooperation in Europe became prominent advocates for

16 Douglas Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachev* (Berkeley, Calif., 1999).

global approaches to environmental protection, even if the initiative for such international efforts often was rooted in national or regional interests, as Kai Hünemörder notes in his contribution to this volume. The ebb and flow of détente both shaped environmental politics and policies and in turn (albeit to a lesser degree) was shaped by them. Thus, the Cold War settings in which environmental issues were debated were never static but subject to political change.

Environmental History, the Cold War, and Science

Looking at the linkages between environmental history and the Cold War, the central role science played within this complex becomes apparent quickly, for both the environment and the Cold War are connected with science in multiple ways. The Cold War world was, in many respects, a scientific world – one in which political, social, and cultural problems were viewed through the lens of science and in which science was believed to offer solutions to the challenges both of everyday life and of international politics, including the Cold War itself. The towering influence of science today on nearly every aspect of individual and political life derives in large measure from the period between the end of World War II and the fall of the Berlin Wall.

To be sure, science – or rather, scientists – had been able to secure an important position for themselves many years before the beginning of the Cold War. During World War I, scientists had proved how relevant their knowledge was to winning increasingly modern (i.e., technically advanced) wars. Public belief in science continued to grow in the industrialized countries during the interwar period, as accelerating modernization processes seemed to require increasingly elaborate, rational, and efficient methods and solutions. Technocracy's breakthrough in the 1920s and 1930s paved the way for what was to become the most scientific war to date. World War II was fought on many fronts, prominently among them the front of science. The Western alliance's victory over Adolf Hitler owed much of its success to scientists' efforts to develop weapons that would destroy the German forces.[17] Those who had doubted the Allies' technological superiority were proved wrong by Hiroshima and Nagasaki. With the deployment of two atomic bombs, American scientists had shown the world that they were capable of ending wars and destroying fascism. What else would have

17 See Alex Roland, "Science, Technology, and War," in *The Modern Physical and Mathematical Sciences*, ed. Mary Jo Nye (Cambridge, U.K., 2003), 561–78.

granted scientists the extraordinarily privileged position vis-à-vis society and politics they acquired after 1945? If scientific knowledge could help to win a world war, it could surely help to contain totalitarianism and to prevent the Cold War from turning hot – a belief that fueled the Cold War logic of deterrence and the buildup of huge arsenals of ever-more-capable weapons of mass destruction.

Mobilizing Science, Mobilizing the Environment

Much has been written about the mobilization of science and the development of the so-called military-industrial-academic complex since World War II.[18] One thing most scholars agree on – apart from the fact that immense amounts of money helped to build a large, multifaceted apparatus of state-sponsored research facilities[19] – is the stability of the relationship between state and science, strategists and researchers. Whereas earlier studies tended to look on this relationship as a one-way street on which scientists followed political and military leads, more recent scholarship has made clear that the relation was an interdependent one, profitable to all parties, and that scientists were quite willing and able to shape it to serve individual and disciplinary interests.[20]

The study of Cold War science has blossomed over the past fifteen years, and its traditional focus on physics and engineering has widened to include the social sciences.[21] However, little has been written about the development and importance of the environmental sciences.[22] This is even more astonishing, as the latter owe their successful career to the Cold War in many respects. Actually, many Cold War strategists credited them with playing an

18 See, e.g., Leslie W. Stuart, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York, 1993); Michael Fortun and Sylvan S. Schweber, "Scientists and the State: The Legacy of World War II," in *Trends in the Historiography of Science*, ed. Kostas Gavroglu, Jean Christianidis, and Efthymios Nicolaidis (Dordrecht, 1994), 327–54.

19 See, among others, Daniel J. Kevles, "'K1 S2': Korea, Science, and the State," in *Big Science: The Growth of Large-Scale Research*, ed. Peter Galison and Bruce Hevly (Stanford, Calif., 1992), 312–33; Sam S. Schweber, "Big Science in Context: Cornell and MIT," in ibid., 149–83.

20 For example, see John Krige and Dominique Pestre, "Introduction," in *Science in the Twentieth Century*, ed. John Krige and Dominique Pestre (Amsterdam, 1997), xxi–xxxv, xxxiii.

21 For an overview, see Corinna R. Unger, "Cold War Science: Wissenschaft, Politik und Ideologie im Kalten Krieg," *Neue Politische Literatur* 51, no. 1 (2006): 49–68. On universities in the Cold War, see David C. Engerman, "Rethinking Cold War Universities: Some Recent Histories," *Journal of Cold War Studies* 5, no. 3 (2003): 80–95.

22 Exceptions are, among others, John Cloud, "Imagining the World in a Barrel: CORONA and the Clandestine Convergence of the Earth Sciences," *Social Studies of Science* 31, no. 2 (2001): 231–51; and Jacob Darwin Hamblin, *Oceanographers and the Cold War: Disciples of Marine Science* (Seattle, 2005).

important role in winning the conflict. Climate research, the topic of Kristine Harper and Ronald Doel's essay on the U.S. Defense Department's efforts to produce rain in India, probably would not have triggered such sincere interest or have received such generous support had atmospheric scientists not promised to help win the battle for democracy. The same holds true for those disciplines whose representatives made an effort to understand human behavior in different surroundings and to optimize it according to strategic demands, as Matthew Farish shows in his chapter. Demography and agronomy, water management, and botany might not have been at the forefront of strategists' minds at Potsdam in August 1945, but it soon became clear that the evolving Cold War was a most extraordinary, highly unconventional conflict and that its universal character – both from a spatial and from a politico-ideological point of view – demanded unusual approaches to winning it, among them environmental warfare. American military agencies seriously discussed the use of radiological, chemical, and biological weapons in the early postwar years, but bureaucratic and political difficulties prevented those ideas from becoming reality, as Jacob Hamblin argues in his essay.

Transnational Approaches

Studying the intersections of environmental and Cold War history offers an opportunity to approach twentieth-century world history from a transnational perspective. The environment is a transnational actor and setting per se, transcending all political and cultural borders, and environmental exchange and transfer, two of the central analytical categories in transnational studies, take place on a quite "natural" basis.[23] Similarly, the Cold War, by its very nature, transcended traditional borders. Its global dimension and the universalism claimed by its defining ideologies overcame former geographic divides and gave rise to the most unlikely alliances – sometimes with, but more often against the environment.

That neither the Cold War nor the environment was constrained by national borders holds two advantages for historians. First, it helps to complement the traditional view of the Cold War as a conflict fought by diplomats, intelligence agencies, and the military in Washington and Moscow by integrating the environment as an immensely influential factor and, in some respects, an agent. Second, it offers a key to unlocking the door to the Cold

23 This is not to suggest the existence of a time-transcending state of environmental harmony; such a romanticizing picture of the environment is surely inadequate, especially when set in contrast to the conflictual twentieth century.

War's periphery. It was there, in the so-called Third World that the Cold War's proxy wars were fought, and it was inhabitants of those countries who suffered most severely the immediate consequences of the struggle between the two blocs. Practices such as nuclear testing and the military use of defoliants were linked in one way or another to Cold War interests and strategies. Interventions into the environment as part of fighting the conflict between East and West may not always have qualified as warfare by traditional definitions but their aggressive, often-destructive character is very visible today.

Controlling the Environment

The fear of communism and its inherent threat to individual liberty, economic prosperity, and political freedom defined Western views of the environment to a large degree. The effort to stabilize one's individual and national standing vis-à-vis an apparently totalitarian enemy resulted in the attempt to exercise as much control as possible over all aspects of life – including the wild, unpredictable environment. This kind of applied fear management clearly depended on science's ability to understand the ways the environment worked, and once scientists had made this knowledge available, it seemed possible to influence even the behavior of the environment. Thus, one did not have to comply with the environment's supposedly atavistic forces any longer but could steer them according to political and economic needs and even use them as a weapon against the enemy. To be sure, such technocratic thinking was not new. Already in the 1920s and 1930s, the Soviet Union had proved one of its most loyal disciples, as described by Paul Josephson in his chapter here on Soviet environmental interventions. But the Cold War added a special urgency to the centuries-old effort to overcome humanity's subordination to the environment. Modern technology offered new, increasingly effective ways of doing so. Faith in science and technology, moreover, encouraged bold environmental interventions.

Scientific Experts and Environmentalism

The expert culture that arose from the political privileging of science remained powerful until the late 1960s. At that time, the liberal consensus and its national security dogma were coming under growing pressure from civic, mostly left-wing groups protesting Vietnam and other allegedly imperialist ventures by the United States, and the close collaboration among scientists, the state, and the military began to come under increasingly harsh criticism. Scientists were accused of selling their knowledge for immoral causes and of sacrificing science's freedom for personal advantage. Some scholars joined the call for scientists to return to the ivory tower and to regain at least some of the freedom they had given up since the end of World War II.[24]

The technocratic view of the environment came under pressure for other reasons as well. Nuclear testing; the use of herbicides, pesticides, and defoliants; chemical and biological warfare – all of these were criticized by scientists, politicians, and ordinary citizens early on (see the chapters by Higuchi, Zierler, Deese, and Merlin and Gonzalez).[25] Although the groups and individuals involved often had a difficult stand vis-à-vis the military-industrial-academic complex, they succeeded in attracting growing attention and support. In some ways, their success was facilitated by the Cold War itself. Satellite photography, one of the most characteristic Cold War inventions, produced images of Earth that made evident both its coherence and its fragility; those images, in turn, fostered a rediscovery of organic thinking and the emergence of deep ecology.[26] Similarly, scientists' privileged status and prestige helped lend credibility to civic protests against the destruction of the environment and the risks the Cold War rivalry posed to humankind. As experts, scientists could make authoritative statements about the environmental effects of Cold War–related practices, and it was difficult for politicians and strategists to question those statements without risking their own credibility. Thus, in a dialectical sense, the Cold War, by conferring on scientists a special position within society, produced its own, severest critics.

A PARTING SHOT

It is important to recognize that some things happened during the Cold War years that had little or nothing to do with the Cold War. Some of the environmental changes that took place would have happened even had there been no Cold War. For example, the overfishing in many of the seas' richest fisheries owed little or nothing to the Cold War. The same holds for the

24 See, among others, Immanuel Wallerstein, "The Unintended Consequences of Cold War Area Studies," in *The Cold War and the University: Toward an Intellectual History of the Postwar Years*, ed. Noam Chomsky (New York, 1997), 195–231, 220–3; Ron Robin, *The Making of the Cold War Enemy: Culture and Politics in the Military-Intellectual Complex* (Princeton, N.J., 2001), 235–7.

25 Also see Christof Mauch, Nathan Stoltzfus, and Douglas R. Weiner, "Introduction," in *Shades of Green: Environmental Activism around the Globe*, ed. Christof Mauch, Nathan Stoltzfus, and Douglas R. Weiner (Lanham, Md., 2006), 1–12; Frank Zelko, "Challenging Modernity: The Origins of Postwar Environmental Protest in the United States," in ibid., 13–40.

26 See Denis Cosgrove, "Contested Global Visions: *One-World*, *Whole-Earth*, and the Apollo Space Photographs," *Annals of the Association of American Geographers* 84, no. 2 (1994): 270–94.

substantial deforestation of the moist tropical-forest belt that once ran across West Africa. The creation of this, that, or the other park or conservation refuge normally had nothing, or next to nothing, to do with the Cold War. Equally, the rise of modern science and the prestige and power enjoyed by scientists occurred in Finland and Switzerland as well as in the Cold War powers – although it took a rather different shape there.

Still, it is hard to find much of significance in environmental history during the Cold War years that did not have some direct or indirect connection to the Cold War. Some fishermen made use of satellite imagery to guide them in their quest for schools of fish, something that might not have happened or might have happened only later on a smaller scale, without the impetus the Cold War gave to space technology. Population growth lay behind West African deforestation (although, of course, other causes were involved, too), and to some extent that population growth depended on public health initiatives, food programs, and the like that sometimes derived, in part, from Cold War motives. And the fate of science and scientists unconnected to Cold War research was nevertheless indirectly linked, through exchanges of information, international collaborations, and so forth, to scientists at the Massachusetts Institute of Technology, Stanford, Los Alamos, Moscow State, Akademogorsk, and other centers of Cold War science. Thus, if one is prepared to follow the ligaments far enough, almost everything that happened during the years from 1945 to 1989 bore some connection to the Cold War.

In the pages that follow, we offer some examples of connections between environmental history and the Cold War. Some of those connections are indirect; others are clear and strong. All of them, we hope, will be of interest.

PART I

Science and Planning

1

War on Nature as Part of the Cold War

The Strategic and Ideological Roots of Environmental Degradation in the Soviet Union

PAUL JOSEPHSON

One aspect of Cold War competition between the United States and the Soviet Union involved sparring over a range of environmental issues. Soviet political leaders claimed to manage resources in the name of the proletariat, whereas American officials spoke about the inviolability of private property. American specialists referred to great success in creating the legal framework to combat pollution; Soviet policy makers and scientists followed with the passage of statutes to demonstrate that the nation cared more about the citizen and the environment than the U.S. government did. Most observers agree that the United States won this Cold War battle owing to the successful implementation of the National Environmental Protection Act (1969), together with a series of clean air acts dating to 1955; the Clean Water Act (1972); and a variety of other legislative, juridical, and voluntary measures. Soviet policies and practices led to environmental degradation on a scale that may be exceeded only by current practices in China. The impacts on the environment and public health will continue to be felt for decades to come.[1]

The Soviet environmental legacy is fields of toxic waste that continue to leak into the groundwater and costly, massive, failed white elephants – nature transformation projects and huge inefficient factories – that dominate the landscape. In some regions, pollution led to the formation of extensive tracts of land devoid of trees, where only the hardiest of grasses survive, what might be called industrial deserts. Residents still suffer from a variety of acute and chronic diseases and high mortality rates.[2]

1 On the critical Chinese situation, see Judith Shapiro, *Mao's War against Nature* (Cambridge, 2001). For an encyclopedic compilation of the human and environmental costs of the Soviet development model, see Murray Feshbach and Alfred Friendly Jr., *Ecocide in the USSR* (New York, 1992).

2 Paul Josephson, "Industrial Deserts: Industry, Science and the Destruction of Nature in the Soviet Union," *Slavonic and East European Review* 85, no. 2 (April 2007): 294–321. It does little to celebrate this seeming victory when, culminating with the abandonment of the Republican conservationist

Several interrelated political, economic, and ideological factors distinguished the war on nature carried out during nearly three-quarters of a century of Soviet power, an assault that accelerated during the Cold War years. The first was the almost-fetishistic embrace of planning mechanisms with the certainty that the plan would enable the socialist economy to avoid the costs of industrialization – squalor, dingy and dangerous workplaces, smoke-belching factories – that capitalist nations and their workers had endured. Similarly, through scientific application of plans, nature itself could be made to function in a machinelike fashion. The second was the bureaucratic nature of Bolshevik rule that led almost inevitably to the pursuit of large-scale, centralized development projects, each of which acquired nearly unstoppable technological momentum. Soviet ideologists and officials argued that massive facilities such as thermal and (later) nuclear power stations, dams, hydroelectric stations and irrigation systems, smelting and petrochemical factories, and the like permitted them to achieve economies of scale, yet they overlooked the inefficiency of such facilities and their human and environmental costs. The so-called hero projects of Soviet power – massive technologies and entire cities devoted to industrial production – had ideological and political purposes that forestalled apprehension of the costs. They enabled party spokespeople to claim that the socialist system was capable of achieving size, scale, and production on a level impossible in the capitalist West while simultaneously providing a forum in which nearly illiterate peasants could be transformed into politically conscious workers devoted to industrialization.

Last, the constant struggle against enemies, against hostile capitalist encirclement even before World War II, then against fascist Germany, and against the United States and its allies during the Cold War, was always accompanied by war against capricious nature itself. Those who advocated a moderate approach to resource development, consideration of the social factors of production, or the creation of nature preserves were ignored, hounded for their lack of communist conviction, or at times even labeled as "wreckers" in the life-and-death struggle with the West.[3] The language of war on nature was not unique to the Soviet Union,[4] but it was ubiquitous there.

As Douglas Weiner and others have shown, many scientists did not embrace this engineering mentality against nature. Researchers were able to

legacy, shortsighted antiregulatory fervor has replaced publicly endorsed and successful efforts to tackle resource use and pollution problems openly and honestly. Newspeak ("open skies") has replaced real policy. Snowmobiles and Jet Skis now assault national parks.

3 Loren Graham, *The Ghost of the Executed Engineer* (Cambridge, Mass., 1992).

4 Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (Cambridge, 2001).

secure the establishment of a network of small but important nature preserves, albeit at the cost of making concessions to economic development.[5] But the Soviet system proved extremely capable in training legions of engineers whose hubris knew few bounds. On the eve of its breakup in 1991, the Soviet Union had one-third of the world's engineers and one-quarter of its physicists. They apprehended the world through narrow metallurgical, chemical, construction, and other specialties. Environmental training programs and understandings were late to develop. Combining Enlightenment faith in progress with deterministic Marxian notions of the development of the productive forces as the sine qua non for the communist future, they focused the tools of their trade on achieving high production targets and saw nature only as a commodity. There were, to be sure, a number of paradoxes here: fascination with large-scale technological systems, yet poverty of capital and heavy reliance on labor; rhetorical faith in the ability to preserve nature, yet allegiance to its subjugation; and above all, workers, the putative beneficiaries of the Soviet transformation of nature, had to endure mortally dangerous work sites and short- and long-term exposure to toxins.

Two issues make it difficult in the Soviet case to distinguish between environmental effects that happened during the Cold War and those that occurred because of the Cold War. First, a constant, impatient, heroic, and violent effort to transform the nation – its people, institutions, nature, and resources, including primarily, as the Marxists would say, its productive forces and relations of production – prevailed throughout Soviet history. Beyond the sine qua non of Soviet existence – increasing industrial production by leaps and bounds – this effort reflected the belief among Soviet leaders that they must remain vigilant against enemies at home and abroad who threatened that transformation. Those enemies included both capricious nature and engineers who were hesitant to endorse the path and tempo of industrialization and collectivization even if they welcomed its scope and potential to modernize the nation. Party officials labeled these individuals "wreckers." More obvious among the enemies were the hostile capitalist nations that surrounded the Soviet Union, especially after Europe's proletariat failed to follow Russia's revolutionary example. Of course, National Socialist Germany (through 1945) and the United States (through the end of the Cold War in 1989–90) were the major external enemies. Regardless

5 Douglas Weiner, *A Little Corner of Freedom* (Berkeley, Calif., 1999). See also Marshall Goldman, *The Spoils of War* (Cambridge, Mass., 1972); Thane Gustafson, *Reform in the Soviet Union: Lessons of Recent Policies on Land and Water* (Cambridge, 1981); and the work of Vladimir Evgenevich Boreiko, Joan DeBardeleben, Donald Kelly, Feliks Robertovich Shtil'mark, and Anton Struchov. For a discussion of nature conservation, see Philip Pryde, *Conservation in the Soviet Union* (Cambridge, 1972).

of the particular enemy at any given time, Soviet preparedness against these enemies demanded rapid economic development with ferocious human and environmental costs.

Second, Soviet industry was tempered at the forge of Stalinism and maintained its major features of large-scale enterprises hitched to the desiderata of production until the breakup of the Soviet Union. In many respects, political commissars had embraced the militarization of production from the first steps of Soviet socialism under war communism, when Leon Trotsky introduced it in a futile effort to stem anarchy in industry after the Bolshevik seizure of power. Many of the features of militarization – organization of workers into brigades, harsh punishments for "violation of labor discipline" (tardiness, absenteeism, drunkenness) and for pilfering, the appointment of Bolshevik managers who had learned to secure victory at any cost at the front in the Red Army, not at the forge in the factory – carried through to the Gorbachev era. Another feature of industry that contributed to environmental degradation was the massive size of enterprises and trusts. Although ostensibly enabling the embrace of economies of scale, size reflected even more the expediencies of the needs to supervise and control workers whom officials did not entirely trust and to ensure the political, cultural, technical education of poorly motivated laborers, most of whom had migrated from the countryside because of economic necessity or had been forced to move. In the absence of incentives to promote productivity or individual initiative among workers such as higher wages, better consumer goods, comfortable housing, and meaningful promotions, leaders resorted to exhortation. They engaged in constant campaigns urging workers to "storm" to reach planning goals and to follow the example of Stakhanovite heroes who achieved superhuman feats of production.[6] The primacy of the politics of production paradoxically created an economy that was very inefficient; the rational plan was irrational. Given the resulting industrial style and the mind-set of party officials, managers, and workers, it was difficult, if not impossible, to ensure efficient use of resources. Concerns about the costs of industrial production for humans and nature alike wafted into the smoky sky, flowed into the murky rivers, and piled up in haphazard dumps proximate to home, field, and factory. Yet as we shall see, during the Cold War, the enormous size of military programs, the nature of Cold War weapons, and the absence of public involvement in questions of resource management, pollution, and

6 Among the many good studies of Stakhanovism, see Lewis Siegelbaum, *Stakhanovism and the Politics of Productivity in the USSR, 1935–1941* (Cambridge, 1988).

safety contributed to environmental impacts that differed from the preceding periods in scale, reach, and longevity.

SOVIET NATURE TRANSFORMATION ACROSS SPACE AND ECOSYSTEMS

No matter which period of Cold War history, no matter which ecosystem, the Soviet environment experienced rapid and seemingly irreversible degradation. Planners ordered the damming of river after river, moving inexorably from the European Soviet Union in the 1920s to the Urals during World War II to the major rivers of Siberia (the Ob', Irtysh, Enesei, Angara, and Amur) in the period from the 1950s through the 1980s with larger and larger hydroelectric power stations reaching capacities of millions of kilowatts. They powered the stations with serially produced (and, over the years, larger and larger) Elektrosila turbogenerators. The eastward thrust reflected both necessity (the European Dnieper, Volga, Don, and Kama had been tamed) and strategic concerns. The Siberian rivers were far from the European borders, and they powered tungsten, manganese, and aluminum mining and smelting operations and burgeoning plutonium production facilities from Cheliabinsk to Krasnoiarsk. These industries required copious amounts of water and electrical energy. Because production served military purposes, residential needs were not met, and agriculture was starved for electricity. There was no counterpart, for example, to the U.S. Rural Electrification Administration, although in the 1950s under Nikita Khrushchev, regional construction and electrification companies began to bring the lightbulb to the farm and the forest. But in general, peasants in villages remained poorly served. In the construction of these hydroelectric stations and associated locks and irrigation systems, planners seldom considered environmental consequences, damming rivers willy-nilly at great cost to inland fisheries. This forced the fishing industry to the high seas. Untreated waste flowed into most rivers and found its way into municipal water supplies. Fish kills were the rule. By the 1960s, such anadromous fish as sturgeon had essentially been destroyed. But military needs were paramount.

Forests fared little better, even though the Soviet Union possessed roughly one-half of the world's forests. Inefficient, even reckless harvesting, transport, and processing practices contributed to their degradation, as did poorly developed infrastructure. The forest sector developed at first primarily under the gulag administration, which relied heavily on forced labor in service of state needs for lumber. In the postwar years, the forestry sector remained poorly capitalized. Roads and narrow-gauge railroads were limited in extent and durability, so that clear-cutting close to access roads rather than selective cutting was employed to meet targets. Harvest far exceeded raw material demands for pulp, paper, or lumber production because planners readily expected waste. Much of the harvest rotted on the forest floor, sank to river bottoms during the spring floats, or became unused chips and sawdust at mills. Industry managed to use no more than 60 percent of the tree versus 90–95 percent in leading capitalist nations. And when European forests near access roads had been subjugated, Siberian trees fell in equally damaging and indiscriminate clear-cutting. The industry also used copious amounts of pesticides and herbicides, including DDT, to eradicate worms, mites, and other pests and to create monocultures of various hard- and softwoods. As in the agricultural sector, where officials authorized the use of three to five times more chemicals per hectare than in Europe or the United States, so in the woods foresters overused harsh biocides and applied them haphazardly. This meant airborne drift and waterborne spread of poisons with significant impact on flora and fauna.

The same story held for each sector of the economy. For example, mining and metallurgy enterprises in service of Cold War factories, armaments, and other materiel left behind open scars, tailings, and polluted rivers and streams. Even in the capital city, Moscow, heavy metal concentrations in the atmosphere far exceeded norms for virtually the entire south-southwest region of the Soviet Union. Waste, inefficiency, and disregard for people and the environment characterized the constant struggle for increased production and military preparedness.

Conceptually, significant changes in worldview accompanied Cold War Soviet resource management and exploitation practices. These changes went beyond those common to Enlightenment thinking about the desirability of reshaping nature to serve human needs, the inevitability of progress, and the ability of humans – and increasingly their research, financial, industrial, and state institutions as major actors in the process – to subjugate nature. After all, Bolshevik leaders were Marxists trained in the European tradition who believed that both humans and capricious nature might function according to plans and dictates; as it turned out in the Soviet case, both received serious and often coercive reeducation. The changes included the belief that nature was an enemy and must be joined to state programs to protect the motherland. According to National Socialist thinking in Germany, the Aryan people – the *Volk* – had special status with respect to nature as the sole beneficiaries of proper nature preservation and management, and they were the only ones capable of properly tending it. Similarly, in the Soviet

Union, the proletariat benefited from Bolshevik management of nature. One of the benefits was military preparedness.

IDEOLOGICAL COMPETITION BETWEEN THE SUPERPOWERS BEFORE THE COLD WAR

Competition to develop strategic resources between the United States and the Soviet Union predates the Cold War and contributed to Cold War posturing that shaped environmental policy and practices. Not long after the Bolsheviks seized power in 1917, they promulgated a series of laws to nationalize land, industry, and banks, and to take control of natural resources. They claimed that socialist resource management practices would serve all people, not only the wealthy capitalist owners of resources. Capitalist ownership of parcels of land interfered with rational management because each owner sought to enrich him- or herself at the expense of others and because it was impossible to impose scientific practices across property lines, let alone across county and state boundaries. The Bolsheviks assumed that nationalization in the name of the proletariat would enable long-term, rational management practices. Civil war and anarchy instead led to rapacious harvesting and poaching, even in protected areas, so that conservation practices were postponed until the late 1920s.

Visions of the desirability and inevitability of the control of nature predominated among Russian Marxist theorists. Such analysts as Georgii Plekhanov, the founder of Russian Marxism, believed that Russia's backwardness – economic and psychological – was the result of environmental conditions, with the result that he was castigated in the Stalin period for having "exaggerated geographic influences."[7] Lenin saw the modern manufactory as the key to the Bolshevization of nature. Leon Trotsky also saw technology as a solution to Russia's backwardness, the source of which was natural conditions.[8] Although many of these same leaders saw in America's technological prowess the key to such problems as rational resource use in the Soviet and employed European and American specialists in their very first major nature transformation projects, they also believed that the Soviet economic development paradigm would enable them to create a

7 Mark Bassin, "Geographical Determinism in Fin-de-siecle Marxism: Georgii Plekhanov and the Environmental Basis of Russian History," *Annals of the Association of American Geographers* 82, no. 1 (March 1992): 3–22. See also Bassin, "Turner, Solov'ev and the 'Frontier Hypothesis': The Nationalist Signification of Open Spaces," *Journal of Modern History* 65, no. 3 (September 1993): 1–17.

8 Leon Trotsky, *The Russian Revolution* (New York, 1959), 1. Douglas Weiner has shown that the Bolsheviks from Lenin onward considered industry Russia's salvation against capricious nature; see his *Models of Nature* (Bloomington, Ind., 1988), 22–4, 229–31.

grand industrial garden while escaping the costs of development so clear in Manchester, Pittsburgh, the Ruhrgebiet, and elsewhere.[9]

In the early 1920s and early 1930s, the Soviets sought European and American technical assistance from Siemens, General Electric, and other foreign firms at the Dnieper hydroelectric power station (Dnieprostroi), the Ural steel city Magnitogorsk, and elsewhere. Under Stalin, the nation pursued economic, scientific, and technological autarky, in part based on the assumption that war between two incompatible systems was inevitable. The go-it-alone approach led to the design of functional, if rudimentary, technologies and processes that often lacked safety redundancies, filters, or other features to make them more efficient and environmentally sound. From smelters to harvesters and fellers, from furnaces to turbines, these devices were intended to produce according to production targets that had been established far from the field or shop floor by such Moscow-based organizations as Gosplan, the state planning administration, and that reflected little concern for worker safety or the environment.

The long-postponed assault on nature to control its resources in the name of the struggle against backwardness and hostile capitalist encirclement commenced in earnest under Stalin's leadership toward the ends of building an unassailable Bolshevik fortress. Party officials orchestrated a series of conquests of nature intended to reveal Soviet military might and technological prowess. A radical restructuring of economic planning with decisive impact on natural resources occurred with Stalin's self-proclaimed "Great Break" with past programs and policies. This is visible from the very first projects: the Dnieprostroi project, the socialist reconstruction of Moscow, the building of the steel city Magnitogorsk, and the construction of the Belomor (White Sea–Baltic) Canal. In Moscow, planners set a pattern for future projects of great ideological significance with the Moscow metro and the new system of dams, canals, and water supply intended to make the capital a showcase for socialism. Soviet pilots and explorers also turned their attention to the stratosphere and to the Arctic. Although a number of the highly publicized projects resulted in disaster – lost aircraft, stranded explorers – for the propagandists, the meaning was clear: the selfless war on nature would be won.

9 "American Methods Win Fight to Control Russian River," *Engineering News Record*, June 23, 1932, 877–82. See also Kendell Bailes, "The Politics of Technology: Stalin and Technocratic Thinking among Soviet Engineers," *American Historical Review* 79, no. 2 (April 1974): 445–69; Bailes, "The American Connection: Ideology and the Transfer of American Technology to the Soviet Union, 1917–1941," *Comparative Studies in Society and History* 23 (1981): 421–48; and Charles Maier, "Between Taylorism and Technocracy: European Ideologies and the Vision of Industrial Productivity in the 1920s," *Journal of Contemporary History* 5 (1970): 27–61.

The NKVD, the predecessor to the KGB, designed the Belomor Canal project to showcase both the technological sophistication of the Soviet Union and the potential of grandiose projects to reeducate the masses, in particular politically suspect individuals. The project was unsound from hydrological, geological, and other perspectives, and the canal was never able to carry the freight for which it was intended. The canal bed leaked, and it was too narrow and shallow to carry most boats. Further, tens of thousands of prisoners labored on the project in inhuman conditions – mud and mosquitoes in the summer, ice and wind in the winter – using picks, wheelbarrows, and their hands. But the importance of the project was its ideological significance in indicating control over nature. In the maudlin literary commemoration of Belomor, the Soviet playwright Maxim Gorky and others described the victory over nature after an "assault on the watershed," giving "neither the people nor the rocks" any rest. Record makers and shock workers learned proletarian geology on the spot, and slackers faced public ridicule.[10] At the same time, the entire country burned with new construction projects, all covered with the same metaphors in the central press: the Cheliabinsk tractor plant, the Uralmash factory, the Magnitogorsk blast furnaces, the Zaporozhe aluminum smelter, the Kuznetsk open-hearth furnace, the Gorky automobile factory, and so on.

The artifacts of Cold War environmental devastation – the cement, ferrous and nonferrous metallurgy factories with their smelters and furnaces, the petrochemical plants, and so on – had developed a recognizable technological style already during Stalin's first five-year plans, noteworthy for rudimentary if functional designs. Planners and officials insisted on improbable production targets for heavy industry; improbably, officials declared they had met those targets ahead of schedule. Soviet workers built 1,500 factories during the first and second five-year plans. Eyewitness accounts reveal frantic energy devoted to digging foundations, erecting scaffolding, and commencing production nearly simultaneously, all while insisting on control of people and subjugation of the land and the ore within it. Waste of ore and of human life was inevitable, as was haphazard disposal of waste as the cheapest way to cut costs and to save time, as eyewitness accounts from Magnitogorsk and elsewhere indicate.[11]

10 Maxim Gorky et al., *Belomor* (1935; repr., Westport, Conn., 1977), 270–2. See also V. M. Molotov, "On the Opening of the White Sea-Baltic Canal Named after Stalin," *Pravda*, March 11, 1931.

11 John Scott, *Behind the Urals* (Cambridge, Mass., 1942). See also Stephen Kotkin, *Steeltown USSR* (Berkeley, Calif., 1991) on the political and environmental fate of Magnitogorsk in the late Soviet period.

GULAG: SLAVE LABOR AND THE ENVIRONMENT

Ultimately, many of the mining and smelting, lumbering, railroad, and other construction projects in the far northern and far eastern areas of the country fell under the jurisdiction of the NKVD through its Main Administration of Prisons (Gulag). The Cold War network of production cities dedicated to strategic minerals, steels, aluminum, and so on had prewar roots in the gulag system and spread through the gulag after the war in nuclear weapons, rocketry, and other military technologies. The secret police gained the authority from the politburo to create an empire of hero projects and hero cities to develop natural resources and secure the safety of the nation against internal and external enemies. They gained control over vast regions and resources, and used millions of slave laborers – political prisoners and criminals – to exploit resources. The Gulag marshaled entire armies of enemies of the people – political prisoners, kulaks (the allegedly wealthy peasants who had exploited their neighbors), and such mistrusted national minorities as Tatars, Poles, and Volga Germans. The organizations focused on mineral wealth (iron, gold, silver, and tin), lumber, water, and transport. Many of these resources lay in arctic or subarctic regions inhabited by such indigenous peoples as the Komi, Nenets, Chukchi, and Yakut. Later, they simply removed the Nenets from Novaia Zemliia and used these arctic islands as a test site for nuclear weapons and haphazard waste disposal, as they used Kazakh lands for testing near Semipalatinsk. As is the case in many societies throughout the globe undergoing rapid change, the development of resources and the pressures of Cold War competition led to the displacement of indigenous peoples and the destruction of their ways of life.[12]

Glavsevmorput, the Main Administration of the Northern Sea Route, was part of the drive to conquer the Arctic in the 1930s, "one of the most stirring and memorable episodes of the Stalinist era." The goal was to tame the north and turn its bleak, icy emptiness into a productive powerhouse. Military metaphors and aggressive language characterized the efforts of arctic explorers who were on the attack at the arctic front, engaged in assault and final conquest, and exhorted to "storm the Arctic." Gulag personnel ordered the development of a sea route, the expansion of harbors, the construction of railroads, and later the building of roads, all using poorly equipped and poorly dressed laborers. The Arctic fought back, leading to great costs to people and materiel.[13]

12 Yuri Slezkine, *Arctic Mirrors* (Ithaca, N.Y., 1994).
13 John McCannon, *Red Arctic* (New York, 1998), 5–7, 83–5.

Facing labor shortages everywhere during the industrialization campaign and seeking complete political control over areas geographically distant from Moscow, the Soviet leadership expanded the gulag network from the Solovetskii Islands, Karelia, and its White Sea and Baltic Canal to the far north, on the basis of a politburo resolution of June 1929, "On the Use of Prison Labor." The Council of Labor and Defense established Dalstroi, the Main Administration for Construction in the Far North, in 1931, to locate and develop gold and other deposits in the Kolyma River basin. Over the course of fifty years, perhaps 1 million prisoners were sent to Magadan and then on to the hard labor camps of Kolyma and Chukotka, where Dalstroi sought to subjugate a 3-million-square-kilometer area stretching from the Lena River to the Bering Strait.

At first, the authorities established so-called cultural stations among the indigenous peoples to serve as emissaries of modernity and Marxism. Cultural assimilation gave way to rapid and forced political and economic colonization. Realizing the importance of gold and other strategic minerals, Stalin authorized a violent effort to enforce a sedentary lifestyle on the nomadic reindeer herders through collectivization of the herds, and in so doing destroying the successful if fragile reindeer-meat economy that had evolved over centuries. Stalin also recognized the strategic importance of the far east and the need to secure it militarily. Dalstroi set out to build highways and industry to facilitate mineral excavation. Gulag branches spread west toward the Lena and east toward the Chukotka Peninsula, ultimately with perhaps two hundred thousand inmates at the height of Dalstroi's reach and power in the taiga and tundra.[14]

At the notorious camps in Kolyma, whose brutal life has been captured in Varlam Shalamov's *Kolyma Tales*,[15] gold mining was the focus. Laborers clothed in rags and armed only with picks, pries, and shovels attempted to bore into permafrost to add to Stalin's gold reserves. The process was damaging to the permafrost and harmful to the workers. In open pit mines, they dug holes in the frozen earth to blast with dynamite. These were safer than the underground mines, where frequent cave-ins killed scores of prisoners; once their bodies were hauled to the surface, their hands were cut off to prove to the authorities that they had died and the bodies tossed aside. Miners bored and blasted sands, which they pushed into single piles, then drove steam into the pile from hoses connected to boilers to thaw the sands. The thawed sand was washed with water generated from ice also thawed

14 David Nordlander, "Origins of a Gulag Capital: Magadan and Stalinist Control in the Early 1930s," *Slavic Review* 57, no. 4 (Winter 1998): 791–812.

15 Varlam Shalamov, *Kolymskie rasskazy* (Paris, 1982).

by steam hoses. Winter panning made little sense, as the sands were never fully unfrozen, and the process took four times as much labor as summer panning to produce a similar amount of gold. Geologists determined that almost three-quarters of the gold was washed away during the thawing and panning.[16]

THE IMPACT OF WORLD WAR II ON THE SOVIET ENVIRONMENT

Industrial expansion in eastern and western Siberia took off after the Nazi invasion of the Soviet Union in June 1941. Soviet planners had fortuitously created a foundation for this sudden expansion with the first five-year plans that focused investment on Magnitogorsk in the Urals, the Kuznetsk Basin in Siberia south of Tomsk for coal and iron, and at Komsomolsk on the Amur River with the construction of Amurstal (the Amur Steel Works). From June to December 1941 alone, more than 1 million wagonloads of evacuated factory equipment arrived in Siberia along with millions of refugees who were immediately set to work producing war matériel and developing natural resources. The off-loading of U.S. lend-lease equipment at Vladivostok contributed to far eastern development.

World War II and the Cold War led to the establishment of a series of large-scale attempts to develop strategic minerals and expand the chemical, metal, and (later) nuclear and bioweapons industries. The Urals region in particular was transformed into an armed camp. Nothing – not pollution abatement, not hazardous waste monitoring and disposal, not public health considerations – was permitted to slow production. The presence of large numbers of forced laborers – first Soviet citizens, then German prisoners of war – also contributed to cheapening the value of nature and human life.

On the eve of the war, the Urals region, consisting of the Molotovsk (now Perm), Sverdlovsk, Cheliabinsk, and Chkalovsk regions and the Bashkir autonomous republic, extended over more than eight hundred thousand square kilometers and had more than 12 million inhabitants. It contained extensive mineral wealth: more than sixty different important elements and twelve thousand cataloged sites of such strategic materials as bauxite, potassium, nickel, cobalt, titanium, tin, beryllium, bromine, magnesium, rubidium, cesium, chrome, vanadium, industrial diamonds, and copper, along with peat and lumber. The Urals region held the Soviet Union's largest reserves of many of these materials and likewise led in extracting them.

16 Robert Conquest, *Kolyma: The Arctic Death Camps* (New York, 1978), 108–9.

Military metaphors had characterized the Soviet approach toward the economic development of the Urals from the outset. World War II accelerated the transformation of the region into an industrial armed camp that served the metallurgical, mining, and military industries. As quickly as they could, in many cases just ahead of advancing German divisions, the Soviets evacuated entire institutes and factories to the east, loading them onto trains and hoping to avoid airplane attacks.[17] In August 1941, on the order of Academy President V. L. Komarov, the Committee for Mobilization of Resources of the Ural Region for the War Effort was established to transform the Urals region into a military production facility. The focus was new kinds of steels, the identification of strategic metals, new production methods, new magnetic apparatuses for the protection of ships from mines, and quality control in manufacturing artillery shells. Economists at the Institute of Geography created detailed descriptions of more than eighty cities, towns, and villages in the region with a view toward relocating the evacuated facilities. Other researchers identified locations for hydropower stations, railway lines, and collective farms. One study listed sixty potential sites for hydroelectricity in the Urals alone.[18] Of course, in life-and-death matters of war, little attention could be focused on environmental considerations. As the secretary of the Molotovsk provincial party committee, N. I. Gusarov, acknowledged, the natural resources of the province and the growing power of its industry enabled the "Stalinist Urals" to serve as "the main arsenal of the Red Army."[19]

Two hundred enterprises were evacuated to the Cheliabinsk region alone, most between September and December 1941. Schools, workers' clubs, and theaters were turned into factories. Given the influx of machinery and workers needing space, the average living area per inhabitant declined to 2 or 2.5 cubic meters per person. But the workers got smelters and boilers on line within weeks. Industrial production in several Urals cities grew seven- or eightfold between 1940 and 1944. Entirely new facilities appeared in the cities of Miass, Chebarkul, Sterlitamak, Tavda, Irbit, and

17 By one estimate, there were roughly one hundred thousand scientific workers in the country on the eve of World War II, most of whom represented rather narrow engineering specialists, and 25 percent of whom were in civil and mechanical engineering crucial to the war effort. These engineers contributed to the rapid construction of mining, metallurgical, and nuclear artifacts. See G. M. Shcherbo, "Razvitie otechestvennoi stroitel'noi nauki v 1941–45 gg," in *Nauka i uchenye Rossii v Gody Velikoi Otechestvennoi voiny, 1941–45*, ed. B. V. Levshin et al. (Moscow, 1996), 127–8.

18 S. V. Vonsovskii, "Uchenye Urala – frontu," in Levshin, *Nauka i uchenye*, 48–53.

19 N. I. Gusarov, *Prirodnye, Ekonomicheskie resursy i perspektivy razvitiia khoziaistva molotovskoi oblasti* (Molotovsk, 1945), 4–16.

Shadrinsk.[20] In Berezniki – "the city of Ural chemists" – the construction of clubs, kindergartens, nursery schools, and roads lagged until well after the war's end because workers were driven to increase the production of soda manifold for tank armor, self-propelled guns, glass, and soap. Workers lived in dug-out earthen huts, hastily assembled barracks, or tents.[21] Twenty-six new mines opened during the war, and another thirty were slated to open during the fourth five-year plan (1946–50). All were strip and open pit mines to minimize expense on materials and labor, thereby guaranteeing that there were long-term environmental costs.[22] In the absence of efficient, modern equipment, reclamation projects, or proper disposal practices, the mine waste filled rivers, streams, and valleys.

As machinery and laborers arrived from the west, sleepy villages and towns were transformed overnight into industrial centers where production grew three-, four-, and fivefold in the stretch of months. We are accustomed to thinking of urbanization in England, Germany, and the United States during the industrial revolution as a violent, sudden, unplanned process with great environmental and human costs. Yet in the Soviet Union, the migration was even more sudden and violent – frequently carried out at the point of a gun – and often paradoxically unplanned. Hundreds of thousands of people arrived in the Urals to power industry. Cities grew rapidly during the war, doubling in size in two or three years – Sverdlovsk to 425,000, Novosibirsk to 406,000, and Kemerevo to 133,000. The inventory of construction enterprises in the Urals and West Siberia grew threefold from 1940 to 1943, with 2,250 large industrial enterprises built in the eastern Soviet Union between 1942 and 1944.[23] The workers disassembled, crated, shipped, and reassembled milling machines for armor taken from Mariupol', Ukraine, and Leningrad (from the Izhorsk Metallurgical Factory) to Nizhnii Tagil and Magnitogorsk during the winter of 1941–2. Literally overnight, they set to the production of tanks, airplanes, mortars, artillery guns, rifles, bombs, bullets, and charges. Haste and inexperience meant a constant struggle to use stamps, extruders, lathes, and other machine tools efficiently.[24] Resource waste was endemic. The war experience had forced Soviet leaders and citizens to embrace wasteful industrial practices, to ignore resource scarcities, and to denigrate the worth of both humans and nature. This

20 K. Klimenko, *Ural'skoi promyshlennoi raion* (Moscow, 1945), 26, 30, 37; and V. Gusev, "Kak kirovtsy delali tanki v Cheliabinske," *Znamia*, August 1974, 141–6.

21 A. F. Zhdanov, *Berezniki – Gorod ural'skikh khimikov* (Molotovsk, 1956), 22–33.

22 Klimenko, *Ural'skoi*, 29.

23 Shcherbo, "Razvitie otechestvennoi stroitel'noi nauki," 122–36.

24 Mikhail Polisiuk, "Ural – kuznitsa smertonosnogo oruzhiia," in *Stalinskii Ural. XXV Let Oktiabria* (Moscow, 1942), 77–98.

mind-set carried over into the Soviet subjugation of the Arctic and the nation generally during the Cold War.

SUBJUGATION OF THE FAR NORTH

If citizens anticipated relief from the frantic emphasis on heavy industry as a celebration of victory in the costly war against Nazi Germany, Stalin insisted instead during the fourth five-year plan (1946–50) on redoubled efforts to rebuild the nation's industrial capacity. Perhaps understandably, planners emphasized resurrection in short order: perhaps 1,500 cities, towns, and villages reduced to rubble and restoration of the nation's farmland, the most productive of which had been destroyed. In reality, industry – metallurgical, chemical, and electrical – received the lion's share of investment, and agriculture was deprived. Famine resulted, during which between 1 million and 2 million people died.

One postwar phenomenon dedicated to Cold War resource development was the mining and smelting city. Many such cities were built at great cost in the Arctic near rich deposits of strategic minerals. Their construction involved the uprooting of indigenous peoples and the destruction of the permafrost. Three of them are paradigmatic for their local, regional, and international impacts, Nikel, Noril'sk, and Vorkuta. Many Westerners first became acquainted with Nikel, located seven kilometers from the Norwegian border above the Arctic Circle, through a photograph published in 1994 in the *New York Times*. In the photo, a worker without a hard hat or special clothing stokes a superheated oven in a nickel-smelting plant. His respirator is a garden hose, one end of which he holds between his teeth; the hose runs through a window outside, where the air was slightly less laden with heavy metals.[25] The emissions of heavy metals and sulfur dioxide from Nikel's smelters have caused extensive environmental damage and have had a devastating impact on public health and indigenous cultures in the region. The same holds true for a score of other arctic and subarctic cities created to exploit Siberia's mineral resources.[26]

25 Michael Specter, "Far North in Russia, the Mines' Fatal Blight," *New York Times*, March 28, 1994.
26 M. L. Gytarskii et al., "Monitoring of Forest Ecosystems in the Russian Subarctic – Effects of Industrial Pollution," *Science of the Total Environment* 164, no. 1 (March 1995): 57–68; B. A. Revich, "Public Health and Ambient Air Pollution in Arctic and Subarctic Cities of Russia," *Science of the Total Environment* 161 (1995): 585–92; N. V. Vasiliev et al., "The Role of Migration Processes in Oncological Epidemiology of Siberia and the Far East," *Vestnik Rossiiskoi Akademii Meditsinskikh Nauk*, no. 7 (1994): 34–9; A. R. Bond, "Air Pollution in Norilsk – A Soviet Worst Case," *Soviet Geography* 15, no. 9 (1984): 665–9; A. A. Vinogradova and V. A. Egorov, "Contributions of Industrial Areas of the Northern Hemisphere to Air Pollution in the Russian Arctic," *Izvestiia Akademii Nauk. Fizika Atmosfery i Okeana* 33, no. 6 (November–December 1997): 750–7; D. R. Klein, "Arctic

The arctic city Vorkuta, founded in 1932 as the site of a large Soviet forced-labor camp to develop Pechora Basin coal, also grew rapidly in the postwar years because of its contributions to defense industries. Before the war, only one mine had been opened. During the war, ten more mines opened, a power station came into operation, and a rail link was built to connect Vorkuta to the nation's rail network. Pechora coal was crucial during the war because the Don Basin had been lost. Pechora coal was crucial for supplying blockaded Leningrad and the northwest as well as the Baltic and northern naval fleets. Although the Pechora coal reserves had been known since the mid-nineteenth century, high costs had hindered their development. Without a railroad, the coal – and various ore deposits – had to be shipped by boat and transferred five or six times before reaching rail facilities. Along the way, it often sat at waterside for months awaiting reloading on smaller vessels. Even with the gulag system and the creation of Vorkutstroi, the gulag construction organization established to build the city, in 1938, the dispatch of supplies to Vorkuta and raw materials back was often delayed. Delivery over a sixty-four-kilometer-long narrow gauge railroad from Vorkuta to Rudnik took up to ten hours even when the railroad operated at full capacity. Engineers, managers, and prisoners had no idea how to build roadways, structures, or mines in the permafrost. Decades later, visitors noted that power-generating equipment was in complete collapse; that buildings needed repair the moment they were finished; that bridges were untrustworthy; and that the construction of housing, stores, schools, and hospitals lagged.[27]

The city of Noril'sk on the Taimyr Peninsula grew out of the Norgulag, which used tens of thousands of prisoners from 1935 to 1956 to extract ore from the world's largest deposits of nickel, copper, and palladium from underneath the permafrost. Thousands died at forced labor, especially during the war and immediately after because of short supplies of food. Production of the metals commenced in 1939. Before World War II, the Noril'sk combine was small, consisting of a temporary power station, three open-cast coal pits, three mines (with others under construction), sandstone and

Grazing Systems and Industrial Development: Can We Minimize Conflicts?" *Polar Research* 19, no. 1 (2000): 91–8; V. Shevchenko et al., "Heavy Metals in Aerosols over the Seas of the Russian Arctic," *Science of the Total Environment* 306, nos. 1–3 (May 2003): 11–25; and S. M. Allen-Gil et al., "Heavy Metal Contamination in the Taimyr Peninsula, Siberian Arctic," *Science of the Total Environment* 301, nos. 1–3 (January 2003): 119–38.

27 P. I. Negretov, "How Vorkuta Began," *Soviet Studies* 29, no. 4 (October 1977): 565–75. Camp prisoner uprisings occurred in the 1950s, and there is evidence that some of the camps in the region remained open until the 1980s. A bleak, concrete town of two hundred thousand individuals in 2005, today some five of thirteen mines remain open.

limestone quarries, a railway, an airport, and a port at Dudinka on the Enesei River. By 1953, the combine was producing 35 percent of the Soviet Union's total nickel output, 12 percent of its copper, 30 percent of its cobalt, and 90 percent of its platinum group metals.

The Soviets not only turned to the north for metals and timber but also even dreamed of turning the empty land into collective farms. The great obstacles to assimilation – climate and desolation – did not deter the effort. Before railroads and roads were built, planners intended to use rivers for transport during the three months out of the year they were not icebound. They focused on building icebreakers. By the mid-1930s, they had established a chain of fifty-seven radio stations along the coast that operated year-round and provided meteorological and other information. Ice-watch airplanes also assisted the icebreakers. The goal was to open the arctic route from Murmansk to Arkhangel'sk, to the Ob', Enesei, and Lena deltas, and then to the Kolyma, Indigirka, and Anadyr rivers of the far east.[28]

The authorities ordered prison labor to harvest Siberian timber as well. One gulag camp, Igarka, 650 kilometers inland on the Enesei River, focused on forest resources. It was glorified by Soviet writers, including, again, Maxim Gorky. By the early 1930s, Igarka had grown rapidly to fourteen thousand people, including four thousand kulaks exiled in 1930 and 1931 during collectivization. A Western observer was convinced that the prisoners were well dressed against the climate and well fed for their backbreaking labor, and that they received "normal wages for their work, are free to move about the town, and their children study side by side with the children of free workers. . . . Of course they cannot leave Igarka." He also apparently approved of the impact of Soviet practices on the 160,000 natives living in the Arctic and subarctic, members of tribes living at an "extremely primitive level." The presence of tribal councils enabled so-called Red Missionaries rapidly to create indigenous Soviets. The red missionaries organized "red tepees" (*krasnye chumye*) to gather the reindeer herders, whom they considered deeply backward. The herders and their families were taught to read and write, and they were also encouraged to socialize their herds (i.e., to manage their herds collectively), which would allow more men to work in town and their children to go to school to learn about great Russian achievements.[29]

The arctic region – the ice-covered areas of the ocean, islands covered by continental glaciers, cold tundra with permafrost and parts of the northern

28 H. P. Smolka, "Soviet Development of the Arctic New Industries and Strategical Possibilities," *International Affairs* 16, no. 4 (July 1937): 564–78.
29 Ibid.

taiga – served the state through its rich natural resources. Over the course of fifty years, the Soviet leadership established a series of facilities to exploit the raw materials found in the southern Arctic: mining and metallurgical combines in Pechenga, Apatity, Vorkuta, Olenegorsk, Kovdor, Lovozero, and Noril'sk. Exploitation of oil and gas on the Yamal Peninsula accelerated in the late Soviet period. About 10 million people now live in this network of industrial facilities across the north from Zapolyarny, Nikel, Murmansk, Monchegorsk, Apatity, Kirovsk, to Vorkuta, and to the surrounding miners' settlements at Labytnanga, Salekhard, Dudinka, Tiksi, and Anadyr. All of these facilities served the Soviet military establishment directly. Officials built hundreds of thermoelectric power stations and steam boilers to support the population. A typical settlement of ten thousand inhabitants has at least ten heating plants discharging sulfur dioxide, nickel, dust, and other pollutants. According to Vasiliy Kryuchkov, of the Institute of Economic Problems of the Kola Science Center, "The northern ecosystems cannot sustain such impacts and are being destroyed." The major impacts are from sulfur fallout and heavy metals that have stripped taiga ecosystems of vegetation, thereby leading to industrially created wasteland. As deforestation accelerated, winds became more intense; snow was compacted; rivers, soil, and lakes froze to greater depths; and summer and winter air and soil temperatures decreased.[30]

POSTWAR RESOURCE DEVELOPMENT IN SIBERIA AND BEYOND

The postwar period consisted of a protracted effort toward military preparedness. Housing, light industry, consumer goods, and public health were starved for investment as Stalin directed his underlings to keep pace with the United States in conventional and nuclear armaments. He ordered his armies to keep Eastern Europe within the Soviet orbit. Along with the development of the far north, the far east, and Siberia, and efforts to control the labor and natural resources of Eastern Europe, the Cold War involved a redoubled effort to recast rivers of the European Soviet Union to conform to the dictates of the plan. In 1948, Stalin announced a plan for the transformation of nature that would tame the Volga, Don, Dnieper, and other western rivers through the construction of cascades of dams, hydroelectric power stations, irrigation systems, and canals to create a unitary agricultural, transport, and power-generation machine. The plan included instructions to plant seventy thousand kilometers of forest defense belts to

30 Vasiliy Kryuchkov, "Extreme Anthropogenic Loads and the Northern Ecosystem Condition," *Ecological Applications* 3, no. 4 (1993): 622–30.

protect farmlands and vineyards from hot, dry winds.[31] A number of these plans had prewar roots, but the Cold War gave impetus to more extravagant construction targets. Never again would the Soviet Union be vulnerable to attack from the capitalist world. Under Khrushchev and Leonid Brezhnev, the effort to rebuild nature extended to Siberian rivers.

Of course, the United States, too, undertook extensive geo-engineering projects – the construction of dams, irrigation systems, and hydroelectric power stations – that had dual military-civilian purposes. Not surprisingly, many of the major aluminum and nuclear weapons factories of the Cold War were built near or in conjunction with major projects of the Tennessee Valley Administration and the Bonneville Power Authority on the Columbia River to supply the Oak Ridge, Tennessee, and Hanford, Washington, nuclear materials factories. So, too, the construction of the Kuibyshev, Volgograd, Rybinsk, and other hydroelectric power stations on the Volga served strategic interests. Even more, U.S. and Soviet leaders referred to their dams as better serving the citizens in truly democratic societies than the Cold War opponent could build.[32]

During the Cold War, both Khrushchev and Brezhnev endorsed policies to continue the expansion of industrial might and to locate and exploit the empire's great natural and mineral resources. Siberia came directly into the planner's attention and fell to the worker's shovel and ax. The southern reaches of the major Siberian rivers – the Ob', Irtysh, Angara, and Amur – all saw ambitious new projects to produce hydroelectricity and to power aluminum and other nonferrous metallurgy plants. Towns to house the workers often arose as an afterthought at the construction sites. In a failure of rational Soviet planning, hydroelectric power stations produced far more electricity than could be consumed until the factories came on line and until transmission lines were built to carry the electricity to major cities.

The Cold War effort to tame Siberia gained national attention in 1947 at a conference of party officials, economic planners, scientists, and engineers in Irkutsk. But because of the Stalinist plan to transform European nature, the authorities did not allocate sufficient funds for Siberian projects. After the death of Stalin, officials spoke more honestly about the huge costs of Stalin's plan. In particular, the notion of planting forest defense belts was scaled back significantly. This enabled Soviet leadership under Khrushchev (1953–64) to embark more confidently on Siberian development, especially after a national conference in 1958 devoted to encyclopedic consideration

31 Paul Josephson, *Industrialized Nature* (Covelo, Calif., 2002).

32 For one discussion of the inherently democratic nature of Tennessee Valley Administration programs, see David Lilienthal, *TVA: Democracy on the March* (New York, 1954).

of the development of the productive forces east of the Ural Mountains.[33] Construction focused on new factories, power-generation facilities, dams, and the development of the forestry and agricultural sectors of Siberia.[34]

Nikita Khrushchev abandoned Stalin's assumption of the inevitability of armed conflict for peaceful coexistence, in which the advantages of the socialist system over the capitalist would be revealed. Yet the military and heavy industry sectors were pressed without letup to maintain a strong presence in Eastern Europe and other arenas of conflict and to press ahead aggressively in the nuclear arms race. Military leaders lobbied constantly for increased resources to counter the American threat. This contributed to Khrushchev's efforts to marshal Siberian resources toward military ends. It led directly to one of the most far-fetched projects ever set forth: an engineer at the Moscow Hydrological Design Institute proposed using twenty thousand tons of TNT, an amount equivalent to the detonation at Hiroshima, to lower the shorelines of the Angara River outflow from Lake Baikal by several meters over the course of dozens of kilometers. This would, he calculated, permit millions of cubic meters of water to flow out and through the turbines of the Irkutsk hydroelectric power station to generate billions of additional kilowatts of electricity. Though not pursued, the project boldly showed the primacy of military concerns over those of nature protection and indicated how military means could be employed in making nature function according to plan.

As a result of de-Stalinization, amnesties, and posthumous rehabilitation of political prisoners, the Gulag shrank significantly. Most of its camps were subsumed into the general state prison system, and thus they no longer served as the main engine of the conquest of the far north, Siberia, and the far east. Yet wasteful and environmentally dangerous enterprises opened with alarming speed to supplant the gulag network, often in the form of free enterprises that had grown out of the gulag system. One of the leading engines of hydrological engineering, the Zhuk Institute in Moscow, in fact saw first light as the NKVD organization running the construction of the Belomor Canal. In the Brezhnev era, this and other organizations grew without pause. The government constituted entire development programs of ten- to fifteen-year durations that involved literally scores of organizations and bureaucracies in service of economic growth, military preparedness

33 V. S. Nemchinov, I. P. Bardin, et al., *Razvitie proizvoditel'nykh sil vostochnoi sibiri*, 13 vols. (Moscow, 1960).

34 K. Lubny-Gertsyk, *Problemy ispol'zovaniia Irtysha* (Moscow, 1931). On Siberian hydroelectricity, see also S. V. Klopov, *Gidroenergeticheskie resursy Basseina amura* (Blagoveshchensk, 1958); N. P. Bakhtin, *Reka Enisei* (Leningrad, 1961); and L. P. Mikhailov, Iu. A. Grigor'ev, and S. I. Sadovskii, *Gigant energetiki v siannakh* (Moscow, 1980).

and nature transformation. These included the Siberia program, a new trans-Siberian railroad (the BAM, the Baikal-Amur Magistral), and Siberian river diversion through massive transfer canals, all of them with significant environmental impact.

BREZHNEV, THE COLD WAR, AND NATURE

During the Brezhnev era (1964–83), the Soviet leadership sought détente with the United States. Détente hardly slowed the arms race or the assault on natural resources. Détente in fact involved the pursuit of parity in military power that resulted in conventional Warsaw Pact forces having an overwhelming advantage over NATO forces, and the accelerated manufacture and deployment of intercontinental ballistic missiles with multiple warheads, submarines, and bombers. Scores of military bases and weapons testing grounds contributed through their scale and the criminal mismanagement of ordnance, biological and chemical weapons, and dangerous waste to extensive pollution, the extent of which is still classified. Although the Brezhnev administration sought increased investment in housing and agriculture, the lion's share of that investment went either directly or indirectly to military programs.

In the 1970s and 1980s, planners ran into difficulties allocating increasingly tight resources among the competing needs to continue to develop Siberian resources and to rebuild and renovate industry in the European Soviet Union. Embracing large-scale projects as exemplars of his rule during the period of so-called developed socialism, Brezhnev was determined to continue traditional programs for resource development. For example, Soviet planners promoted rapid increases in investment in northwestern Siberia following the discovery of oil and natural gas there. This region received virtually no funding in 1964, but already by 1970, 20 percent of capital outlay of oil industry fell to the area of oil north of the Sverdlovsk-Tiumen-Krasnoiarsk railway. What had been an area of bogs, forest, and tundra became, in typical Soviet fashion, a network of towns, roads, and industrial waste dumps. The scale of Soviet achievements may be beyond question, but the true costs were not fully considered and have been great.

Brezhnev approved two major nature transformation projects. One was the new trans-Siberian railroad known by the acronym BAM. The poor construction practices employed in building BAM magnified the project's significant environmental impact on fragile ecosystems, including those in the area around Lake Baikal. The BAM railway stretched 2,300 miles from Tayshet to Bratsk and on to Sovetskaia Gavan' on the Pacific Coast. A work crew of at least thirty thousand built sixty new towns, 2,400 miles of auxiliary roads, 2,237 bridges, and 1,525 storm drains that served as what I call corridors of modernization into the countryside. But the urban industrialization of Siberia was precisely the point, as planning documents for BAM first advanced during the 1930s indicate.

The entire Soviet Union in 1932 had only 146,000 kilometers of roads, many of which were dirt and became impassable during much of the spring. The United States, by contrast, had 4.9 million kilometers of road at that time, although it was only about a third as large as the Soviet Union. Hence, to move beyond reliance on the Lena, Enesei, and other rivers for transport, planners included in the second five-year plan a large share of investment in transport for Siberian railroads, roads, and water transport, including a Baikal-Amur Railroad to facilitate access to Yakutsk fur, gold, tin, copper, lead, silver, and especially lumber.[35] Some construction actually commenced in 1944 using gulag labor and German and Japanese prisoners of war.[36]

The second project was the infamous plan for the redistribution of up to 10 percent of the volume of such Siberian rivers as the Ob' to the watersheds of the European and, in particular, Central Asian parts of the empire for fruit, vegetable, and cotton cultures. With diversion canals, some up to 1,500 kilometers in length, pumping stations and the road, electrical, and industrial infrastructure to support them, some have likened Siberian river diversion to the Pharaoh's sphinxes and pyramids. The determination to engage in this outrageously costly and environmentally suspect project reflected its strategic significance. Official publications implausibly concluded that only minor local environmental impacts would result from the project. The centralized project acquired great technological momentum. It grew to include several hundred research institutes, design bureaus, and construction firms across a series of major ministries.[37] Along with river geo-engineering, the construction of immense dams proceeded on the major Siberian rivers, in particular the Saiano-Sushenskaia hydroelectric power station – at 242 meters high and 6,400 megawatts, the Soviet Union's largest dam – that served the aluminum and nuclear industries in Krasnoiarsk region.

Soviet jurists and politicians adapted environmental legal structures to the needs of the Cold War. In some sense, the laws, codes, and fines never

35 Harriet Moore, "Basic Transport Facilities in Siberia," *Far Eastern Survey* 4, no. 15 (July 1935): 113–19.

36 A. G. Aganbegian and A. A. Kin, eds., *BAM: Pervoe desiatiletie* (Novosibirsk, 1985).

37 G. V. Voropaev and D. Ia. Ratkovich, *Problema territorial'nogo pereraspredeleniia vodnykh resursov* (Moscow, 1985).

afforded much protection to nature. Before the Brezhnev period, statutes were inadequate, enforcement powers and personnel insufficient, and fines too low to encourage managers and others to follow the law. (Stalin-era punishments for poaching – illegal fishing, lumbering, and other activities – did, however, discourage so-called theft of state property through draconian prison terms and even the death penalty.) Managers rarely risked prosecution for violations and found it cheaper to pay fines than to miss a production target established from above that also carried the stern weight of law. In the Brezhnev era, as specialists were encouraged to create scientific and rational practices and policies that differed from the harebrained schemes that officials claimed characterized the Khrushchev era, scientists and jurists began to frame new statutes to punish polluters and protect resources. Protected areas (*zapovedniki*) expanded in area and in number.

Party officials sought new laws in part in Cold War competition with the United States to demonstrate to other nations that they were world leaders in the environmental protection movement. No Soviet counterparts to Rachel Carson's *Silent Spring* or the Club of Rome's *Limits to Growth* existed; Soviet officials showed that they were progressive leaders in the movement, not followers, through the promulgation of new laws and the establishment of state environmental protection committees. They claimed they were protecting nature on behalf of all citizens, not only the wealthy leisure classes. Yet production usually trumped nature protection, and conventional, nuclear, biological, and chemical weapons development in pursuit of parity with the United States despoiled vast tracts of land.

THE NUCLEAR ENTERPRISE

The Cold War nuclear industry expanded rapidly from 1945 until the Chernobyl disaster of 1986. Nuclear weapons production took first position, and civilian applications were far less important. Both the civilian and the military nuclear industries stand out for their contribution to significant hazardous waste problems. They include the jettisoning of submarine reactor vessels in the Arctic and Pacific Oceans and the haphazard disposal of solid and liquid waste, including at sites that have not been recorded officially. They extend from naval bases in Murmansk to the far east, and from Novaia Zemliia, a site of extensive nuclear testing in the far north, to Kazakhstan in the south.[38]

38 Among the dozens of excellent compilations and reports that indicate the extent of nuclear waste and other problems of the Soviet Cold War legacy, see the Bellona Foundation reports: Nils Bøhmer, Aleksandr Nikitin, Igor Kudrik, Thomas Nilsen, Andrey Zolotkov, and Michael H. McGovern,

Engineers quickly built a series of massive but environmentally unsound plutonium production reactors, uranium isotope separation and enrichment facilities, and fuel fabrication plants. The best-known center was Maiak in Cheliabinsk for the manufacture of plutonium. Haphazardly managed high- and low-level radioactive waste dumps serving Maiak and dozens of other facilities filled the Urals region.[39] The decision to locate these facilities in the central Urals region near the metallurgical, construction, and chemical factories of Cheliabinsk, Perm, and Sverdlovsk provinces was based on strategic considerations and proximity to industry and employees. On the southern shore of Sinar Lake they established Cheliabinsk-70 (now Snezhinsk) and Cheliabinsk-40 (now Ozersk), where Maiak is located. Like similar facilities in the United States and Great Britain, uranium and plutonium production facilities in the Soviet Union were massive. One factory, the Ural Electrochemical Combine, used gaseous diffusion to separate uranium isotopes.[40] The combine, established in 1946, introduced industrial centrifuges in 1960, and its main building was almost one kilometer long and held seven hundred thousand centrifuges. A sixth generation of serial centrifuges was completed in the early 1980s.[41] As with chemical fertilizers, asbestos, steel, coal, and other products, rapid production and large scale were central to the design of facilities, and safety was a second thought.[42]

Rather than provide extensive chapter and verse on this well-documented and frightening situation, let us consider three paradigmatic failures in the nuclear enterprise to demonstrate how Soviet officials and scientists contributed to extensive environmental degradation because of unsound and, some would say, immoral practices. The first involved a forty-square-kilometer area near the confluence of the Techa and Misheliak rivers containing two hundred waste storage sites, twenty-five of which remain open. Between 1949 and 1956, vast quantities of highly radioactive waste entered

The Arctic Nuclear Challenge (Oslo, 2001); and Igor Kudrik, Aleksandr Nikitin, Charles Digges, Nils Bøhmer, Vladislav Larin, and Vladimir Kuznetsov, *The Russian Nuclear Industry – The Need for Reform* (Oslo, 2004).

39 As Andrei Sakharov noted in his *Memoirs*, the scientists had no doubts that they worked for the socialist motherland in a life-and-death battle with the United States. Their patriotism trumped any concerns about the state of the slave laborers' lives or the environmental costs of their activities. Besides, they lived comfortably, albeit behind barbed-wire fences, with access to good foods, delicacies, nice clothing, and comfortable and spacious apartments.

40 T. Artemov and A. E. Bedel, *Ukroshchenie urana* (Yekaterinburg, 1999), 252–5.

41 Ibid., 131, 138, 195, 211–12. At the end of the 1950s and early 1960s, Soviet capacities for gaseous diffusion expanded greatly at the new Siberian Chemical Combine at Tomsk 7 and the Angarsk Electrolytic Chemical Combine, as well as the Electrochemical Factory at Krasnoiarsk 45. This required production of fantastical amounts of filters, which had reached 66.7 million by 1961 and 1 billion within thirty years, with a total length of five hundred thousand kilometers (ibid., *Ukroshchenie urana*, 96).

42 Paul Josephson, *Red Atom* (Pittsburgh, 2005), 28–32, 74–8.

the watershed at the source of the Techa and spread far and wide. The second occurred in September 1957, when a nuclear waste dump at Kyshtym exploded, sending millions of curies of concentrated military radioactive waste into the atmosphere – a significantly larger quantity than at Chernobyl. The explosion required the evacuation of eleven thousand people and created a dead zone of several hundred square kilometers.[43]

The third failure concerns the Maiak facility that included a series of reservoirs for nuclear waste with a total capacity of 380 million cubic meters. The reservoirs were separated from the Techa River by a simple dam. In 1951, the nuclear authorities began to pump billions of curies of cesium- and strontium-laced radioactive waste from the reservoirs into the bottom of the nearby Lake Karachai. The resulting reservoir held twenty-four times the radioactive debris released in Chernobyl. In a drought during the summer of 1967, Lake Karachai evaporated, and winds blew the radioactive dust more than fifty kilometers, affecting forty-one thousand people.[44] By early 1996, the Maiak complex had accumulated five hundred thousand cubic meters of solid radioactive waste and four hundred thousand cubic meters of liquid radioactive waste deposited in reservoirs throughout the region. The plant continues to discharge twenty-five Bq (becquerels) of liquid waste annually. According to a study conducted by the Russian and Norwegian governments, since 1948, the Maiak nuclear complex has leaked 8,900 peta-Bq of the radioactive isotopes strontium 90 and cesium 137 into the environment as a result of accidents and the deliberate discharge of liquid waste.[45]

The Ural region was also a center of biological and chemical weapons production. In April 1979, an anthrax epidemic killed dozens of people and afflicted perhaps thousands more in Sverdlovsk. The Soviet authorities reported that the anthrax had come from meat sold on the black market. Many persons in the Soviet Union and elsewhere believed that the cause of the anthrax was the unintentional release of a biological weapon. After the breakup of the Soviet Union, an international team of researchers investigated the cause and extent of the epidemic. They concluded that an unintentional release of anthrax spores in aerosol form from a biological weapons facility had descended on the city. Given the nature of the Soviet system, it is not surprising that the government jeopardized health and safety in a city of 1.2 million inhabitants by locating a biological weapons facility

43 Zhores Medvedev, *Nuclear Disaster in the Urals* (New York, 1979).

44 Josephson, *Red Atom*, 279–80.

45 "Russia: Mayak Radioactive Waste Facilities," *Nuclear Threat Initiative*, http://www.nti.org/db/nisprofs/russia/fissmat/pumayak/nucwaste.htm (accessed May 13, 2009).

in it rather than at an isolated site, not to mention one that operated with safety the paramount concern.[46]

Reporters with the investigative television program *Kak eto bylo* ("The Way It Was") revealed that Soviet military officials had exposed soldiers to the same kind of immoral experiments that U.S. military officials had sanctioned in the 1950s. The program documented how soldiers had been sent to ground zero immediately after a nuclear blast as part of a war exercise to determine how quickly they could secure the region. Not only the "downwinders" of Semipalatinsk, Kazakhstan, but also the nuclear veterans of the Soviet Union have much in common with their Cold War American counterparts. The Soviet Union exploded at least 718 nuclear bombs between 1949 and 1998, the vast majority of them above ground until 1962.[47] Igor Kurchatov, the father of the Soviet atomic bomb, and Andrei Sakharov, the creator of the hydrogen bomb, later political dissident and Nobel Peace Prize winner, tried to convince Nikita Khrushchev from 1958 onward to sign an atmospheric test-ban treaty. The human and environmental costs of the Soviet nuclear enterprise will be with us for decades more to come.

PERESTROIKA AND THE END OF THE COLD WAR

Most specialists believe that 30 or 40 percent of the Soviet industrial effort was devoted to the military. Certainly, a much greater percentage of investment went to military enterprises and research institutes in the Soviet Union during the Cold War than in the United States. We can fairly conclude that nature, workers, and entire cities were placed into servitude to the military-industrial complex. The environmental and public health costs have been extensive, and the Yeltsin and Putin governments allocated insufficient attention or funds to study and cleanup. Indeed, the Putin administration disbanded the federal environmental protection agency, placing responsibilities for law enforcement at the provincial level but providing neither manpower nor funding to do so and focusing instead on the development of natural resources from oil to timber to strategic minerals in support of a booming economy.

Before the breakup of the Soviet Union, Mikhail Gorbachev contributed to short-lived optimism among many scientists, environmentalists, writers, and ordinary citizens through perestroika and glasnost that ecological

46 Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak* (Berkeley, Calif., 1999).
47 V. I. Bulatov, *200 Iadernykh poligonov SSSR* (Novosibirsk, 1993).

approaches might be explored. Of course, Gorbachev's engagement of the United States to end the Cold War was the single most important factor in ending the war on nature that had been part of the nuclear arms race. Beyond that, his reforms promoted open consideration of the many policy failings under Soviet power. This led newspapers and journals to publish exposés on the significant environmental costs incurred over the previous fifty years. These included chapter and verse on the impact of the fallout from Chernobyl. Although some of the exposés exaggerated the crimes against nature, together they painted a picture of total disregard for public health and ecology.

Under the editor Sergei Zalygin, a self-proclaimed reformed hydrological engineer, the monthly journal *Novyi mir* ("New World") published a series of extensive studies about the Soviet war on nature. Zalygin's own opposition to Siberian river diversion led to the publication of a series of articles criticizing the environmental unsoundness and unbridled momentum of the project, and ridiculing the scientific credentials of individuals in the euphemistically called the Institute of Water Problems. He saw to the publication in serial form of Grigori Medvedev's *The Truth about Chernobyl*, an exaggerated but largely sound examination of the roots of the Chernobyl disaster in the Soviet hubristic engineering mind-set. Authors belonging to the village prose genre used fiction and nonfiction alike to criticize the war against nature. The best-known of these writers, Valentin Rasputin, published *Farewell to Matyora* (1976; film adaptation 1982), a fictional account of the destruction of the way of life on a small island town about to be inundated by the waters backing up behind a new Brezhnev-era hydroelectric power station, perhaps on the Angara River. He wrote a series of short accounts of Siberian life that addressed these issues head-on, published in the west as *Siberia! Siberia!*[48]

The Cold War contributed to the formation of vast regions of the former Soviet Union so polluted that recovery may be impossible. A number of writers have called them industrial deserts or industrial wastelands. The military-industrial infrastructure capably produced oil, coal, metals, timber, and nuclear weapons, but it did so inefficiently and at great cost to public health and the environment. According to one study, the operation of copper-nickel smelters in Monchegorsk and Nikel-Zapolyarnyi in the Kola Peninsula has "predisposed the pines to freezing injuries, thus contributing to forest decline." Significant acidification, defoliation, and needle loss resulted from extremely high emissions of sulfur dioxide and

48 Valentin Rasputin, *Siberia! Siberia!* (Evanston, Ill., 1991).

heavy metals.[49] In another study, cancer researchers have now established that the cities where ferrous and nonferrous metallurgy, chemical industry, and machine building was concentrated in the former Soviet Union (Magnitogorsk, Lipetsk, Donets, Cheliabinsk, and especially Noril'sk among many others) have respiratory cancer incident rates higher than those of other cities, related closely to the content of polycyclic aromatic hydrocarbons from urban air, vehicle, and industrial emissions.[50]

Because the Soviets had always taken an aggressive, exploitative, and careless approach to nature, was the Cold War approach to environmental issues no different from standard operating procedure? On the contrary, evolving Soviet industrial, agricultural, and resource management practices were linked to the exigencies of the Cold War in a variety of ways. First, the scale of military enterprises dwarfed that of the civilian sector on which they were often based. Part of the reason for this was the nature of what military enterprises produced and how they produced it. In some sense, there was no difference between the production of tanks and the production of nuclear warheads. But the nuclear industry was much more massive and used materials and processes far more dangerous for the environment. The tens of thousands of centrifuges that separated fissile and nonfissile uranium and the concrete canyons laden with acids to separate cladding from nuclear fuel produced hundreds of millions of liters of liquid waste and hundreds of millions of cubic meters of solid waste. Indeed, the scale of environmental degradation increased to scores and hundreds of square kilometers of territory spoiled to human habitation and dangerous for other flora and fauna. On many occasions, after an accident or oversight – or simply because of standard operating procedure – the authorities were forced to evacuate huge swaths of land because of acute radioactive or biological contamination. If military industry learned from the military sector how to employ workers and ore as fodder for industrial processes, it contributed to the environmental degradation that will long remind citizens of the military legacy. Further, there was a direct link between military strategy, testing, and environmental effects that included, for example, the detonation of nuclear devices or the release of biosubstances on inhabited territory or near population centers with little regard for local people, many of them indigenous, or soldiers.

49 Marja-Liisa Sutinen et al. (Rovaniemi Research Station), "Effects of Emissions from Copper-Nickel Smelters on the Frost Hardiness of *Pinus sylvestris* Needles in the Subarctic Region," *New Phytologist* 132 (1996): 502–12.

50 Alexandra Khesina, "Urban Air Pollution by Carcinogenic and Genotoxic Polyaromatic Hydrocarbons in the Former USSR," *Environmental Health Perspectives* 102, suppl. 4 (October 1994): 49–53.

Third, if Soviet society was a closed society in which the public had little opportunity to voice environmental concerns, then in the scores of secret, closed military production facilities and entire military cities created during the Cold War, there were even greater restrictions on citizens' behavior. Whether civilian or military personnel, they were often drafted into service in these closed cities. The authorities essentially precluded their movement into new, nonclassified jobs and even dictated where they could travel for vacations. Not surprisingly, individuals working in facilities dedicated to defending the nation nurtured a patriotic mind-set of security at any cost. Andrei Sakharov had no doubts that his work to design nuclear weapons was an act of patriotism absolutely necessary to the nation's self-defense. Officers, engineers, scientists, and other employees were simply not accustomed to thinking about environmental issues. They lived in isolation from those concerns in the struggle against American imperialism. Not only were they kept inside closed cities; the authorities kept unauthorized individuals out, setting up checkpoints manned by tough young guards. As of 2008, any foreigner wishing to gain entry to such cities as Severodvinsk (founded as Molotovsk in 1938 to build ships for the navy, and transformed into the major nuclear submarine facility in the late 1950s) required the permission of the FSB, the Federal Security Service, inheritor of the KGB.

Hence, the Cold War gave great impetus to environmental degradation in the Soviet Union both by exacerbating the impact of existing features of the Soviet economy, polity, and ideology and by generating new ones. Reflecting the technological momentum that Soviet institutions acquired, the scale and geographic reach of engineering firms, construction organizations, and factories and enterprises knew few bounds. The economy, always directed to secure self-sufficiency, to increase industrial production, and to make the nation safe against capitalist aggression, largely served military ends. In spite of this, we must not fall into the trap of ignoring the fact that the call for national security produced the same negative environmental impacts in other nations during the Cold War, especially in China, France, England, and the United States.

2

Creating Cold War Climates

The Laboratories of American Globalism

MATTHEW FARISH

Since any aspect of environment (in its widest sense) may be significant to military activities, the designer of equipment, as well as the military planner and operator, must consider all the implications of man-machine-environment interrelationships if the full potential of military power is to be realized.

– *Southwest Asia: Environment and Its Relationship to Military Activities* (1959)[1]

On coming into the Arctic a man from a warm climate must learn a new set of templates for processing the routine data of living. If he has previously learned to learn – that is, to commit himself to the environment and to act with it, rather than *fearing-fighting* it – the transition period is rapid.

– David McK. Rioch, Walter Reed Army Institute of Research, 1960[2]

THE NATURE OF WAR

In an October 2005 *New York Times* op-ed titled "Next: A War against Nature," the well-traveled correspondent and commentator Robert Kaplan, famous for his coming-anarchy thesis of the 1990s, argued that "[the] rest of the world and even quite a few Americans are uncomfortable with the globe-trotting United States military. But in future years they will see much

1 Environmental Protection Research Division, Quartermaster Research and Engineering Center, *Southwest Asia: Environment and Its Relationship to Military Activities* (Natick, Mass., 1959), foreword.
2 David McK. Rioch, "Psychiatric Problems of Man in the Arctic," in *Man Living in the Arctic: Proceedings of a Conference, Quartermaster Research and Engineering Center, Natick, Massachusetts, 1, 2 December 1960*, ed. Frank R. Fisher (Washington, D.C., 1961), 103–14, quote at 110 (emphasis in original). This address was reprinted in John Sater, coord., *The Arctic Basin* (Washington, D.C., 1963), 214–22.

I owe Alan Earls a great debt for allowing me to reproduce several of the fine images from his photographic history of the Natick Laboratories. Conversations with Alana Boland, Edward Jones-Imhotep, Scott Kirsch, Whitney Lackenbauer, Scott Prudham, Katharine Rankin, and Rachel Silvey were invaluable in the preparation and revision of this chapter. Questions and comments from audiences in Chapel Hill, Chicago, and Toronto were also very useful. Finally, I am grateful to Corinna Unger, John McNeill, and the participants in the "Environmental History and the Cold War" workshop, a cordial group who nonetheless subjected each paper to detailed scrutiny.

more of it. The causes will be more related to the natural environment than to terrorism." He went on to describe the United States military as "the world's most effective relief organization," having recently dispensed aid in Pakistan and the Philippines.[3]

Not coincidentally, Pakistan and the Philippines were also mentioned in Kaplan's *Atlantic Monthly* essay of the same month – but in that case, they were described as "laboratories of counterinsurgency."[4] Whether conjuring lessons from the past or casting prophetically toward the future, Kaplan's dispatches are part of a venerable tradition of writing, by foreign correspondents and others, on imperial encounters with hostile forms of culture and nature (the two are quite inseparable). Surveying such literature with a more critical eye, historians and geographers have recently documented numerous intimate relationships between empire and environment, from colonial "improvement" projects to botanical expeditions.[5]

Knowing nature, in other words, has long been useful to imperial campaigns, and this knowledge depends on circulatory networks of scientific collection and contemplation, networks of field and laboratory sites created or enlisted by military agencies.[6] But in the twentieth century, a variety of new technologies gave laboratories additional geographic authority and reach, with the result that the world's climatic conditions were increasingly simulated within the confines of domestic territory. Given the lingering global presence of American troops during this American Century, it is not

3 Robert D. Kaplan, "Next: A War against Nature," *New York Times*, October 12, 2005. Kaplan's coming-anarchy thesis was first articulated in the February 1994 issue of the *Atlantic Monthly*. For longer treatments, see Robert D. Kaplan, *The Ends of the Earth: From Togo to Turkmenistan, from Iran to Cambodia – A Journey to the Frontiers of Anarchy* (New York, 1997); and Kaplan, *The Coming Anarchy: Shattering the Dreams of the Post-Cold War* (New York, 2000). For two very different critiques of Kaplan, see Simon Dalby, "The Environment as Geopolitical Threat: Reading Robert Kaplan's 'Coming Anarchy,'" *Ecumene* 3, no. 4 (1996): 472–96; and Tom Bissell, "Euphorias of Perrier: The Case against Robert D. Kaplan," *Virginia Quarterly Review* (Summer 2006): 235–52, http://www.vqronline.org/articles/2006/summer/bissell-euphoria-perrier/ (accessed December 11, 2006).

4 Kaplan, "Imperial Grunts," *Atlantic Monthly*, October 2005, http://www.theatlantic.com/doc/200510/kaplan-us-special-forces (accessed January 21, 2007). The inevitable book is *Imperial Grunts: The American Military on the Ground* (New York, 2005). As David Rieff was quick to note in an extended and devastating review of the latter, Kaplan not only "views today's soldiers' fight against Islamists and terrorists as something very close to the Indian-fighting army of the nineteenth-century American West" but also heartily endorses the use of the phrase "Indian country" by American troops to describe various postings around the globe. Rieff, "The Cowboy Culture," *New Republic*, October 10, 2005, available in full at http://www.powells.com/review/2005_10_06.html (accessed January 21, 2007).

5 See, e.g., David Philip Miller and Peter Hanns Reill, eds., *Visions of Empire: Voyages, Botany, and Representations of Nature* (New York, 1996); Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven, Conn., 2000).

6 See Bruno Latour, "The 'Pedofil' of Boa Vista: A Photo-Philosophical Montage," *Common Knowledge* 4, no. 1 (1995): 145–87; Felix Driver, *Geography Militant: Cultures of Exploration and Empire* (Oxford, 2001).

surprising that some of the most thorough and diverse attempts at summoning Earth's regions took place within the United States and its territories. This research – in medicine, physiology, psychology, and other related human sciences – produced simplistic but nonetheless powerful forms of environmental information.

The specifications and perceived accuracy of climate simulations depend on geographic presuppositions, both human and physical. More importantly, the premises and results of these simulations often escape from their controlled confines to become part of popular geographical discourses, influencing beliefs about human-environment interactions, discussions of cultural difference, and even grand geopolitical theories. If, following Edward Said's pioneering work, we now accord significant weight to the imaginative dimensions of imperialism, then the study and re-creation of other places, often couched in the terms of scientific inquiry, for military purposes is a particularly important subject for environmental historians and geographers.[7]

During the nineteenth century, as Thomas Richards has argued, sustaining the fantasy of a unified, global imperial presence required the construction of coherent and comprehensive archives of information.[8] But it was not until the Second World War that the world's regions were systematically contemplated for the purposes of combat and occupation, as expressed, for instance, in the British Naval Intelligence Handbooks, the publications of the Smithsonian Institution's Ethnogeographic Board, and the analyses of the legendary Office of Strategic Services (OSS), the forerunner of the Central Intelligence Agency.[9] In the United States, the Ethnogeographic Board and the OSS were the two pillars upon which the prominent and problematic field of Cold War area studies was built. But it was a step beyond the collection and distribution of information on distant regions to their re-creation within laboratory spaces, simulations held in tandem with field studies in what were understood to be equivalent North American environments. In this chapter, I examine two laboratories, each with roots in World War II, that were critical to the creation of an environmental Cold War:

7 See Edward W. Said, *Orientalism* (New York, 1978); Said, *Culture and Imperialism* (New York, 1993); and Derek Gregory, "Imaginative Geographies," *Progress in Human Geography* 19, no. 4 (1995): 447–85.

8 Thomas Richards, *The Imperial Archive: Knowledge and the Fantasy of Empire* (London, 1993).

9 See Hugh Clout and Cyril Gosme, "The Naval Intelligence Handbooks: A Monument in Geographical Writing," *Progress in Human Geography* 27, no. 2 (2003): 153–73; Matthew Farish, "Archiving Areas: The Ethnogeographic Board and the Second World War," *Annals of the Association of American Geographers* 95, no. 3 (2005): 663–79; Trevor J. Barnes, "Geographical Intelligence: American Geographers and Research and Analysis in the Office of Strategic Services, 1941–1945," *Journal of Historical Geography* 32 (2006): 149–68.

one in the Massachusetts town of Natick and the other at Alaska's Ladd Air Force Base (today Fort Wainwright). Although not identical, both permitted and enabled the drawing of connections between the global reach of the American military; the strategic significance of certain parts of the planet; the national responsibilities of the United States in a world of threats; and finally, the individual bodies of soldiers destined, it seemed, to encounter peculiar human and natural foes across a truly comprehensive spectrum of locations.

This linkage of scales is evident if we return momentarily to Robert Kaplan's recent writing on American militarism. As he acknowledged in the *Atlantic Monthly*, the United States has had a long imperial association with the Philippines.[10] More detailed histories have shown that this relationship has been characterized not only by frequently brutal counterinsurgency campaigns but also by scientific encounters with *tropicality*.[11] Beginning in the late nineteenth century, the Pacific archipelago was both a specific target of American military power and a node on a global map, a chart divided as much naturally – by environmental differences – as by cultural or political characteristics. And the Tropics, including the Philippines, had already been made legible as a geographic category by earlier colonial projects and perceptions.

As a form of imaginative geography similar to Orientalism – the discursive division of East and West so characteristic of colonial scholarship on the Middle East – tropicality became, according to David Arnold, a "way of defining something environmentally and culturally distinct from Europe, while also perceiving a high degree of common identity between the constituent regions of the tropical world."[12] The "seismically, climatically, and environmentally fragile areas" traversed by Kaplan's troops are thus part of a long-standing trope that is as much conceptual, dependent on certain popular notions of cultural and ecological difference and vulnerability, as it is linked to specific events such as earthquakes, famines, or plagues.[13] In

10 Kaplan, "Imperial Grunts."

11 See, e.g., Greg Bankoff, "A Question of Breeding: Zootechny and Colonial Attitudes toward the Tropical Environment in the Late Nineteenth-Century Philippines," *Journal of Asian Studies* 60, no. 2 (2001): 413–37. On tropicality, the definitive source is David Arnold, *The Problem of Nature: Environment, Culture, and European Expansion* (Oxford, 1996). See also the special March 2000 (21, no. 1) issue of the *Singapore Journal of Tropical Geography*, "Constructing the Tropics."

12 Arnold is quoted in Felix Driver and Brenda S. A. Yeoh, "Constructing the Tropics: Introduction," *Singapore Journal of Tropical Geography* 21, no. 1 (2000): 1.

13 Kaplan, "Next"; see also Greg Bankoff, "The Historical Geography of Disaster: 'Vulnerability' and 'Local Knowledge' in Western Discourse," in *Mapping Vulnerability: Disasters, Development, and People*, ed. Greg Bankoff, Georg Frerks, and Dorothea Hilhorst (London, 2004), 25–36; Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (London, 2001).

addition, if we are to follow Neil Smith's chronology of American globalism – American aspirations to global authority, in some ways realized, in other ways just hypothesized – then we need to acknowledge the symbolic arrival of American naval forces in Manila Bay in 1898. This event, Smith writes, "marked the first and last serious foray by the United States into extraterritorial colonization," but its singularity nonetheless "gave way to the first contours of a new global geography."[14]

SURVIVING GLOBAL DANGERS

The American colonization of the Philippines – along with the 1893 coup in Hawaii – marked the beginning of a long century of regime change and preventive wars launched by American presidents in the name of national security and global stability.[15] But the specific Pacific concerns of the United States in the 1890s were only a preface to a period, a half century later, when the country could boast (or bemoan) forces stationed so disparately that the Army Air Force had to create, during the Second World War, an agency with the telling name of the Arctic, Desert, and Tropic Information Center (ADTIC). Such institutions were only partially concerned with the generalities of regional description. At the heart of ADTIC's mission was the relationship between an individual soldier and a specific landscape that could, for the sake of convenience, be placed in a category such as "Arctic." According to a history of military medicine:

> Until World War II there was little government interest or support in the United States for environmental research on the effects of heat, cold, or altitude. Then these effects became of critical government concern, with US military pilots flying high-altitude missions; tank crews fighting in the desert; infantry living and fighting in the jungle; the mountain division in Northern Italy; troops in winter in Alaska trying to repel Japanese attacks on the Aleutian Island chain; and naval crews sailing in tropical seas trying to work in confined gun turrets, boiler rooms, and the like.[16]

By the time of the Second World War, then, the world, in the words of the modernization theorist and psychological warrior Daniel Lerner, had become a "global arena of national action," epitomized by President

14 Neil Smith, *American Empire: Roosevelt's Geographer and the Prelude to Globalization* (Berkeley, Calif., 2003), 31.

15 See Stephen Kinzer, *Overthrow: America's Century of Regime Change from Hawaii to Iraq* (New York, 2006).

16 Ralph L. Goldman, "Introduction to Heat-Related Problems in Military Operations," in *Medical Aspects of Harsh Environments*, ed. Kent B. Pandolf and Robert E. Burr (Washington, D.C., 2001), 1:43.

Franklin Roosevelt's famous wartime radio instructions to his constituents: "take out and spread before you a map of the whole earth."[17] Roosevelt's ideal map was in fact a globe, which like the prolific period maps positioned above the North Pole suited the age of air power far better than the distortions of the Mercator projection. For Christmas of 1942, Army Chief of Staff George C. Marshall gave Roosevelt and British Prime Minister Winston Churchill copies of the largest military globe ever constructed.[18] These objects were undoubtedly of practical use, but it was the broader impression of the world as a military globe, a hostile sphere featuring numerous theaters of danger and interest, that migrated unambiguously into and defined the Cold War period.

The role of geographical knowledge as a valuable and popular wartime commodity was compatible with the authority of laboratory science and social science mobilized for a global conflict. As William Borden put it in his 1946 book *There Will Be No Time*, there was "no geographical approach to U.S. strategy which does not wind up finally in the laboratory."[19] Borden was specifically alluding to the creation of the atomic bomb in the secret spaces of the Manhattan Project, but his comment can be read in a second sense, following Bruno Latour's clever phrasing, with reference to Louis Pasteur: "Give me a laboratory and I will raise the world."[20] This grandiose proposition, set in the context of the Second World War and the subsequent Cold War, begins to appear awfully accurate. From now-famous sites such as the Massachusetts Institute of Technology's Lincoln Laboratory, where the Cold War continental defense network was designed, to equally intriguing locations such as the RAND Corporation's Systems Research Laboratory, where that same network was localized and simulated inside a Santa Monica pool hall (turned into a model of an air defense radar center), military science produced powerful new forms of knowledge that spread outward beyond laboratory walls to refashion the world, in the process reconfiguring basic geographic categories like "region" and "continent."[21]

17 Daniel Lerner, "American Wehrpolitik and the Military Elite," *New Leader* 26 (April 1954): 21; Roosevelt is quoted in Susan Schulten, *The Geographical Imagination in America, 1880–1950* (Chicago, 2001), 204.

18 See Arthur H. Robinson, "The President's Globe," *Imago Mundi* 49 (1997): 143–52.

19 William L. Borden, *There Will Be No Time: The Revolution in Strategy* (New York, 1946), 166.

20 See Bruno Latour, "Give Me a Laboratory and I Will Raise the World," in *Science Observed: Perspectives on the Social Study of Science*, ed. Karin D. Knorr-Cetina and Michael Mulkay (London, 1983), 141–70. See also Rebecca M. Lemov, *World as Laboratory: Experiments with Mice, Mazes, and Men* (New York, 2005).

21 On the Systems Research Laboratory, see, e.g., Robert L. Chapman, John L. Kennedy, Allen Newell, and William C. Biel, "The Systems Research Laboratory's Air Defense Experiments," *Management Science* 5, no. 3 (1959): 250–69.

World War II had also produced, in units such as the Office of Field Service, a generation of what one official history dubbed "combat scientists," who traveled outward from their American workplaces to various realms of war in search of answers to problems like "Rust, Jungle Rot, and Psychoneurosis" (the title of one of the book's chapters).[22] Military laboratories were thus never removed from the wider world – indeed, they depended on it. This was a relationship made particularly clear in the environmental laboratories built to study and simulate distinct and distant climates.

It was in acts of geographic replication or imitation that the fragile contradictions of military science were most apparent, but also where geographical difference and danger could be most cleanly and powerfully expressed.[23] At RAND, the quintessential Cold War think tank, geopolitical exercises frequently added "nature" as an external factor influencing and disrupting the proper conduct of strategy. To give these scenarios mobility, such that they were meaningful beyond the comfortable confines of the laboratory or gaming room, it was essential to treat nature as an antagonist, replicating a classic trope in military geography.[24] Many textbooks and treatises on the geographical dimensions of war are premised on the assertion that the "natural environment" has been "one of the greatest forces for disaster" during military campaigns – a statement that is indisputable in one sense but also profoundly consequential in its articulation of a hostile natural realm distinct from, but ready to be overcome by, an appropriately trained and equipped army.[25]

Looking back on the survival research conducted at the Arctic, Desert, and Tropic Information Center – reactivated in 1947 at Air University on Alabama's Maxwell Air Force Base – Paul Nesbitt, the center's postwar director, set out the issue clearly: "For our armed forces to operate successfully

22 See Lincoln R. Thiesmeyer and John E. Burchard, *Combat Scientists* (Boston, 1947).

23 Of course, the most notorious type of Cold War simulation was that of nuclear war itself, not only on paper, on think-tank gaming tables, or programmed into a computer, but also in the form of weapons tests. The United States conducted these in the South Pacific and at the sprawling Nevada Test Site, where Camp Desert Rock was conducted in 1951 to house soldiers who would witness blasts and march or bus even closer to ground zero, in repeated, brazen attempts to determine whether conventional war was compatible with its more spectacular counterpart. Desert Rock veterans are discussed in Mary Manning, "Atomic Vets Battle Time," *Bulletin of the Atomic Scientists* 51, no. 1 (1995): 54–60; Michael D'Antonio, "Atomic Guinea Pigs," *New York Times Magazine*, August 31, 1997, 38–43.

24 For an example of RAND's treatment of nature, see J. D. Sartor, *Evaluation of Environmental Effects on Military Operations*, RAND RM-2080, December 21, 1957, RAND Corporation, Santa Monica, Calif. On RAND simulations more generally, see Sharon Ghamari-Tabrizi, "Simulating the Unthinkable: Gaming Future War in the 1950s and 1960s," *Social Studies of Science* 30, no. 2 (2000): 163–223.

25 Bruce C. Paton, "Cold, Casualties, and Conquests: The Effects of Cold on Warfare," in Pandolf and Burr, *Medical Aspects of Harsh Environments*, 1:314.

on a global basis, we must be knowledgeable about the world's different environments in which our forces now operate or are likely to operate in the future as well as about the peculiar operational problems that varied hostile environments present."[26] Some fifteen years earlier, in the landmark 1954 book *American Geography: Inventory and Prospect*, Joseph Russell's "Military Geography" chapter had addressed such ongoing research on "extreme and unfamiliar environments . . . undertaken to note the effects of these environments on men, equipment, and materiel." These investigations were "started during the war, but . . . considerably expanded during the postwar period," and Russell pointed "to the desirability of having ultimately an analysis of the physical environment of world regions in terms of the critical elements or combinations of elements that impede or preclude satisfactory equipment and human performance."[27]

The dangerous regional diversity recognized by Nesbitt and Russell was ultimately a factor to be overcome by a masculine Cold Warrior. Here was where geography could contribute to the resolution of conflict in a cybernetic, high modernist world: recognize a set of hostile natural environments and then regulate them as far as possible. Whether certain regions were of strategic significance was important but secondary; a complete analysis was required to wage a Cold War that valued the entire globe as relevant. When it was necessary to move from this detached worldview to a local position, military travelers – and those who monitored and directed them – could still be at least partially abstracted from specific landscapes through new forms of technology.

More recent developments linking computer mapping to gear worn by the fighter in the field indicate that this Cold War vision of a useful military geography was hardly deluded. The dream of a bloodless victory, powered by information science and detached command structures, requires that rational and technical authority make chaotic geographic conditions comprehensible. And the U.S. Army has continued to test its equipment in what it calls three "natural environmental settings": arctic, desert, and tropic.[28] But what exactly were the studies of "unfamiliar and extreme" places that Joseph Russell had gestured to? Alongside the survival manuals published by ADTIC, some of the most intriguing considerations occurred in research

26 Paul Nesbitt, "A Brief History of the Arctic, Desert, and Tropic Information Center and Its Arctic Research Activities," in *United States Polar Exploration*, ed. Herman R. Friis and Shelby G. Bale Jr. (Athens, Ohio, 1970), 134.

27 Joseph A. Russell, "Military Geography," in *American Geography: Inventory and Prospect*, ed. Preston E. James and Clarence F. Jones (Syracuse, N.Y., 1954), 494, 495.

28 See W. Chris King, Eugene J. Palka, and Russell S. Harmon, "Identifying Optimum Locations for Tropical Testing of United States Army Materiel and Systems," *Singapore Journal of Tropical Geography* 25, no. 1 (2004): 92–108.

facilities devoted to hostile environments. Necessarily incorporating both field and laboratory, these understudied sites were crucial points on a circuit of geographic knowledge. Their sustenance depended on the globalization of American militarism. To properly analyze a specific environment, however, this complex cartography had to be reduced to a stable and constrained scientific experiment. The results of such trials were understandably local and bodily, concerned as they were, in Russell's words, with the performance of "men, equipment, and materiel." But they were also inevitably global, part of a utopian effort to create a sort of universal soldier, because with time and judgment, the world itself could become a laboratory.

BEGINNINGS: HARVARD AND LAWRENCE

When the Harvard Fatigue Laboratory was established in 1927, it represented, according to its official historians, "the first laboratory for the comprehensive study of normal man," an interdisciplinary home for physiologists, psychologists, biologists, physicians, and others. The Fatigue Lab pioneered the holistic examination of human adaptation to "unusual stresses, such as athletic competition, exposure to strange environments, and war."[29] Led by the research director David B. Dill, the author of the 1938 book *Life, Heat, and Altitude*, the laboratory, initially attuned to the predicaments of productive workers, acquired a very specific orientation during the Second World War.[30] Dill himself was pulled away to positions with the U.S. Army Air Corps and the Quartermaster Corps, working on "clothing and equipment for the soldier, especially in extreme climatic environments," and traveling to North Africa, Italy, and the Pacific to tackle unsolved physiological predicaments.[31]

Other Fatigue Laboratory employees were also "fully devoted to military research," focusing on "the nutrition and climatic adaptation of the soldier in wartime," an emphasis with both immediate and longer-term implications.[32] One significant study traced daily feeding habits among ground troops in "temperate, mountain, desert, jungle, arctic and subarctic areas,"

29 Steven M. and Elizabeth C. Horvath, *The Harvard Fatigue Laboratory: Its History and Contributions* (Englewood Cliffs, N.J., 1973), ix.

30 David B. Dill, *Life, Heat, and Altitude: Physiological Effects of Hot Climates and Great Heights* (Cambridge, Mass., 1938).

31 D. B. Dill, "The Harvard Fatigue Laboratory: Its Development, Contributions, and Demise," *Circulation Research* 20, no. 3 (suppl. 1) (1967): 169; Dill, "Physiologists in World War II," *Physiologist* 7, no. 1 (1964): 37. See also the biography of Dill, recognizing his service as the twenty-third president of the American Physiological Society, at http://www.the-aps.org/about/pres/introdbd.htm (accessed February 19, 2007).

32 D. B. Dill, "Physiologists in World War II," 36; Horvath and Horvath, *Harvard Fatigue Laboratory*, 53.

using data collected between 1941 and 1946 to show that, though the types of rations could remain constant across this spectrum of environments, troops in cold weather required more calories. This project was certainly of interest to its army sponsors, who were continuing to forecast the presence of American troops in bastions around the globe.[33]

Crucially, a close liaison was established during the war between the Fatigue Laboratory and the army's new Climatic Research Laboratory (CRL) set up "on the second floor of an old building of the Pacific Mills" in nearby Lawrence, Massachusetts – a location chosen because of the proximity to Cambridge but also because the site possessed a large, abandoned cold room that had been used for the freeze-cleaning of wool.[34] Fatigue Laboratory staff also traveled to the Armored Medical Research Laboratory at Kentucky's Fort Knox to conduct additional cold research relating primarily to tank crews.[35]

These two military sites, at Lawrence and Fort Knox, were profiled in a fascinating 1943 *National Geographic* article, titled "Fit to Fight Anywhere," documenting attempts to re-create the "strange conditions" of war in various hostile environments. According to the author, Frederick Simpich, the "build-up of soldiers as machines, with both mental and physical qualities," was accomplished in two ways: small groups of men were "'processed' and observed in fatigue and climatic laboratories," and then

> large masses of men are actually conditioned at once, as when whole army corps maneuver through southern States in sham battles, or when armored divisions and mechanized cavalry drill in such dry, hot regions as California's blistering Mojave Desert to prepare for combat, say, in North Africa.[36]

The two activities Simpich described were united by their status as simulations, but each prioritized a different approach. In a laboratory, the focus was on replicating climatic conditions accurately and determining the implications of severe climates for individual bodies. In the field, a greater emphasis was placed on re-creating acts of war and considering the military mass as a disciplined unit. Reports of inadequate equipment used in field

33 Robert E. Johnson and Robert M. Kark, "Environment and Food Intake in Man," *Science* 105 (April 11, 1947): 378. This research was followed directly by later, more specific projects on caloric intake in subarctic, desert, and other regions sponsored by the Quartermaster Research and Development Command in Natick, Massachusetts. For a summary, see Elsworth R. Buskirk, "Energetics and Climate with Emphasis on Heat: A Historical Perspective," in *Nutritional Needs in Hot Environments: Application for Military Personnel in Field Operations*, ed. Bernadette M. Marriott (Washington, D.C., 1993), 97–116.

34 Robert F. Forster, "My Affair with the JAP," *Journal of Applied Physiology* 85, no. 1 (1998): 45–6. See also Alan R. Earls, *U.S. Army Natick Laboratories: The Science behind the Soldier* (Charleston, S.C., 2005), 7.

35 Horvath and Horvath, *Harvard Fatigue Laboratory*, 55–7.

36 Frederick Simpich, "Fit to Fight Anywhere," *National Geographic* 84, no. 2 (1943): 233.

trials were sent back to the laboratories where the equipment had been developed and tested under more controlled, and thus limited, circumstances. But whereas the Mojave Desert was used as a stand-in for a particular region, or at least a particular type of region, climate laboratories were more flexible and universal. At Fort Knox, Simpich wrote, soldiers encountered "every kind of weather 'from Greenland's icy mountains' to 'India's coral strand,'" and he additionally described the specifics of this masculine encounter:

> I stepped into the "hot room" at one laboratory, and was astonished to see stark-naked soldier volunteers running on treadmills, in humid "jungle air" where the temperature was near 100° Fahrenheit. . . . At another laboratory, in a "cold room," soldiers tested Arctic clothing. On piles of snow at subzero temperatures men dozed in sleeping bags, their heads invisible.[37]

The snow itself was generated in the facility "by the use of atomizers which squirt a fine spray into the room at a low temperature. They can make a half-inch snowfall each hour."[38]

As David Dill noted in a postwar speech, the CRL owed its existence to research conducted in 1942 by Harvard staff on improving clothing and equipment for cold weather use. Dill additionally and specifically credited two men for the formation of the Lawrence laboratory: Georges Doriot, a Harvard Business School professor of industrial management now best known for his postwar role as an early venture capitalist but who was also head of the Quartermaster Corps' Research and Development Branch through the Second World War, and the geographer and Antarctic explorer Paul Siple, who worked under Doriot and later moved to the Department of the Army. With their support, and using a company of volunteer soldiers shared with the Fatigue Laboratory, the Lawrence facility "made a notable contribution to the problems confronting the Quartermaster Corps in clothing and equipping soldiers engaged in a global war."[39] It was "designed as a laboratory in which all climatic conditions that our soldiers were likely to encounter could be simulated and where their clothing

37 Ibid., 244, 233. It is not clear which laboratories Simpich is referring to, but the two candidates are almost certainly Fort Knox (hot) and Lawrence (cold). In the second, cold example, a photograph (249) shows soldiers in sleeping bags huddled next to a Dictograph, which recorded "their observations to observers outside the cold chamber." Another photograph (254) showed an observer, pen in hand, sitting next to a bank of speakers, recorders, and control switches.

38 Ibid., 250.

39 D. B. Dill, "Highlights of Physiological Research in Military Laboratories," in *Symposium on Military Physiology* (Panel on Physiology, Committee on Geographical Exploration, Research and Development Board, December 1947), 12. See also Dill, "The Harvard Fatigue Laboratory," 168. Siple's connection to geography is evident in his "The Application of Geographical Research to U.S. Army Needs," *Professional Geographer* 7 (April 1948): 1–3. For a biography of Siple, see http://www.southpole.com/p0000111.htm (accessed February 21, 2007).

and equipment could be tested," and as such a "jungle chamber," complete with water jets, was added to the existing cold facilities in August 1944.[40]

Doriot's role with the Quartermaster Corps was "to prepare soldiers for war in all possible climates."[41] In an April 1944 speech to the American Philosophical Society, he focused directly on nature, or "the weather, terrain, vegetation, and all those things over which the enemy has little control." In doing so, Doriot – and David Dill, reading the speech in the absence of its author, who was on "war duties" – were expanding the scope of war, noting that combat casualties were outnumbered by those resulting from illness, cold, and other environmental factors. But such claims were insufficient if unsupported by documentation of the "wide extremes" faced by poorly equipped soldiers. The science of "environmental protection" was a thoroughly geopolitical pursuit, the banal physiological details Doriot offered and his preoccupation with collars notwithstanding.[42] By calling for the military modernization of the textile industry, Doriot was also contributing to the study of what the Yale psychologist and biologist Robert Yerkes had recently dubbed "human engineering."[43]

The Lawrence laboratory's research thus explicitly addressed and blurred the relationship between field and laboratory, blending reports from ongoing military campaigns with geographic presuppositions and scientific tests to create what a later ADTIC study called "survival geography."[44] As Dill noted:

> It was a major responsibility during this period to guide our research in the light of reports by Quartermaster Corps observers on the reactions of soldiers to their rations, clothing, and equipment in the desert, in the tropics, and in the cold-wet conditions of North Africa, Italy, and Germany.[45]

40 Ralph Francesconi, Robert Byrom, and Milton Mager, "United States Army Research Institute of Environmental Medicine: First Quarter Century," *Physiologist* 29, no. 5 (suppl.) (1986): 58.

41 Marcia L. Lightbody, "Building a Future: World War II Quartermaster Corps," *Military Review* 81, no. 1 (2001): 90.

42 Georges F. Doriot, "Environmental Protection," *Proceedings of the American Philosophical Society* 88, no. 3 (1944): 196, 198.

43 Robert M. Yerkes, "Man-Power and Military Effectiveness: The Case for Human Engineering," *Journal of Consulting Psychology* 5, no. 5 (1941): 205–9.

44 Maxwell Air Force Base, AL: Arctic, Desert, Tropic Information Center, Aerospace Studies Institute, *Survival Geography of South America: A Survey of the Jungles and Deserts of South America* (1961). In his preface, Paul Nesbitt, the head of ADTIC, deemed the book useful to those "working in the survival, counterinsurgency, and human factors fields" (iii).

45 Dill, "Highlights of Physiological Research in Military Laboratories," 12. A tribute to Georges Doriot in the Quartermaster's hall of fame mentions "the development of all new uniforms and equipment for use in every kind of climate and geographic region around the world." Quoted in Jeffrey L. Cruikshank, *Shaping the Waves: A History of Entrepreneurship at Harvard Business School* (Cambridge, Mass., 2005), 60.

The Lawrence facility, the former American Physiological Society president Robert Forster recalled, was "used to test the effectiveness of clothing under tropical and arctic conditions during work and became a training ground for many physiologists."[46] Some 350 technical reports were published by the CRL over the course of its twelve-year existence, and authors with Lawrence affiliations also appeared in a wide variety of scientific journals.[47] Forster's work on thermal conductivity, for instance, was reproduced in the new *Journal of Applied Physiology*, a periodical launched in 1948 to distribute physiological work "related to the practical needs of the military."[48] Under the direction of the physical anthropologist Russell Newman, long a fixture at the Climatic Research Laboratory and its Natick successor, Paul Baker spent three summers in the 1950s studying the weight and body composition of soldiers ordered to march along "carefully laid desert tracks" near Yuma, Arizona, which led Baker to global conclusions about desert environments.[49]

Not surprisingly, these were scientific practices and scientific languages that bled into geographic scholarship. Douglas H. K. Lee, a professor of physiological climatology at Johns Hopkins University, also spent time near Yuma – in his case, in the summer of 1952 – "studying the effects of solar radiation upon human performance under desert conditions." The *Professional Geographer* reported that a mobile climatic laboratory built at Johns Hopkins for the Quartermaster Corps was employed in this project, which was being carried out with support from the Climatic Research Laboratory.[50] Lee was also the author, with Hoyt Lemons of the Quartermaster

46 Forster, "My Affair," 45. David Dill and A. Clifford Barger, a Harvard student who worked with Dill in the Fatigue Laboratory and later moved to the Climatic Research Laboratory, were also American Physiological Society presidents. See Barger's biography at http://www.the-aps.org/about/pres/introacb.htm (accessed October 12, 2006).

47 Francesconi et al., "United States Army Research Institute of Environmental Medicine," 59.

48 The results of Forster's project are summarized in H. C. Bazett et al., "Temperature Changes in Blood Flowing in Arteries and Veins in Man," *Journal of Applied Physiology* 1, no. 1 (1948): 3–19. The role of the Lawrence laboratory is not mentioned in this article. For Forster's biography, see http://www.the-aps.org/about/pres/introref.htm (accessed February 21, 2007).

49 Paul T. Baker, "Adventures in Human Population Biology," *Annual Review of Anthropology* 25 (1996): 3; Baker, "The Biological Adaptation of Man to Hot Deserts," *American Naturalist* 92 (November–December 1958): 337–57; Baker, "Russell W. Newman, 1919–1981," *American Journal of Physical Anthropology* 55, no. 4 (1981): 421–2. Looking back on the Yuma Desert studies, Baker concluded that many of his results "remain unchallenged today" but allowed that some of his conclusions regarding "population differences" – namely race – "seem debatable to me now because of uncontrolled sampling variables." Baker, "Adventures in Human Population Biology," 3. See also Baker, "Racial Differences in Heat Tolerance," *American Journal of Physical Anthropology* 16 (1958): 287–306.

50 See the section on Johns Hopkins in "News from Geographic Centers," *Professional Geographer* 4, no. 5 (1952): 35–41. The Mobile Climatic Laboratory was featured on a May 1953 episode of the *Johns Hopkins Science Review*, a pioneering television program broadcast (by that year) across the United States and in Canada, Britain, France, and a number of other countries. In the episode,

Corps, of a long 1949 *Geographical Review* article on "Clothing for Global Man," which lamented the absence of climatic data "for vast stretches of the earth's surface."[51] Both Lee and Lemons were also involved in a symposium, organized for the 1947 annual meeting of the Association of American Geographers, on geographic research in the Quartermaster Corps. And Lemons, who would later go on to work in the similarly booming field of disaster studies, also presented a paper at the same meeting on "Geography as an Applied Science in Quartermaster Research." Emphasizing "the stresses of the Arctic desert, tropics and mountains," he suggested that geographers, responsible for cataloging the "regional and temporal distribution of these stresses," could work closely with physiologists, charged with examining the impact of these stresses on bodies, in what he called – echoing Doriot – environmental protection. Lemons went on to note the library, field, and laboratory inquiries that combined in the pursuit of environmental protection and listed a number of distinguished geography departments as partners in this research.[52]

Those such as Dill, Doriot, and Siple who were heavily involved in promoting Harvard and Lawrence laboratory research no doubt appealed to the practical benefits of specific studies on clothing and equipment, offering "a short cut to the field testing that is necessary before any item can be accepted for military use." After the Second World War, however, these men were also credited with a much broader awareness: the foresight "to see that studies of man in relationship to his environment, and studies of the protective needs of man in stressful environments, could yield information which would improve the efficiency and comfort of the fighting man."[53]

Douglas Lee described the operation of the Mobile Laboratory, which consisted of "an engine room with generators, an anteroom with controls, and a climatic chamber with treadmill and other equipment. Test subjects are wired to provide data to a recorder as they exercise on a treadmill under different temperature and humidity levels." See the description at http://www.library.jhu.edu/collections/specialcollections/jhuxmlkineFind.body.html (accessed March 12, 2007).

51 Douglas H. K. Lee and Hoyt Lemons, "Clothing for Global Man," *Geographical Review* 39, no. 2 (1949): 187.

52 See "Abstracts of Papers Contributed to the Program of the Forty-Fourth Annual Meeting, held in Charlottesville, Virginia, December 27 to 31, 1947," *Annals of the Association of American Geographers* 38, no. 1 (1948): 51–109; the Lemons abstract is at 104. For his later work on civil defense, see Hoyt Lemons, "Physical Characteristics of Disasters: Historical and Statistical Review," *Annals of the American Academy of Political and Social Science* 309, no. 1 (1957): 1–14.

53 Harwood S. Belding, "Quartermaster Corps Climatic Research Laboratory," in *Symposium on Military Physiology*, 35. Later in his presentation to the symposium, Belding noted that the Quartermaster Corps was "now operating a Field Laboratory in a higher latitude as an aid in solving some of our problems. . . . I am sure that you feel that no matter how well environments may be simulated in the Laboratory, it is still necessary to conduct field studies" (40). The Lawrence laboratory's successor in Natick, Massachusetts, certainly had a relationship with the Canadian military's facility at Fort Churchill, Manitoba; for a representative study, see Fernand De Percin and Sigmund J. Falkowski, *A Topoclimatic Study, Fort Churchill, Canada* (Natick, Mass., 1956).

This was a global vision that, because of its generality, downplayed the applied aspects of individual tests for a more basic approach to human-environment relations, but one that was still eminently suited to the military conduct of the American Cold War. Before human interaction with and responses to a particular environment could be studied, the environment as a geographic and climatic unit had to be understood in broader terms, meaning that the Lawrence climatic laboratory, in its various postwar guises, became a natural equivalent to the cultural area studies institutes springing up on American university campuses. Moreover, the Lawrence laboratory and others like it were clearly important examples of what the historian of science Stuart Leslie has called the military-industrial-academic complex, alongside numerous other Cold War agencies bridging personnel, funding, and ideas from all three of these influential social sectors.[54]

Characteristically, the Climatic Research Laboratory was an interdisciplinary space, combining physiologists, biochemists, biophysicists, and psychologists, for instance, in projects on adaptation. In one study, conducted in the laboratory's jungle chamber, "seven young, healthy, white soldiers" exercised in a hot and humid room for twenty-five weeks between November 1945 and April 1946, and their pulses, sweat rates, and temperatures were regularly measured (Figure 2.1).[55] Other experiments sought to more accurately measure the "stress" of climates on bodies, occasionally substituting recruits for a "Copper Man" placed outdoors and dressed in standard clothing, or to design better protection against these stresses by testing various "garment assemblies."[56]

54 See Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York, 1993). Other important sources on this complex include Peter Galison, "Physics between War and Peace," in *Science, Technology and the Military*, ed. Everett Mendelsohn et al. (Dordrecht, 1988), 1:47–86; Roger L. Geiger, "Science, Universities, and National Defense, 1945–1970," *Osiris* 7 (1992): 26–48; Daniel Lee Kleinman, *Politics on the Endless Frontier: Postwar Research Policy in the United States* (Durham, N.C., 1995); Noam Chomsky et al., *The Cold War and the University: Toward an Intellectual History of the Postwar Years* (New York, 1997); and John Cloud, "Crossing the Olentangy River: The Figure of the Earth and the Military-Industrial-Academic-Complex, 1947–1972," *Studies in History and Philosophy of Modern Physics* 31, no. 3 (2000): 371–404. See also the review by David Engerman: "Rethinking Cold War Universities: Some Recent Histories," *Journal of Cold War Studies* 5, no. 3 (2003): 80–95.

55 William R. Christensen, "Long Term Acclimatization to Heat," *American Journal of Physiology* 148, no. 1 (1947): 86.

56 Belding, "Quartermaster Corps Climatic Laboratory," 39. Belding, the first scientific director of the Climatic Research Laboratory, was himself responsible for development of Copper Man, considered one of the first effective thermal manikins built for the American military. A history of this bizarre if important character can be found at http://www.mtnw-usa.com/thermalsystems/history.html (accessed February 22, 2007): "In September 1945, General Electric was asked to build the next generation thermal manikin for the Climatic Research Laboratory. General Electric combined its previous manikin expertise along with detailed data from an anthropometric study of nearly 3000 Army Air Force cadets to construct another electroplated copper shell manikin with a total of six separate electrical circuits and based on the average physical dimensions of a young U.S. military recruit."

Figure 2.1. Army scientists and research volunteers conducting physiological testing in the jungle room at the U.S. Army Climatic Research Laboratory, Lawrence, Mass., in 1945. This was one of five paintings by U.S. Army Technician, 4th Grade, Moore, an enlisted soldier assigned to the facility. Reproduced from Thomas E. Beam and Linette R. Sparacino, eds., *Military Medical Ethics* (Washington, D.C.: Borden Institute, Walter Reed Army Medical Center, 2003), 2:564.

Although the Harvard laboratory's staff was committed to the principles of general physiology, their emphasis on fatigue reflects the unit's origins in a decade consumed by interest in industrial productivity and management. The biological chemist Lawrence J. Henderson, one of the laboratory's founders, had suggested in 1935 that if the concern was "the physiological experiences of everyday life," fatigue was widely understood to be important, but "there is no agreement about what the word is supposed to mean."[57] The result was a wide scope for investigation but also an acceptance of the human body as a system, to the point where Henderson was, like many prominent scholars who embraced the field of cybernetics in the 1940s,

57 Henderson, writing in the *Harvard Alumni Bulletin*, is quoted in Carleton B. Chapman, "The Long Reach of Harvard's Fatigue Laboratory," *Perspectives in Biology and Medicine* 34, no. 1 (1990): 19. This article is astonishing for its minimal mention of the Fatigue Lab's military connections and descendents; the second-generation offshoots specified are all university based.

"beyond doubt, bioscientist *and* philosopher."[58] What this telling comment suggests is that the ambitions of the scientists associated most closely with American environmental laboratories were hardly containable within the walls of a climate chamber. Similarly, the mountain research captured in David Dill's *Life, Heat and Altitude*, the product of a 1935 expedition to the Andes, was not simply of interest to other scientists or individual adventurers but also found larger audiences within various national air forces.

With Dill's departure late in 1946 to become director of medical research for the U.S. Army Chemical Research and Development Laboratory at Maryland's Army Chemical Center, the Harvard lab formally dissolved. But Dill was not devastated; he had, he said shortly thereafter, "little hesitation in accepting" his new position, "nor have there been regrets for that decision."[59] In a later retrospective article for the journal *Circulation Research*, he mused that "successful organisms have a way of reaching maturity, declining, and dying, but not without perpetuating their kind. So it was with the Fatigue Laboratory."[60] As with the regional inquiries of the Ethnogeographic Board and the Office of Strategic Services, the Fatigue Laboratory, and its Lawrence neighbor, gave way to a host of Cold War successors.

NATURE AT NATICK

Shortly after leaving Harvard, David Dill and two other scientists at the Army Chemical Center organized a symposium in Washington, D.C., on the subject of military physiology. The meeting, sponsored by the new Research and Development Board and attended by representatives from both military and nonmilitary laboratories, was yet another indication of the armed forces' interest in a wide range of basic and applied research after the Second World War.[61] In his introductory remarks, Major General

58 Ibid., 20, emphasis in the original. On cybernetics, see Steve Joshua Heims, *The Cybernetics Group, 1946–1953: Constructing a Social Science for Postwar America* (Cambridge, Mass., 1993).

59 Dill, "Highlights of Physiological Research," 13.

60 Dill, "Harvard Fatigue Laboratory," 169; see also Horvath and Horvath, *Harvard Fatigue Laboratory*, 84. Chapman, "Long Reach," 28–9, attributes the demise of the Fatigue Laboratory to the powerful Harvard president James B. Conant, who could not justify its rather anomalous location in the business school. Intriguingly, Conant also played a major role in eliminating geography from Harvard in the same year; see Neil Smith, "'Academic War over the Field of Geography': The Elimination of Geography at Harvard, 1947–1951," *Annals of the Association of American Geographers* 77, no. 2 (1987): 155–72. The results were the same, however: the members of both programs fanned out across the country, settling in new and ultimately influential homes.

61 Material on the somewhat elusive but ubiquitous Research and Development Board can be found in Kleinman, *Politics on the Endless Frontier*. The board's intriguing Human Resources panel, which addressed military research in the social sciences, is discussed in Lyle H. Lanier, "The Psychological and Social Sciences in the National Military Establishment," *American Psychologist* 4, no. 5 (1949): 127–47.

Raymond Bliss, the army's surgeon general, stated that "great strides in the advancement of medical science are only made during periods of conflict." With the end of World War II, he noted, "the nation as a whole is in a position to revert again to the time honored practice of leisurely and independent pursuit of knowledge." The irony, however, was that "[o]nly institutions with substantial resources can afford to support such research in a comprehensive manner," and the implication was that these institutions were first and foremost military agencies.[62] As Dill added in his symposium address, between basic and applied inquiry, "there is a great middle ground, where distinction is impossible. Investigators in military laboratories should be given much freedom for work in this area."[63]

A short genealogy is necessary here. The Climatic Research Laboratory, built in 1943, shifted south (after a temporary stop in a Framingham, Massachusetts, hospital) from Lawrence to the Boston suburb of Natick in 1954 and was renamed the Environmental Research and Protection Division (ERPD) (Figure 2.2). In Natick, the new Quartermaster Research and Development Command facility, of which the ERPD was an important part, was dedicated on October 14 of that year (Figures 2.3 and 2.4).[64] The ceremony was attended by a substantial crowd of military and political leaders, including Secretary of the Army Robert Stevens and Speaker of the House of Representatives Joseph Martin.[65] In 1961, the ERPD merged with Fort Knox's Armored Medical Research Laboratory to become the U.S. Army Research Institute of Environmental Medicine (USARIEM), which by 1968, occupied a new seventy-five-thousand-square-foot building.[66]

Despite the amalgamations and name changes, what remained constant, even persistent, were "militarily relevant, clinically important, and

62 Major General R. W. Bliss, "Introductory Remarks: Address of Welcome at Opening of Symposium on Military Physiology," in *Symposium on Military Physiology*, 7, 8.

63 Dill, "Highlights of Physiological Research," 16.

64 Environmental Protection was one of six divisions of the new Quartermaster Research and Development Command center at Natick; the others were Mechanical Engineering, Chemicals and Plastics, Dispensing and Handling Equipment, Textile, Clothing, and Footwear, and the Pioneering Research Laboratory. Earlier versions of these divisions were scattered around the United States; with the establishment of the Natick facility, "duplicative effort caused by geographical dispersion will be eliminated and our problems can be attacked on a team basis in a healthy scientific atmosphere under closely coordinated military supervision." Brig. Gen. J. C. Odell, "The New Quartermaster Research & Development Command," *Quartermaster Review*, July–August 1954, available at http://www.qmfound/quartermaster_research_development_command.htm (accessed February 28, 2007).

65 Photographs from this ceremony can be found in Earls, *U.S. Army Natick Laboratories*, chap. 3.

66 See Goldman, "Introduction to Heat-Related Problems in Military Operations," 46–7; Francesconi et al., "United States Army Research Institute of Environmental Medicine," 58; "USARIEM History and Background," at http://www.usariem.army.mil/ariemhis.htm (accessed December 10, 2006). This last source recognizes the important original role of the Harvard Fatigue Laboratory.

Figure 2.2. Aerial view of the Natick Laboratories, on the shores of Lake Cochituate in Massachusetts, taken not long after the laboratory's dedication in 1954. Some building projects were still under way. Reproduced with permission from Alan Earls, *U.S. Army Natick Laboratories: The Science behind the Soldier* (Charleston, S.C.: Arcadia, 2005), 74–5.

Figure 2.3. The main gate of the Natick Quartermaster facility in 1956. Reproduced with permission from Earls, *U.S. Army Natick Laboratories*, 12.

Figure 2.4. Workers install fan sections of the Doriot Climatic Chambers at the Natick facility, n.d. (1953–4). Reproduced with permission from Earls, *U.S. Army Natick Laboratories*, 24.

scientifically significant" research topics. In 1962, for instance, the conceptual chain from laboratory to field was reaffirmed when USARIEM physicians followed several hundred "test subjects who deployed to the Panama Canal Zone for maneuvers." The "determined pursuit of environmental test scenarios designed to mimic real world military situations" has since taken USARIEM staff all over the world, traveling and living with American troops overseas, and to dozens of military sites across the United States.[67] Today, the USARIEM is a central component of a larger 124-building complex on Natick's Lake Cochituate called the Army Soldier Systems Center.[68] A flattering 2002 *Los Angeles Times* profile cataloged the history of inventions at the Natick compound, from freeze-dried beverages and irradiated or "restructured" meats (the inspiration for Chicken McNuggets) to bulletproof vests, and hinted at ongoing research on "courage pills" and spray-on clothing.[69]

67 Francesconi et al., "United States Army Research Institute of Environmental Medicine," 59, 60.
68 The center's Web site clearly states its mandate as "the Science behind the Soldier. . . . Everything the Soldier wears, carries and consumes is either designed, developed or integrated here." See http://www.natick.army.mil/ (accessed December 10, 2006).
69 Roy Rivenberg, "The Army's Mad Lab," *Los Angeles Times*, August 25, 2002.

According to an equally enthusiastic 2003 profile of Natick on the *Newsweek* Web site, "recruits call it Camp Happy." Volunteers step into the Doriot Climatic Chambers, rooms that can be set from –70 to 165 degrees Fahrenheit, "though no human has ever been subjected to those extremes."[70] The article's author, Martha Brant, who also penned a piece on military-sponsored nanotechnology research at MIT in the concurrent print edition of *Newsweek*, continued:

> Natick, for all its success, was born out of failure. In World War II, soldiers found that leftover gear from the last war wasn't made for the jungles of the South Pacific. Within days, their tents disintegrated. Commercially tinned food had to be pitched in the sea. Back in Washington, the Quartermaster General decided to open a research-and-development branch.[71]

When the climatic laboratory shifted south from Lawrence to Natick it was marketed, like its Harvard ancestor, as what Georges Doriot called an "institute of man."[72] A floor plan of the facility from the same year reveals an arctic wing and a tropic wing, each with its own dressing room, conditioning room, instrumentation room, and wind tunnel (Figure 2.5). A dormitory, briefing room, and kitchen were all nearby. In addition to experiments conducted "in these superb research laboratory facilities," Natick employees also carried out "field studies in arctic, desert, and tropical climates," at locations such as the subarctic landscape around Fort Churchill, Manitoba, home to Canada's Defence Research Northern Laboratory.[73]

A photographic history of the Natick compound published in 2005 reveals the extensive and extraordinary participatory science conducted within various laboratory spaces and the blending of scientist and soldier that resulted. A researcher inserts his arm into a box containing a mosquito colony, to ensure its survival; five personnel walk in circles for hours, wearing rain gear; two technicians enter a "subzero test chamber maintained at negative 60 degrees Fahrenheit" (Figure 2.6); four men, wearing Natick-designed survival suits, float in the Pentagon Lagoon; and four women taste maple-syrup samples. Although the photographs display numerous

70 Martha Brant, "Greetings from Natick, Mass.," *Newsweek Online*, February 12, 2003, http://www.msnbc.com/news/871981.asp (accessed February 25, 2003). The Doriot Climatic Chambers are mentioned in Earls, *U.S. Army Natick Laboratories*, 11.

71 Brant, "Greetings from Natick, Mass." This quote is similar to a paragraph in Lightbody, "Building a Future," 90. On Second World War field science in the Pacific, see, in particular, Thiesmeyer and Burchard, *Combat Scientists*, and the essays in Roy MacLeod, ed., *Science and the Pacific War: Science and Survival in the Pacific, 1939–1945* (Dordrecht, 2000).

72 Brant, "Greetings from Natick"; Lightbody, "Building the Future," 92.

73 Goldman, "Introduction to Heat-Related Problems in Military Operations," 46. The floor plan can be found in ibid., 45. On the Churchill laboratory, see *Defence Research Northern Laboratory, 1947–1965* (Ottawa, 1966).

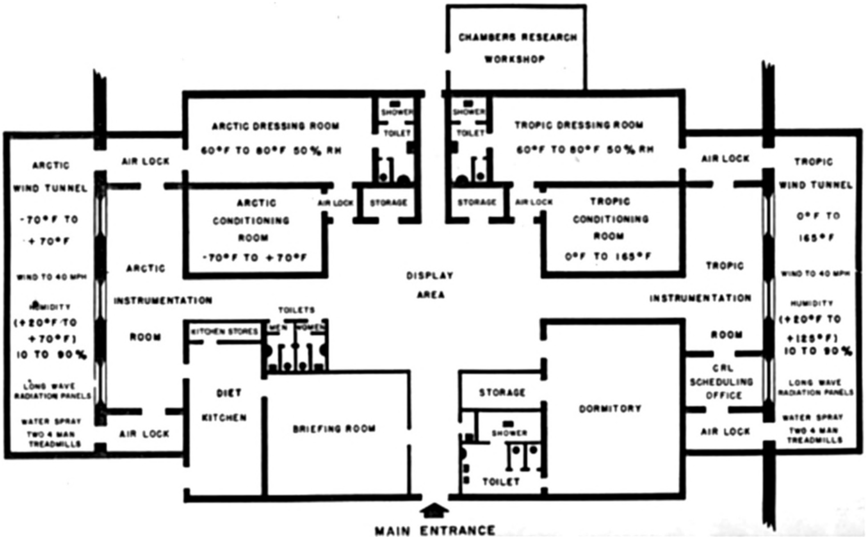

Figure 2.5. Floor plan of the Climatic Research Laboratory, Natick, Mass., c. 1954. Reproduced from *Medical Aspects of Harsh Environments* (Washington, D.C.: Borden Institute, Walter Reed Army Medical Center, 2001), 1:45.

intriguing technologies, from burst testers and abraders to the wonderfully named "fade-o-meter," the focus of the Natick facility was ultimately, as Doriot suggested, on the human – and more specifically the masculine – body. And the body, as a scale for the practice of Cold War geopolitics, was, like the city, the continent, the region, and the globe, an interdisciplinary concern; the Natick facility boasted representatives from at least fifteen scientific disciplines, including "chemistry, physics, biology, psychology, geography, anthropology, and so on." By 1954, more than one hundred projects were already under way, many coordinated with other agencies and facilities that together constituted the vast archipelago of Cold War military research. A number of these projects were "farmed out under contracts to leading industrial and university laboratories," drawing, no doubt, on the burgeoning postwar research network in the Boston area located around the "Magic Semicircle" of Route 128.[74]

74 Odell, "The New Quartermaster Research & Development Command." On military-related research and Route 128, including Georges Doriot's important role as a Boston-area venture capitalist, see AnnaLee Saxenixan, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass., 1996). On the scales of the American Cold War, see Matthew Farish, "Frontier Engineering: From the Globe to the Body in the Cold War Arctic," *The Canadian Geographer* 50, no. 2 (2006): 177–96. On the general relationship between military, industrial, and academic concerns in the early Cold War, see Leslie, *Cold War and American Science*.

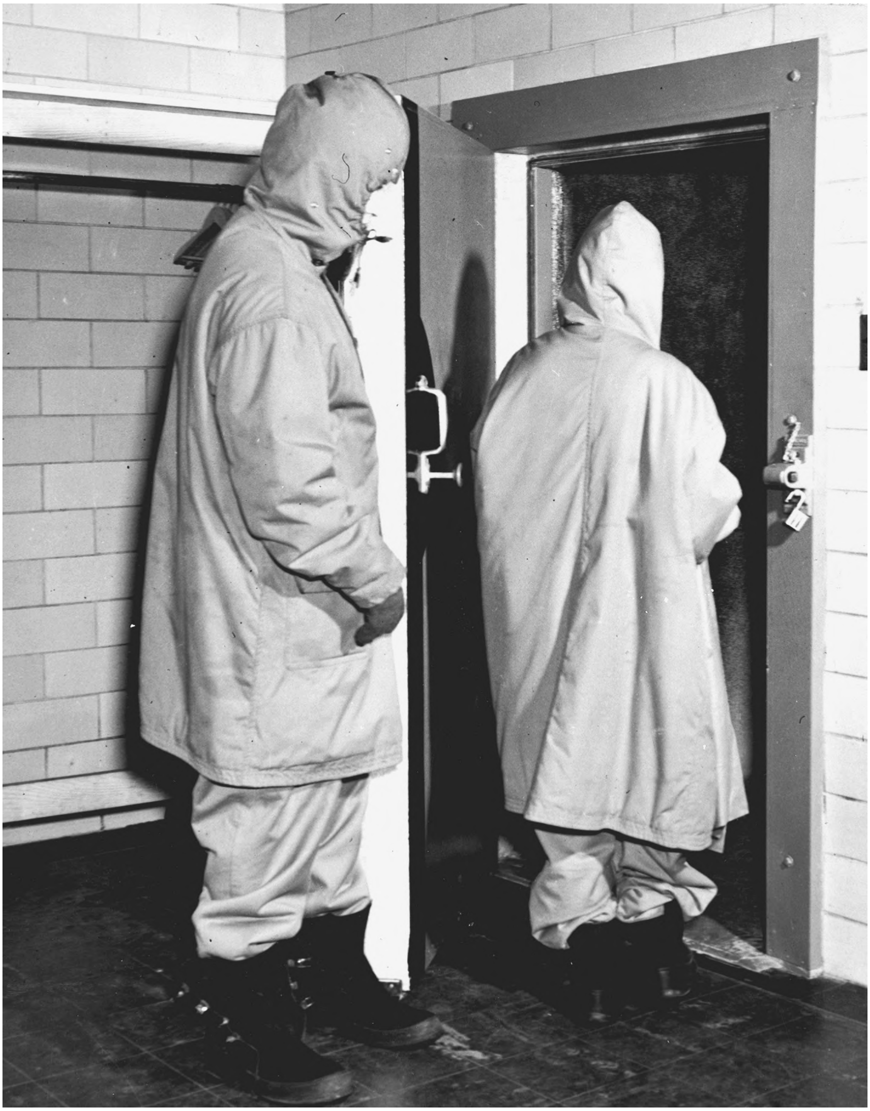

Figure 2.6. Natick technicians enter a test chamber maintained at negative sixty degrees Fahrenheit. Reproduced with permission from Earls, *U.S. Army Natick Laboratories*, 49.

Among the staff at Natick was the Australian explorer and aviator George Hubert Wilkins, who worked on various projects there for several years before his death in 1958. He famously "tested his own clothing prototypes for flame resistance by walking into a blazing gasoline fire."[75] A local police officer once found Wilkins dozing beside a rail line one evening, inside a "new chicken-feather sleeping bag."[76] Following his death, the arctic test chamber at Natick was named after Wilkins.[77]

Wilkins was not alone in putting himself at risk for his research. Another Natick legend, recounted by Georges Doriot in a 1967 speech, featured two navy commanders who experimented with body armor by firing a gun at one another.[78] Such brazen feats not only gave the Natick facility an aura of mysterious extremity – in keeping with the extreme environments it was designed to simulate – but also echoed the broader challenges to ethical standards across the spectrum of Cold War scientific research. Historians have documented the exposure of navy personnel to mustard gas; extensive radiation experiments, including those associated with the aforementioned Camp Desert Rock at the Nevada Test Site; and the infamous administration of mind-altering drugs to both volunteers and a wide range of unwitting subjects.[79] Not surprisingly, the history of research on environmental protection has also received some scrutiny, particularly in Alaska. Despite accolades for the development, during the 1950s, of a relatively progressive "military test subject program" involving informed consent at Natick, this topic remains sensitive there as well.[80] A 2003 Soldier Systems Center Press release noted the 3,700 soldiers who had volunteered, over the long history of the facility, to attempt tasks similar to those experienced by troops "in the field to see what happens under actual conditions," and stressed the care taken in experimental monitoring and review. However, the release also admitted, with reference to Wilkins and others, that the "daringness of the pioneering researchers wouldn't be tried today."[81] In addition, because of some of the same outlandish

75 See "SSC-Natick Press Release," Public Affairs Office, U.S. Army Soldier Systems Center-Natick, January 30, 2003, http://www.natick.army.mil/about/pao/2003/03–01.htm (accessed March 5, 2007). This press release was reprinted verbatim, with photographs, in the January–February issue of the Soldier Systems Center's publication *The Warrior*, available at http://www.natick.army.mil/about/pao/pubs/warrior/index.htm (accessed March 5, 2007). Wilkins's association with Natick is mentioned in "Correction," *Arctic* 12, no. 2 (1959): 121, but not in the obituary corrected: Bernt Balchen, "Sir Hubert Wilkins, (1888–1958)," *Arctic* 11, no. 4 (1958): 258–9. Nor is it detailed in Walter A. Wood, "George Hubert Wilkins," *Geographical Review* 49, no. 3 (1959): 410–16, although Wood (416) does mention "man's ever-broadening mastery of his environment, a command to which [Wilkins] had contributed so much."

76 Earls, *U.S. Army Natick Laboratories*, 79.

77 Rivenberg, "Army's Mad Lab."

78 "SSC-Natick Press Release."

79 A good, if brief, summary of this research is Paul J. Amoroso and Lynn L. Wenger, "The Human Volunteer in Military Biomedical Research," in *Military Medical Ethics*, ed. Thomas E. Beam and Linette R. Sparacino (Washington, D.C., 2003), 2:563–660.

80 Ibid., 572.

81 Ibid. Earls, *U.S. Army Natick Laboratories*, 73, notes that one prominent device at Natick "was the giant heliostat (solar furnace) located close to the shore of Lake Cochituate. Its reflective surfaces were capable of producing intense concentrations of solar energy that could simulate the thermal effects

experiments, "nobody was too surprised" when the Natick facility was designated a Superfund cleanup site in 1994; environmental remediation is likely to continue until 2030.[82]

SURVIVAL TREKS AND SLEEPING BAGS: THE ARCTIC AEROMEDICAL LABORATORY

The creation of the Army's Tenth Mountain Division during the Second World War marked the first significant practical effort on the part of the Department of Defense (then the War Department) to consider the challenges of winter and high-altitude warfare. Based at Colorado's Camp Hale, Mountain Division recruits were led through a series of grueling training exercises:

> From the onset the maneuvers were a fiasco. It was mid-winter in Colorado. Icy blizzards were sweeping the mountains. Because of their lack of training men became casualties from the elements with terrifying rapidity. The tactical situation was forgotten, lost in the simple struggle for survival, bewildered troops staggered down the mountains with frost-bitten feet hands and faces. Some of them were raw recruits with only a few days of military training of any kind.[83]

Not surprisingly, such exercises emphasized not only the physiological but also the psychological effects of cold, a pairing that drove subsequent Arctic research. An equally significant motivator was the bizarre World War II campaign in the Aleutian Islands. Endless rain, snow, and fog led, for example, to twenty-three accidental deaths on the island of Kiska after disoriented troops perceived advancing soldiers in the mist and opened fire, when in fact the steep terrain had been evacuated by Japanese forces two weeks earlier.[84]

These examples and others from the Second World War formed the backdrop for the widespread postwar study of cold weather combat. One history of the subject describes the 1950s and 1960s as a "golden era in

of nuclear explosions. . . . At lower temperatures, according to some sources, the facility was used to test sunscreen-like lotions on animals in a quest to produce substances that could better protect American soldiers and civilians from the effect of nuclear blasts." The heliostat was transferred to the sunnier location of White Sands, New Mexico – ironically the site of the first nuclear blast – in the 1970s.

82 Rivenberg, "Army's Mad Lab." For information on the Natick Superfund site, see http://naticklabs.org/naticklabs.html (accessed March 13, 2007).

83 Memoir of A. Black and C. Hampton, qtd. in Paton, "Cold, Casualties and Conquests," 333. See also Jack A. Benson, "Skiing at Camp Hale: Mountain Troops during World War II," *Western Historical Quarterly* 15, no. 2 (1984): 163–74.

84 Paton, "Cold, Casualties, and Conquests," 335. See also Galen R. Perras, *Stepping Stones to Nowhere: The Aleutian Islands, Alaska, and American Military Strategy, 1867–1945* (Vancouver, 2003).

frostbite research."[85] Natick staff were consistently involved in such detailed studies, but a survey of reports from the period indicates a more distant interest at Natick in the north as a military region – leading, for instance, to an *Atlas of Arctic Environment*, complete with several polar-projection maps, in 1961.[86] But Cold War American research on the north was even more closely associated with two Alaskan laboratories that both opened in 1947. The Naval Arctic Research Laboratory, run by the powerful Office of Naval Research, was concerned more with ostensibly basic science and will not be addressed here.[87] The other was the Air Force's Arctic Aeromedical Laboratory, one of the most intriguing and unusual sites of American Cold War science.

Alaska, the Arctic advocate John J. Teal Jr. wrote in a 1948 issue of *Foreign Affairs*, was once a "forgotten corner," but a global war and the age of air power had focused attention on its geographical destiny "near the center of the earth's land mass." Still over a decade from statehood, Alaska was, after the Second World War, suddenly at the top of the list of strategic regions, prompting Teal to report that the newly established and undersupported Alaskan Command would be unable to prevent a single enemy battalion from seizing the territory. Both invaders and defenders, Teal acknowledged, would first have to contend with the particular challenges of northern warfare.[88] These were common concerns by the late 1940s, as supporters of militarization and economic development in Alaska repeatedly invoked traditions of northern exploration while simultaneously contrasting such individual pursuits with the sort of systematic scientific effort required to bring the territory, and the Arctic as a whole, within the "frontiers of knowledge."[89] The result, as Laurel Hummel has explained, was that Alaska became a "militarized landscape," the scene of enormous defense spending that was particularly dramatic during the 1950s – an era of

85 Paton, "Cold, Casualties, and Conquests," 342. For an example from the Climatic Research Laboratory, see Martin B. Macht, Mortimer E. Bader, and Jere Mead, with the technical assistance of Elizabeth L. Pillion, "The Inhibition of Frostbite Wheals by the Iontophoresis of Antihistaminic Agents," *Journal of Clinical Investigation* 28, no. 3 (1949): 564–6.

86 Andrew D. Hastings Jr., *Atlas of Arctic Environment* (Natick, Mass., 1961). For material on the Soviet interest in the Cold War north, see Paul Josephson's chapter in this volume.

87 On the Naval Arctic Research Laboratory, see, among other sources, John C. Reed and Andreas G. Ronhovde, *Arctic Laboratory: A History (1947–1966) of the Naval Arctic Research Laboratory at Point Barrow, Alaska* (Washington, D.C., 1971). For another useful summary of Arctic research conducted during the Cold War – on construction and permafrost, in particular – see *CRREL's First 25 Years, 1961–1986* (Hanover, N.H., 1986).

88 John J. Teal Jr., "Alaska, Fulcrum of Power," *Foreign Affairs* 27, no. 1 (1948): 86.

89 John C. Reed, "The United States Turns North," *Geographical Review* 48, no. 3 (1958): 321. I discuss the strategic role of Cold War Arctic science in Farish, "Frontier Engineering."

cold-weather combat in Korea and fears of a Soviet invasion over the North Pole.[90]

The new era in Alaskan research was signaled when the National Academy of Sciences and the National Research Council sponsored the first Alaskan Science Conference, in Washington, D.C., in November 1950. Some three hundred American and Canadian participants worried over the lack of both adequate data and coordination across the biological, physical, and social sciences. Speakers in the opening session included Alaska's territorial governor, Ernest Gruening; representatives from the U.S. Departments of Commerce, Defense, and Interior; and officials from the Smithsonian Institution and the Arctic Institute of North America.[91] This event marked an unprecedented synchronization of Alaskan inquiry but also the formal recognition of military science already under way in the north. In addition to several successive Alaskan science conferences, a number of significant military-sponsored symposia were put together during the 1950s and 1960s on what one history calls "environmental physiology" in cold environments.[92]

One of these symposia, "Man Living in the Arctic," was held in December 1960 at the Quartermaster Research and Engineering Center in Natick. The Planning Committee was chaired by Paul Siple, then a scientific adviser to the Army Research Office. In his foreword to the conference proceedings, Siple described the establishment of the Climatic Research Laboratory in World War II and subsequent advances in Arctic research, and he emphasized a historical distinction with a geographic corollary, arguing that against "the former concept of the Arctic as a hostile wasteland, avoided by all but bold adventurers, we believe that we are striving for continued advance of man's successful conquest of an area of the world that will sometime be a populated and essential part of man's habitat."[93] Siple's actual conference speech stressed that it was "only when man attempts to conquer his environment that progress is made," because environmental hazards could become "a source of strength" if overcome.[94] This language of conquest, which could accommodate descriptions of scientific, social, or military endeavors,

90 Laurel J. Hummel, "The U.S. Military as Geographical Agent: The Case of Cold War Alaska," *Geographical Review* 95, no. 1 (2005): 47. A 1961 guide to the new state claimed that "[a]lmost everything the state has today it owes to military spending." Qtd. in ibid., 58.

91 See *Proceedings of the Alaskan Science Conference* (Washington, D.C., 1951); John C. Reed and Harold J. Coolidge, "The Alaskan Science Conference," *Science* 113 (March 2, 1951): 223–7.

92 Eldon W. Askew, "Cold Weather and High-Altitude Nutrition: Overview of the Issues," in Bernadette M. Marriott and Sydne J. Carlson, eds., *Nutritional Needs in Cold and High-Altitude Environments: Applications for Military Personnel in Field Operations* (Washington, D.C., 1996), 85.

93 Paul A. Siple, "Foreword," in Fisher, *Man Living in the Arctic*, iv.

94 Paul A. Siple, "Limitations to Living in the Arctic Regions," in ibid., 14, 15.

reappeared in other presentations. The Quartermaster General, Andrew T. McNamara, described the Arctic as "virgin territory" for the military services, emphasizing the essential "training and discipline" of average soldiers who were less resourceful than northern natives or determined explorers.[95] Arthur Trudeau, chief of research and development for the army, insisted that "man must press on to dominate the Arctic," what he called "an almost fantastically hostile environment."[96] And in his concluding address, "Man's Future Conquest of the Arctic," Steven Horvath, a former Harvard Fatigue Laboratory employee, was even more dramatic:

> We are faced with the problem of deciding whether or not man has reached a point where he had become so familiar with the Arctic that he looks upon it with a certain degree of contempt – that the problems of Arctic living are no longer serious because man brings his own environment with him.[97]

The sweeping statements made by speakers at the 1960 Natick conference could not have been uttered without the ongoing work of a research laboratory located in the Arctic and devoted specifically to military dominance of northern nature. Organized initially at the Air Force's School of Aviation Medicine in Texas, and moved quickly to Alaska, the Arctic Aeromedical Laboratory (AAL) pursued a series of diverse and unusual experiments on cold-weather warfare from 1947 to 1967. By 1955, Quonset huts at Ladd Air Force Base in Fairbanks had been replaced by a permanent two-story structure devoted to the study of "human factors" in the north.[98] Its Departments of Biochemistry, Environmental Medicine, Protective Equipment, Psychology, and Physiology were collectively interested in the Arctic – and Alaska more specifically – as a landscape for living, working, and warring. In search of improved northern knowledge, staff staged survival treks, studied hibernating animals, tested a piece of cold-weather clothing dubbed the "walk-around sleeping bag" (Figure 2.7), and considered the mental health of soldiers posted to isolated locations in the north – a subject that was clearly linked to the construction during the 1950s, of the Distant Early Warning Line of radar sites across the high Arctic.[99] The laboratory was, in

95 Andrew T. McNamara, "The Significance of Logistics in the Arctic," in ibid., 4, 5.

96 Arthur G. Trudeau, "Significance of Research and Development in the Arctic," in ibid., 7.

97 Steven M. Horvath, "Summation: Man's Future Conquest of the Arctic," in ibid., 115.

98 See *The Arctic Aeromedical Laboratory: Its History, Mission, Environment* (Fort Wainwright, Alaska, 1961), n.p.

99 Ibid.; Ned Rozell, "Northern Lab Cranked Out the Quirky and Controversial," Alaska Science Forum 7, October 2004, available at http://www.gi.alaska.edu/ScienceForum/ASF17/1719.html (accessed January 20, 2006). For more on the DEW Line and the Cold War north, see Farish, "Frontier Engineering." For an exemplary AAL publication on isolation, see Leo R. Eilbert, *A Survey to Determine Indoctrination Needs for Personnel at Isolated Arctic Sites* (Ladd Air Force Base, Alaska, 1959).

Figure 2.7. The Arctic Aeromedical Laboratory's walk-around sleeping bag, n.d. Reproduced from Ned Rozell, "Northern Lab Cranked Out the Quirky and Controversial," *Alaska Science Forum* 7, October 2004, http://www.gi.alaska.edu/ScienceForum/ASF17/1719.html.

other words, a focal point for the militarization of Alaska in the first two decades of the Cold War. According to one *Air Force Magazine* article, the AAL was respected by the daring pilots of the Alaskan Air Command – even as it simultaneously sponsored numerous articles in scientific journals.[100]

It is fair to say that the walk-around sleeping bag is not why the Arctic Aeromedical Laboratory remains notorious. In May 1993, a conference in Anchorage devoted to the Cold War contamination of the north turned to a very specific study conducted out of the laboratory from 1955 to 1957. In an attempt to determine the role of the thyroid gland in human acclimatization to cold, iodine-131, a radioactive medical tracer, had been fed, in capsule form, to 121 subjects – 19 military volunteers and 102 poorly informed Alaska natives. Some of the research was conducted from a field station in the Inupiat village of Anaktuvuk Pass. Once publicized, this experiment became the subject of a Congress-mandated National Research Council review, which was soon swept into a broader effort to consider the ethical merits of Cold War human radiation experiments. Although the committee concerned with the AAL thyroid research concluded that the "study was scientifically reasonable for the standards of the time," a Fairbanks public hearing and interviews in two rural villages revealed "widespread frustration, and even rage" among Alaskan natives at "what was done to them during this and other past research."[101]

Even if it lacked the extensive facilities of the Massachusetts climate laboratories, the AAL was still able to pursue a dual approach of basic medical inquiry supplemented by the design and testing of Arctic survival technology. In this sense, it perfectly amalgamated the two stages of building "soldiers as machines," described by Frederick Simpich in his 1943 *National Geographic* article.[102] Led by the Norwegian physician Kaare Rodahl, a noted expert on Arctic medicine and travel, the iodine-131 study was one of many

100 Sgt. James R. Doherty, "Top Cover for America . . . Alaskan Air Command," *Air Force Magazine* 41, no. 1 (1958): 52–9. A list of published AAL reports, as of October 1960, can be found in *The Arctic Aeromedical Laboratory*.

101 Committee on Evaluation of 1950s Air Force Human Health Testing in Alaska Using Radioactive Iodine[131], *The Arctic Aeromedical Laboratory's Thyroid Function Study: A Radiological Risk and Ethical Analysis* (Washington, D.C., 1996), 3, viii. See also Hummel, "U.S. Military as Geographical Agent," 64–5; "Eskimos Seek Redress for Cold War Medical Tests," *Reuters*, February 1, 1997 (reprinted at http://www.thepeoplespaths.net/news/alaska/htm; accessed September 14, 2007). On the broader subject of Cold War human subject research, see Eileen Welsome, *The Plutonium Files: America's Secret Medical Experiments in the Cold War* (New York, 1999).

102 Echoing the language of cybernetics, one AAL publication considered the human body "a machine in possession of an elaborate and complicated mechanism which maintains the interior or core at a relatively constant temperature." Loren D. Carlson, *Man in Cold Environment: A Study in Physiology* (Ladd Air Force Base, Alaska, 1954), xiii.

AAL projects concerned with "the nutrition, physiology, and living habits of Alaska natives" across the territory.[103] Related initiatives did not rely on radioactive substances, but nor were they driven solely by scholarly curiosity, despite the appearance of articles written by laboratory staff in publications like the aforementioned *Journal of Applied Physiology*.[104]

It makes little sense to argue that military patronage always determines scientific outcomes and produces an applied variant of science that appears diminished when set next to another more innocent or objective form of inquiry. As Ronald Doel has argued, historians of Cold War science must question not only the types of science resulting from military support but more specifically the myriad ways in which "military patrons sought to enlist scientists in efforts to control nature to further national security aims."[105] And in the case of the Arctic Aeromedical Laboratory, one of the most prominent sites of scientific authority in Alaska, the primary purpose of all research was to aid the lives of military personnel in an outpost of the American Cold War – a region that, to become an object of scientific curiosity, had to be invented as a military environment first.

THE GLOBAL LABORATORY

Although the Arctic Aeromedical Laboratory did not possess either the resources or the climatic scope of its Massachusetts cousins, the increased strategic relevance of the polar regions and the shared interest in human engineering – how to better prepare and equip soldiers for activity in hostile environments – indicates that these locations must be considered together as prominent sites for the simulation of Cold War climates. But though they are individually important and intriguingly comparable, it is essential that the laboratories examined here are also understood as part of a vast midcentury research complex connecting military, industrial, and academic forms of knowledge production. This complex was not only geographic, in terms of the various networks – intellectual, financial, transportation, and so on – which sustained it, but much of it was devoted to the study of geography, to comprehending the world's distinct regions with an eye to

103 *The Arctic Aeromedical Laboratory's Thyroid Function Study*, 11.

104 See, e.g., John P. Meehan, "Body Heat Production and Surface Temperatures in Response to a Cold Stimulus," *Journal of Applied Physiology* 7, no. 5 (1955): 537–41; Thomas Adams and Benjamin Covino, "Racial Variations to a Standardized Cold Stress," *Journal of Applied Physiology* 12, no. 1 (1958): 9–12.

105 Ronald E. Doel, "Constituting the Postwar Earth Sciences: The Military's Influence on the Environmental Sciences in the USA after 1945," *Social Studies of Science* 33, no. 5 (2003): 656.

combat, occupation, or mere survival in these landscapes. Similarly, these laboratories and their specific environmental concerns were also inextricably part of a global geographical vision that saw the study of the Tropics placed alongside the Arctic, or the differentiation of culture from nature, as perfectly reasonable. Inside such laboratories, Frederick Simpich reported in "Fit to Fight Anywhere," "engineers make whatever kind of weather they want," and soldiers participating in climatic experiments "learn it can be as hard to fight the elements as to fight the enemy."[106]

In the 1960 Natick conference on military approaches to northern climates, the army's Arthur Trudeau stated that the "scope of our program is as broad as man's imagination, for our primary purpose is in the soldier and what it takes to sustain him in any hostile environment."[107] This breadth was global – even, by this time, extraterrestrial – but the masculine imagination gestured to by Trudeau was also thoroughly American. And his global view was built on the back of specific regional histories and geographies, even if these had been turned into categorical or simplified scientific vessels.

"During the 20th Century alone," Lieutenant General James Peake, the army's surgeon general, wrote in the foreword to a three-volume 2001 study titled *Medical Aspects of Harsh Environments*:

> US Armed Forces have been involved in terrestrial military operations in hot climates in the North African campaign and Pacific theater operations during World War II, the Vietnam and Persian Gulf Wars, and military and humanitarian operations in Panama, Haiti, Grenada, Rwanda, and Somalia. Our major military operations involving cold climates during the past century include World War I and World War II, the Korean War, and most recently in Bosnia and Kosovo.[108]

This list of locations signifies more than a series of campaigns; it contains many of the century's historical signposts. If the idea of nature and human relationships with nature are central themes in the study of environmental history, it is crucial that we consider military perspectives on these subjects – the history, in other words, of wars on geography. Recent revelations of toxicity at Natick and accusations of exploitation in Alaska suggest, moreover, that the environmental history of the Cold War can be an immensely relevant subject for a more critical generation of scholars concerned not just with the natural dimensions of military geography but also with the folding

106 Simpich, "Fit to Fight Anywhere," 244, 245.
107 Trudeau, "Significance of Research and Development in the Arctic," 8.
108 Lieutenant General James B. Peake, "Foreword," in Pandolf and Burr, *Medical Aspects of Harsh Environments*, 1:xi.

of nature into militarism's geographies.[109] It is entirely appropriate, then, that much of this history has emerged, reflexively, from laboratories and the climates created within.

109 See Rachel Woodward, "From Military Geography to Militarism's Geographies: Disciplinary Engagements with the Geographies of Militarism and Military Activities," *Progress in Human Geography* 29, no. 6 (2005): 718–40.

3

A Global Contamination Zone

Early Cold War Planning for Environmental Warfare

JACOB DARWIN HAMBLIN

Vannevar Bush, the American engineer who dominated government scientific research in the 1940s, once mused that there was something in man that made him hesitate about poisoning or spreading diseases in humans, cattle, or crops. Even Hitler had refrained from it, Bush said in his 1949 book *Modern Arms and Free Men*. Whatever the reason, he wrote, "somewhere deep in the race there is an ancient motivation that makes men draw back when a means of warfare of this sort is proposed."[1] The chapter in which he wrote this dealt in particular with two strange methods of warfare, biological and radiological. Both of these promised to harm one's enemies indirectly through contaminated land, water, or entire ecosystems, and both have since fallen under various rubrics, including weapons of mass destruction and environmental warfare.[2] Bush was intimately familiar with the latest developments on them; he wrote the book while serving as chair of the National Military Establishment's Research and Development Board, which liaised with the Joint Chiefs of Staff (JCS) on military matters related to science and technology. He suggested in his book that few military men took biological weapons seriously, that relatively little money was spent on them, and that scientists shied from involvement in developing such weapons, all because of this innate human reaction against them.[3] Since that time, the general public's antipathy toward biological weapons in particular and toward any kind of modification of the environment for purposes of war

1 Vannevar Bush, *Modern Arms and Free Men: A Discussion of the Role of Science in Preserving Democracy* (New York, 1949), 147.

2 Weapons of mass destruction are more widely known. The term *environmental warfare* denotes the manipulation of the environment for hostile purposes and has come to include many variants beyond the manipulations of the biosphere discussed in this chapter; manipulations of space and/or celestial bodies, the atmosphere, the lithosphere, and the hydrosphere also fall into the category of environmental warfare. See Arthur H. Westing, ed., *Environmental Warfare: A Technical, Legal and Policy Appraisal* (London, 1984).

3 Bush, *Modern Arms and Free Men*, 142–7.

has been borne out by international conventions such as the Biological and Toxin Weapons Convention of 1972 and the Environmental Modification Convention of 1977.

Despite Bush's comments and subsequent developments, studies in the strategic uses of biological and radiological warfare were pursued vigorously by the United States after World War II, partly in collaboration with Canada and the United Kingdom.[4] Most of the scholarly attention toward this research has dealt with biological weapons, and to some extent, the literature has been in the category of exposé, i.e., attempts to uncover actual use of such weapons or suggestively to call attention to the extent of research.[5] Other works deal with contemporary policy issues, with brief attention to the origins of the research. Historical analyses are few and either focus on work during World War II or jump right into specific controversies of the 1950s and 1960s.[6] The present essay carves out a small piece of this story, the United States in the late 1940s, to examine scientists and strategic planners at the dawn of the Cold War. These years are particularly intriguing for a couple of reasons. First, military planners expecting an imminent war with the Soviet Union felt that the war was unlikely to be one in which atomic bombs could prove decisive; the United States did not yet have enough of them, the Soviet Union had not developed them at all, and rocket delivery systems were still a dream of the future. The war to come was likely to

4 The tripartite (U.S., U.K., Canada) collaboration on chemical, biological, and radiological weapons is inventoried and discussed in Gradon Carter and Graham S. Pearson, "North Atlantic Chemical and Biological Research Collaboration: 1916–1995," *Journal of Strategic Studies* 19, no. 1 (1996): 74–103. On the U.K. program, see Brian Balmer, *Britain and Biological Warfare: Expert Advice and Science Policy, 1930–65* (New York, 2001); and Balmer, "Killing 'Without the Distressing Preliminaries': Scientists' Defence of the British Biological Warfare Programme," *Minerva* 40, no. 1 (2002): 57–75.

5 The question of use during the Korean War has provoked the most controversy and has received the most attention. One book that attempts to prove that the United States secretly experimented with biological weapons during the conflict is Stephen L. Endicott and Edward Hagerman, *The United States and Biological Warfare: Secrets from the Early Cold War and Korea* (Bloomington, Ind., 1998). Another book, focused on revelations of secrets, is Seymour M. Hersh, *Chemical and Biological Warfare: America's Hidden Arsenal* (New York, 1968).

6 On World War II, see Barton J. Bernstein, "America's Biological Warfare Program in the Second World War," *Journal of Strategic Studies* 11, no. 3 (1988): 292–317. On the postwar period, for a multiauthored history with thematic chapters devoted to individual countries' programs, allegations of use, terrorism, and other subjects, see Mark Wheelis, Lajos Rózsa, and Malcolm Dando, eds., *Deadly Cultures: Biological Weapons since 1945* (Cambridge, Mass., 2006). For a single-authored account of biological weapons throughout the twentieth century, see Jeanne Guillemin, *Biological Weapons: From the Invention of State-Sponsored Programs to Contemporary Bioterrorism* (New York, 2005). For a thorough analysis of specific pathogens and of the links between prewar and postwar research, see Gerard James Fitzgerald, "From Prevention to Infection: Intramural Aerobiology, Biomedical Technology, and the Origins of Biological Warfare Research in the United States, 1910–1955," Ph.D. diss., Carnegie Mellon University, 2003. Also see George W. Christopher, Theodore J. Cieslak, Julie A. Pavlin, and Edward M. Eitzen Jr., "Biological Warfare: A Historical Perspective," in *Biological Weapons: Limiting the Threat*, ed. Joshua Lederberg (Cambridge, Mass., 1999). A significant historical background on anticrop weapons is included in Simon M. Whitby, *Biological Warfare against Crops* (London, 2002).

be a long total war, as the last had been, and each potentiality had to be considered. Second, these were years of significant reorientation within the corridors of power in the United States – the air force was born; the navy revolted against major budget cuts; the entire military establishment was reorganized; and civilian scientists from the war years (like Bush) wielded unprecedented influence in strategic planning. Many of the conflicts during this period revolved around control of weapons systems and clashes of ideas about how to fight a war.[7] In this historical context, how did they envision the coming confrontation with the Soviet Union, and what role would environmental manipulation and contamination play in that conflict?

Bush's portrait of reluctant American scientists and military leaders, restrained by their abhorrence for this kind of warfare, understates the extent to which the strategic and tactical potential of massive environmental contamination gripped the imagination of the defense establishment during the early years of the Cold War. Radiological and biological weapons attracted not only those wanting cheap yet lethal weapons on a grand scale but also those who believed that the Soviets already possessed them. It is true that some military leaders during World War II, such as Admiral William Leahy, found biological weapons repugnant to Christian ethics;[8] and to be sure, American incorporation of these weapons into war plans was slow, developing only fitfully before the 1950s. But this slowness had little to do with deliberate moral choice and much more to do with the chaotic administrative and political milieu within the defense establishment in the late 1940s. This kind of warfare provoked big questions, certainly, but not exclusively ones of morality; rather, much more practical questions about the future slowed the development of biological and radiological weapons. For every incentive in pushing forward with these weapons, there were potential unpleasant consequences: a rival gaining control of the weapon system, the civilian technocrats second-guessing military policies, political ammunition for the world government movement, and the alienation of key geopolitical allies. There were numerous efforts to integrate radiological and biological, and some new chemical, weapons into war plans, even to develop a unitary strategic concept for them. But the real desire to capitalize on the potentiality of these weapons – or as Bush termed them,

7 On reorganization, see Anna Kasten Nelson, "President Truman and the Evolution of the National Security Council," *Journal of American History* 72, no. 2 (1985): 360–78. On the navy's problems, see Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945–1950* (Washington, D.C., 1994). There are many works written about scientists' postwar roles; on Bush in particular, see G. Pascal Zachary, *Endless Frontier: Vannevar Bush, Engineer of the American Century* (Cambridge, Mass., 1999).

8 Bernstein, "America's Biological Warfare Program," 304.

instrumentalities – was tempered by the negative institutional and political consequences of developing them to their full potential.

RADIOACTIVITY AND THE FUTURE OF WAR

Of the kinds of warfare mentioned above, radiological warfare has been least analyzed by historians.[9] Radiological weapons are not atomic bombs; they can be any kind of device – such as an explosive or spray – that utilizes the highly toxic material from the fission of uranium and/or waste products from the processing of plutonium. Today, they sometimes are called "dirty bombs."[10] These were an early candidate for a decisive weapon system based on environmental contamination, either to prevent troop movement or to attack enemy crops and water supplies.

The use of radioactivity in warfare worried American military planners as early as World War II. General Leslie Groves, the military head of the Manhattan Project, later pointed out that some scientists had believed that radioactive warfare was militarily more significant than the bomb, because a nation could produce the necessary materials without having to build a deliverable fission explosive. In a December 1941 report titled "Radioactive Poisons," the physicists Eugene Wigner and Henry DeWolf Smyth suggested a research program on the subject, so Groves solicited the advice of James Bryant Conant, the president of Harvard University and chair of the National Defense Research Committee. Eventually, both Conant and Groves concluded that offensive use of radioactivity by the enemy would be unlikely because of insufficient material and the inability to deliver it by aircraft.[11] However, such weapons could be used defensively far more easily – for example, by contaminating land from which one's own army had retreated. As the United States planned the invasion of Normandy, this loomed as a disturbing possibility, and in 1943, a Manhattan Project scientist compiled a report on the possible hazards and effects. The principles laid down were used to plan Operation Peppermint, devised as a response to

9 One can run across references to it while looking into other topics, such as biological effects of radiation and/or nuclear fallout, research labs, and (in the case of the present author) radioactive waste. See Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947–1974* (Berkeley, Calif., 1994); Peter J. Westwick, *The National Labs: Science in an American System, 1947–1974* (Cambridge, Mass., 2003); Jacob Darwin Hamblin, *Poison in the Well: Scientists and Radioactive Waste at Sea at the Dawn of the Nuclear Age* (New Brunswick, N.J., forthcoming).

10 A fact sheet about dirty bombs from the Nuclear Regulatory Commission can be found at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/dirty-bombs.html.

11 "Background History," Feb. 15, 1948, attached to L. R. Groves to Joint Chiefs of Staff, Feb. 15, 1948, National Archives and Records Administration (NARA) RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

German use of radioactive weapons against Allied troops.[12] This entailed the manufacture of portable ion-chamber survey meters for troops to detect gamma radiation. Ultimately, however, the Germans did not contaminate the countryside as some Americans had imagined they would.[13]

A number of scientists who had worked on military projects during World War II came to see radiological warfare – not merely atomic bombs – as the environmental weapon of the future. One of these scientists was Joseph G. Hamilton, a researcher at the Radiation Laboratory at the University of California, Berkeley. Under contract with the Manhattan Project, Hamilton conducted experiments on patients without their consent, including injections of plutonium.[14] Such experiments continued during the Cold War, providing the data for studies of radiation effects on humans. After the war, two of Hamilton's colleagues, the soil chemist Roy Overstreet and the plant biochemist Louis Jacobson, promoted the study of radioactive warfare against crops. They wrote to Hamilton in November 1946 about their "belief that one very ominous phase of atomic warfare has not been fully anticipated and has not been given the thorough investigation it requires." On the basis of some small-scale experiments conducted at Berkeley, they predicted that fission products could likely be used to make agricultural land barren.[15] They poured solutions of fission elements into soil columns and discovered that most of the radioactivity remained in the first few millimeters. These upper layers held the radioactive material so tenaciously that Overstreet and Jacobson concluded that it would not sink down by water leeching – and indeed even their efforts to remove the radioactive material efficiently with chemical reagents failed. However, barley plant roots absorbed it quite easily. After a certain degree of concentration, this process proved toxic to the plant.[16]

12 The report was A. V. Peterson, "Manual on Use of Radioactive Materials in Warfare." See "Background History," Feb. 15, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

13 Images of the portable Victoreen Model 247A ion chamber, developed in the war, can be found at the Oak Ridge Associated Universities Web site, at http://www.orau.org/ptp/collection/surveymeters/vic247a.htm.

14 These studies initially were conducted on rats. The human work continued after the war, and Hamilton requested further supplies of plutonium to be used in human studies. Only in December 1946, just before turning over its activities to the newly created Atomic Energy Commission, did the district call a halt to the experiments. Colonel Kenneth D. Nichols said as much in a memorandum, pointing out that human experimentation was neither to be recommended nor interpreted as within the bounds of contract 48-A. However, the studies would be resumed under the AEC in 1947. U.S. Department of Energy, Advisory Committee on Human Radiation Experiments, Final Report, available at http://www.eh.doe.gov/ohre/roadmap/achre/report.html. See chapter 5.

15 R. Overstreet and L. Jacobson to Joseph G. Hamilton, Nov. 11, 1946, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

16 Ibid.

As a means to interfere with an enemy's agriculture, this seemed most promising. After dropping radioactive material onto soil, the fission products would be taken up by plant roots. Even if the plants themselves were not killed, the amount of cesium and strontium they absorbed would transform life-giving, economy-sustaining staple crops into fields of poisonous weeds. One of Overstreet and Jacobson's more suggestive remarks was that the operations at the government's nuclear works at Hanford, Washington, had already produced many megacuries of long-lived radioactive waste, which presently had to be collected and stored safely. "This takes on an added significance," they pointed out, "when one reflects that the widespread distribution of one megacurie of long-lived activity such as Sr^{90} or Cs^{137} may be ample for the destruction of some 250,000 acres of agricultural land for a period of years."[17] It seemed possible to create a powerful weapon cheaply simply by taking out the trash – converting radioactive waste into radioactive weapons.

Overstreet and Jacobson's findings prompted Hamilton and others to speculate on a future in which friendly and enemy food supplies could be contaminated easily. It did not take long to consider even more direct effects on humans. Hamilton took news of these experiments to Colonel Kenneth Nichols at the Manhattan Engineering District. Simultaneously alarmed and brimming with enthusiasm, he wrote of the promising use of "radioactive warfare" against large concentrations of people. Radioactive agents seemed novel in several respects: they could be used in small quantities; they could not be detected by touch, smell, or taste; damage was both acute and chronic, killing some people immediately but causing the decline of others over time; effects could be long lasting; and the process of decontamination would be difficult if not impossible. In addition, the creation of lethal topsoil could prove a "most ominous complication" for humans. Rain and melting snow would wash some of it away, transporting it into creeks and rivers, and then possibly on to major population centers built around major waterways.[18] He strongly urged the armed services to study "the full potentiality of such an agent," as a protection against its possible use by an enemy.[19]

Partly because of the wartime human radiation experiments, Hamilton had a fair grasp of the internal and external effects of fission products on the body, and he had already developed some ideas about how this kind of warfare could target cities. He guessed that if radioactive materials could be

17 Ibid.

18 Joseph G. Hamilton to Colonel K. D. Nichols, Dec. 31, 1946, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

19 Ibid.

spread efficiently, they would create large areas where mortal injury to lungs and bones could be expected. Already the technology existed to make this happen. Radioactive aerosols were used in experiments on the respiratory effects of inhalation by animals. These could be combined with conventional smoke-producing agents designed to obscure ships and troop movements. "Such a type of preparation would appear well adapted," Hamilton wrote, "for producing fission product aerosols to subject urban populations to fission product poisoning by inhalation." And once accomplished, as scientists had learned during Operation Crossroads, a 1946 Pacific Ocean atomic test, exposed structures were nearly impossible to decontaminate.[20]

Hamilton speculated about future military tactics in which the natural and built world would become a radioactive minefield. A bridge, a canal, a road, a mountain pass – all might become targets to prevent the effective movements of armies. Aerosol sprays might, without a shot being fired, render a military base inaccessible and thus unusable. The economic strength of a nation could be sapped by the contamination of railways, shipyards, docks, power plants, factories, and mills. The right mix of fission products with short half-lives might have the advantage of minimizing the destruction of economically important infrastructure, which could then be captured and utilized.[21]

Hamilton had written these reflections on the last day of the Manhattan Engineering District's control of atomic matters, December 31, 1946. The following month, the Atomic Energy Commission (AEC) came into existence, and another body, the Military Liaison Committee, was set up as an interface between the new AEC and the armed services. Nichols wrote to the chair of that committee that the "extensive data" collected in recent years during the Manhattan Project had provided ample evidence to suggest military applications of fission products. He suggested that "the entire problem should be the subject of a comprehensive attack; and that the military services have a vital interest in such a program."[22]

Some military officials, particularly in the army, did not require much convincing. The chief of the Army Chemical Corps, Major General Alden H. Waitt, recommended to the War Department two weeks later that the AEC should start working on such a project right away.[23] For Waitt, this was an obvious course of action. As waste, fission materials were troublesome;

20 Ibid.

21 Ibid.

22 K. D. Nichols to Chairman, Military Liaison Committee, Jan. 24, 1947, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

23 Alden H. Waitt to Director, Research and Development Division, War Department General Staff, Feb. 7, 1947, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

as war materials, they were "potentially far more toxic than most of the agents which have heretofore been developed." He was intrigued by a line in the Smyth Report – the official administrative history of the atomic bomb project, authored by Henry DeWolf Smyth, that was published less than a week after the bombings of Hiroshima and Nagasaki. The line read: "the fission products produced in one day's run of a 100,000 kw chain-reacting pile might be sufficient to make a large area uninhabitable." Thus far, Waitt pointed out, no practical studies had been made by the military "for obtaining such results." Waitt saw the passage from the Smyth Report as a desired outcome by a potential future weapon. He wanted research to be made relevant to weapons production and suggested a program to devise munitions tailored to employing fission products.[24]

None of the foregoing suggests moral restraint on the part of civilian research scientists or military officials, as Bush suggested. Given their enthusiasm, then, how should one explain the failure to develop these weapons and integrate them into strategic plans? For one, the leading scientists in government came to an opposite conclusion, creating ambiguity where previously there had been a clear trajectory for action. It was the civilians on the Joint Research and Development Board, particularly Bush, the chair, and James Conant, the chair of its committee on atomic energy, who put a damper on the enthusiasm for immediate development of offensive weapons in radioactive warfare. Their attitudes were carryovers from the Manhattan Project, during which they had played down the relevance of radioactive weapons, and now they were reluctant to reverse their position. They now decided that various disadvantages – such as the scarcity of materials and the relative ineffectiveness of them – made the initiation of specific projects seem premature. But as a research and development problem it seemed promising. Bush therefore recommended handing it over to the Armed Forces Special Weapons Project (AFSWP), the new army-navy organization that inherited the remaining military responsibilities for atomic energy after the creation of the AEC in 1947.[25]

In fact, both the AFSWP and the AEC initiated research projects on military uses of radioactive material toward the end of 1947 – sometimes

24 War Department, Office of the Chief, Chemical Corps, "Project: Radioactive Materials for Military Purposes," n.d. [forwarded with letter dated Feb. 7, 1947], NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

25 J. B. Conant to Joint Research and Development Board, July 30, 1947, NARA RG 218, Central Decimal File, 1948–1950, box 206, Folder 5a; V. Bush to Chief, Armed Services Special Weapons Project, Oct. 14, 1947, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5. On AFSWP, see Defense Threat Reduction Agency, U.S. Department of Defense, *Defense's Nuclear Agency, 1947–1997* (Washington, D.C., 1997), chap. 1.

using the term *radiological warfare* instead of *radioactive warfare*. This was a period of bitter struggle for control of atomic energy, with the military losing out to the new civilian-dominated AEC. The AFSWP briefly became a fiefdom of Major General Leslie Groves, who moved quickly to initiate military-run studies with the cooperation of high-level civilian scientists, as he had done during the war. He discussed the plans verbally with AEC officials, and they agreed to support a program of research, coordinated by six AFSWP members working under a thick veil of secrecy.[26] In the meantime, however, the AEC also initiated its own civilian-run project at Los Alamos while congratulating Groves on his "wise decision." Both sides promised to keep the other well informed of any developments.[27] This duplication of effort undoubtedly reflected differing views about responsibility for weapons research between civilian and military groups; perhaps both sides saw that this line of inquiry might open a new avenue for control and influence, and neither wanted to leave it to the other.

This wrangling for influence not only kept the development of radiological weapons an open question but also led to disagreements about how – if at all – to integrate environmental contamination into war planning. Ultimately, a number of civilian scientists who advised both the AEC's Military Application Division and AFSWP's group effectively reversed the wartime conclusions of Bush and Conant. They believed that this kind of contamination-based warfare could prove decisive. One report by Paul Aebersold, W. S. Hutchinson, Karl Z. Morgan, and M. D. Peterson identified polonium, dangerous only when inside the body, as an especially promising candidate: it was "difficult to detect, insidious in its nature, practically impossible to decontaminate or defend against," and it was easily manufactured in large quantities by fission. They recommended it for strategic attack on vital population centers or as a sabotage weapon.[28] The eminent mathematician John von Neumann advised the AEC in 1947 on the advantages of radioactive weapons, emphasizing that they could be fashioned to any size, unlike atomic bombs. "In a continuing war," he pointed out during one meeting, "a country which has solved the problem of making plutonium but not the atomic bomb has at that time a military

26 L. R. Groves to Atomic Energy Commission, Dec 8., 1947, NARA RG 218, Central Decimal File, 19481950, Box 206, Folder 5a. The AFSWP members were Captain Frank I. Winant Jr. (navy), Colonel Robert N. Isbell (army), Lieutenant Colonel Karl H. Houghton (army), Major William W. Stone Jr. (army), Dr. Herbert Scoville Jr., and Rosemary T. Porter (USNR).

27 Carroll L. Wilson to Major General Leslie R. Groves, Dec. 24, 1947, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

28 This report, "An Estimation of the Feasibility of Radiological Warfare," May 1947, is quoted in "Background History," Feb. 15, 1948, attached to L. R. Groves to Joint Chiefs of Staff, Feb. 15, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

potential . . . not very different from one who cannot only make plutonium but can also produce a nuclear explosion." Thus, von Neumann argued, a strong nation needed reactors but not necessarily bombs. He calculated that the materials generated from making the Nagasaki bomb could lethally contaminate 6.4 square miles, whereas the bomb itself had produced an "important damage area" of only about 3 square miles. This difference could be increased if more attention were paid to putting waste products to efficient use. All of this would be especially pertinent in a long-term war because stockpiling such weapons, with their short half-lives, would not be effective.[29]

These estimates spurred more interest in radiological warfare, but still no single agency gained control of it. One consequence was that much of the research for it was conducted on a catch-as-catch-can basis within bomb tests, which included most interested parties. Groves noted that Operation Sandstone, the planned atomic test on the Eniwetok Atoll in the Pacific, included participants from both the AEC and the AFSWP radioactive warfare groups. Those charged with keeping the test participants safe were also charged with analyzing the bomb's biological effects and the possible outcomes of being blanketed with nonbomb radioactive debris. Many of the personnel film badges used to record radiation exposure, for example, were intended not as safety monitoring devices but as research tools.[30] "Experiments related to radioactive warfare are being carried out in Operation Sandstone," Groves pointed out; much of the relevant work fit under the rubrics of instrumentation, protective devices, and medical effects.[31] Despite this research, however, there was no single group conducting a concerted, well-directed effort toward development.

ABSOLUTE WEAPONS

The preliminary work on radiological warfare complemented a growing body of recent studies of biological warfare, also devised to harm people directly or indirectly on a large scale. The United States had pursued this secretly during the war, and in 1946, it issued a public report by George W. Merck, who had headed the work. Merck was the president of the American pharmaceutical giant Merck and Company. This report was soon joined

29 Von Neumann is quoted in "Background History," ibid.

30 On the radiation protection group during Operation Sandstone, see Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947–1974* (Berkeley, Calif., 1994), chap. 1.

31 L. R. Groves to Joint Chiefs of Staff, Feb. 15, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5.

by an article in the *Journal of Immunology* by the bacteriologist Theodor Rosebury and his colleagues summarizing some of the prewar work – this was later expanded into the 1949 book *Peace or Pestilence*.[32] Behind the public documents was a robust and more organized program than the ones related to radiological warfare. Still, biological warfare also was impeded by rivalries and institutional roadblocks.

The Joint Chiefs of Staff were far from certain how to incorporate the possibly radical changes in warfare brought about by atomic bombs and biological weapons. Much of their thinking was distilled in a 1947 classified paper titled "Estimate of the Effect on the Nature of War of Future Technical Developments in Weapons," which attempted to look at the face of war ten years ahead. The paper projected a future in which rockets would deliver atomic bombs, submarines would not need to resurface for air, tanks and infantry would be more mobile and possess more reliable equipment, and fighter planes would break the speed of sound. But it also warned of the tendency to jump too far into the future, without diligent attention to present capabilities. After all, "we must not allow ourselves to think that the era of 'push-button' or 'Buck Rogers' warfare has arrived or that it is likely to arrive in the next ten years." The United States should not devote so many resources to future weapons, the document warned, that it finds itself incapable of fighting an unexpected war.[33]

Interservice rivalry and uncertainty about the future of the military both played important roles in constraining the incorporation of atomic and biological weapons into strategic plans. Probably the Buck Rogers comment reflected sensitivity by the navy of a tendency toward exuberance on the part of the newly formed air force. Indeed, over the next couple of years, the navy would be fighting the efforts of the air force to monopolize aviation and to focus on strategic bombing as the cornerstone of American military strategy. The head of the JCS at that time was Leahy, who already had pointed out the immorality of attacking crops with biological and chemical weapons. Yet he did not take a strong moral stand here; perhaps he and others saw an opportunity to ensure the importance of the navy. Under Leahy, the

32 George W. Merck, "Report to the Secretary of War on Biological Warfare," *Bulletin of the Atomic Scientists* 2, no. 16 (1946); T. Rosebury, E. A. Kabat, and M. H. Boldt, "Bacterial Warfare," *Journal of Immunology* 56, no. 7 (1947); Theodor Rosebury, *Peace or Pestilence: Biological Warfare and How to Avoid It* (New York, 1949).

33 "Estimate of the Effect on the Nature of War of Future Technical Developments in Weapons." This document, though classified "restricted," was a version of another higher-classification paper with more sensitive information deleted. No author or date, attached to (and explained in) Fleet Admiral William D. Leahy, memorandum to the Secretary of War and Secretary of the Navy, June 14, 1947, NARA RG 218, Central Decimal File 1948–50, Box 207, Folder "Future Technical Development of New Weapons."

JCS played down strategic atomic bombing, stating that no other nation was likely to have more than a few atomic bombs available for use in the next ten years. And the possibility of their strategic use with long-range rockets was still a distant one. The JCS tried to make the navy seem more relevant to immediate needs, pointing out that submarine-launched rockets could seriously harass American coasts and, if loaded with radioactive materials, could disperse lethal doses onto American cities without need for a bomb at all. Biological weapons were named second after atomic bombs as the weapons developments likely to have an impact on the nature of war. The full potential of such weapons were not known, but "the possibility and, in fact, the probability of biological warfare being extremely effective cannot be ruled out."[34]

As in World War II, the JCS expected the next war to be a total war requiring the participation of every life and drawing upon the nation's industries running at full capacity. As scholars of this concept have argued, total war meant that every person was a combatant, soldier and civilian alike, each a participant in the clash of whole societies, not merely the clash of armies. Total war enlisted all the industrial, human, and technological power of one civilization against another.[35] Weapons of biological annihilation embodied total war thinking, as the environmental historian Edmund Russell has argued regarding chemical weapons, because they implicitly targeted civilians and were seen as tools of extermination.[36] But whereas chemical weapons were deemed most useful in tactical situations, radiological and biological warfare had large-scale strategic potential against people, industry, and agriculture. The JCS expected the era of new weapons to consolidate and extend such total war thinking. "The civil population of the United States," they wrote, "will be drawn much more closely into war of the future than ever before." The underlying assumption was that "the most profitable targets for attack by new weapons" would be the vital areas of industry, military power, communication, and population. Direct attacks on the American industrial system and population (i.e., cities) should be expected.[37] If this were so, the methods of warfare that

34 Ibid.

35 There is considerable literature on the concept of total war; some see origins in the wars of the French revolution, but others have analyzed it in particular regard to the American Civil War and the world wars. See Peter Paret, ed., *Makers of Modern Strategy: From Machiavelli to the Nuclear Age* (Princeton, N.J., 1986).

36 Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (New York, 2001).

37 "Estimate of the Effect on the Nature of War of Future Technical Developments in Weapons." No author or date, attached to Fleet Admiral William D. Leahy, memorandum to the Secretary of War and Secretary of the Navy, June 14, 1947, NARA RG 218, Central Decimal File 1948–50, Box 207, Folder "Future Technical Development of New Weapons."

maximized the death of large numbers of people would prove more decisive than the kinds of weapons that proved tactically advantageous on the battlefield.

Once again, radiological and biological weapons appeared to have a role in the United States' strategic vision, and environmental contamination seemed poised to play an important part in war planning. However, they proved more problematic than atomic bombs amid the tensions of the Cold War, despite frequent arguments that they were more humane. The mere existence of these kinds of weapons began to work against the Truman administration, further complicating their development. Rosebury's article and subsequent book on biological weapons, for example, became headaches for the government. This was not because Rosebury had written a critical exposé, but because the government held to a policy of silence. This became very difficult to justify once Rosebury's work was in the public domain. His book was very explicit about its chronological cutoff point – prior to his participating in the secret wartime work – but one of his chapters was tantalizingly entitled "How Much Can Be Told?" clearly implying that the United States continued to work on such subjects.[38] So the policy of silence became somewhat ridiculous and even counterproductive. Robert W. Berry, assistant to the secretary of defense, had pointed this out to the JCS in March 1948; because "the subject gets frequent and not always judicious discussion in the press," some public statements might help to exert greater control over how journalists treated it.[39]

One of these apparently injudicious treatments was an article that appeared toward the end of 1947 in *United Nations World* titled "Absolute Weapons . . . More Deadly Than the Atom." The author, retired Navy Rear Admiral Ellis M. Zacharias, pointed out that even the disavowal and destruction of atomic bombs would leave weapons in the arsenal that could wipe out mankind. These weapons he called chemical, biological, and "climatological," capable of exterminating not only humans but also all vestiges of animal and human life. He emphasized: "This is not a prediction of horrors to come. *These weapons exist.*" Several countries had them, and even countries incapable of atomic bombs could build them in the future. Rumors had it, he wrote, that the United States had not three major secret weapons projects (atomic, biological, and radiological) but perhaps four or five. Zacharias's sensational article observed that the Soviets were not idle in the face of American successes. He speculated that, in addition to exploring

38 See Rosebury, *Peace or Pestilence*, chap. 2.

39 Robert W. Berry to the Joint Chiefs of Staff, Mar. 1, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 5A.

rocket technology, they were pressing forward with an intensive project on the military applications of cosmic rays.[40]

For Zacharias, the distinctive character of these new "absolute weapons," when coupled with rocket technology, was that they would permit the waging of an intercontinental "push-button" war, and that the war's tactical nuances would be insignificant compared with the strategic goal of destroying lives and property on a massive scale. If the future indeed held this kind of conflict, even seemingly modern armaments like aircraft carriers, long-range bombers, incendiary bombs, and automatic heavy artillery "represent an era of warfare which will never again return." The wars of the future would be enormously destructive, with the landscape continuing to kill trespassing life long after the war itself. The postwar world would be one of quarantine, keeping healthy people out of contaminated areas and keeping infected people in them, with futile attempts to do the same with animals, insects, and vegetation. Zacharias's solution was to take the matter to the United Nations, to abolish these "absolute weapons."[41]

The appeal to international control provoked some to see the existence of such weapons as a potential hobbyhorse for global political agendas. Some were disdainful of its apocalyptic tone. Henry Geiger, whose journal of commentary *Manas* was then in its fourth issue, seethed about it as a prime example of the growing exploitation of fears as a springboard for political action, in this case for strong international organization.[42] The late 1940s saw considerable interest in the movement for world government, with its slogan "One World or None." The most famous advocate of this was the pacifist Albert Einstein, but others whose hands were more closely connected to fabricating weapons held such ideas as well. Harold Urey, no stranger to atomic bombs and other of Zacharias's "absolute weapons," wrote in favor of a "supra-government" and world citizenship in 1949.[43]

Another proponent of world government was the psychiatrist Brock Chisholm, the former Canadian deputy minister of health, and later the director general of the World Health Organization. In a September 1948 address at the annual meeting of the American Psychological Association, Chisholm also spoke of world citizenship. But he spoke of the disturbing fact that the old notion of competitive survival, long aided by science and

40 Rear Admiral Ellis M. Zacharias, "Absolute Weapons . . . More Deadly than the Atom," *United Nations World* (Nov. 1947): 13–15.

41 Ibid.

42 "Periodical: Random Notes," *Manas* 1, no. 4 (1948), 6.

43 Many of these ideas are contained in Morton Grodzins and Eugene Rabinowitch, *The Atomic Age: Scientists in National and World Affairs* (New York, 1963). See esp. Sergei Vavilov, A. N. Frumkin, A. F. Ioffe, and Nikolai Semenov, "On Albert Einstein's Support of World Government," 125–9; Albert Einstein, "Einstein Replies," 130–4; and Harold C. Urey, "The Paramount Problem: A Plea for World Government," 106–20.

technology, "has become synonymous with race suicide." His speech, published in *Science*, emphasized the importance of developing a consciousness of belonging to humanity rather than to any individual nation.[44] The term *race suicide* was not new; it had been employed for years by eugenicists worried about disproportionate breeding between Anglo-Saxon and other ethnic populations. But Chisholm used the term in reference to the entire human race, believing that the risk of damaging it severely or wiping it out completely was quite real.

Chisholm and others coupled the fear of fantastic new weapons with a "one world" solution. But casting these weapons in the language of global contamination – as a menace to all humankind, animals, and vegetation – deeply troubled some of the influential American scientists who thus far had dominated the nexus between science and the state. It also drove them back to defending their initial skepticism about the new weapons. One of these was Harvard president James Conant, who had the displeasure of giving a speech at the same venue as Chisholm on April 28, 1948, at the Waldorf-Astoria Hotel, for the Community Service Society of New York. He was astonished at what he heard Chisholm say and found it "truly alarming," as he wrote his friend Vannevar Bush the next day. Chisholm had made a categorical statement that there was no way that defensive warfare could catch up to the destructive possibilities already existing in offensive warfare; thus, the next war could mean the suicide of the human race. Conant was especially disturbed by Chisholm's decision to single out biological weapons as the culprit:

> The conclusions he drew in terms of education, cooperation, one world, etc. are not to the point. What disturbed me was his categoric statement about bacteriological warfare. It developed that it was not the atomic bomb, which he more or less pooh-poohed, but bacteriological warfare on which he based all his arguments.

Conant saw the political implications clearly when Chisholm's statement that no one should be elected to office except on the issue of survival of the human race met with loud applause by some twelve hundred people in the Waldorf Astoria.[45]

Conant pointed out to Bush that these ideas played directly into the hands of Henry A. Wallace, a critic of President Truman and third-party candidate in the 1948 campaign for the presidency. Wallace advocated for a more conciliatory posture toward the Soviet Union and criticized a variety of Cold War gestures on the part of the administration, such as the atomic

44 George Brock Chisholm, "Social Responsibility," *Science* 109, no. 2820 (1949): 27–30, 43.
45 James Conant to Vannevar Bush, Apr. 29, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

monopoly, the continuance of the military draft, and the growing rhetoric of containing communism.[46] The month before Chisholm's remarks, Truman had taken a hard line against Wallace, explicitly branding him and his supporters as communists. Aside from the election, the political context for this was the communist coup in Czechoslovakia and subsequent war scare of 1948, during which some believed a general war with the Soviet Union was imminent.[47] Whether they admitted it publicly or not, many influential Americans feared a biological conflict. For example, the director of the Rockefeller Foundation's Division of Natural Sciences, Warren Weaver, worried about giving grants to non-Americans conducting biological research: "Under the conditions of modern total war," he wrote a colleague, every element of science would be important to national security. With biological weapons, "food, drugs and many other things are as essential as are the special weapons designed by the physicists and engineers."[48]

In the midst of a war scare, here was Chisholm openly explaining what a total war would mean in a world that possessed biological weapons. Conant, never enamored of biological weapons but a firm believer in the importance of the atomic bomb in deterring Stalin, used the occasion to argue against secrecy. Biological weapons were not significant yet, he felt, and might never be – the public ought to know that. In the face of Chisholm's apocalyptic imagery, it was the government's responsibility to tell the American people whether he was right or wrong rather than just to allow speculation and fear to dominate. "At all events," he wrote, "unless this line of argument can be answered, all intelligence [*sic*] people will end by being on Mr. Wallace's side as far as armament and military policy are concerned." Conant believed that disarming on the part of the United States and efforts to conciliate the Soviet Union would be interpreted as a sign of weakness. He urged Bush to use his influence to organize a civilian panel to tell the truth to the American people. "To do otherwise is to play directly into the hands of Stalin and Molotov," he wrote. "Dr. Chisholm's arguments are worth a fifty-group air force to the Soviet rulers!"[49]

Conant's strongly worded warning reverberated through the military establishment. Bush wrote to Secretary of Defense James Forrestal that it

46 See Richard J. Walton, *Henry Wallace, Harry Truman, and the Cold War* (New York, 1976). On Truman's outlooks on containing communism, see John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of American National Security Policy during the Cold War* (New York, 1982).

47 See Robert A. Divine, "The Cold War and the Election of 1948," *Journal of American History* 59, no. 1 (1972): 90–110.

48 Weaver is quoted in John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (Cambridge, Mass., 2006), 123.

49 James Conant to Vannevar Bush, Apr. 29, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

was time for a public statement on biological warfare. Forrestal had suggested as much to the president two months earlier, along with a request that the United States formulate a definitive national policy, perhaps in conjunction with the United Kingdom. "The existing practice of complete silence which is our present policy on biological warfare has permitted public opinion to drift, impelled often by exaggerated bits of information, sometimes random and sometimes apparently directed, that come from non-official sources." Thus, public awareness was not yet based on a strong foundation of facts.[50] The truth was that no policy toward them existed at all. At the time, Bush's Research and Development Board had felt that making a statement might be premature. After Conant's letter, Bush was less sure and suggested that a statement might be made without the existence of a policy.[51]

The slowness of developing a policy was due, in part, to Bush's own reticence; but in addition, the Joint Chiefs of Staff had not resolved its own reservations and internal conflicts about the importance of environmental contamination. The JCS wanted to make a thorough comparison of the three kinds of contamination-based warfare, namely biological, radiological, and chemical, before committing to their firm incorporation into military planning. All three, as Captain W. G. Lalor put it, "had a similar potential in that they would be employed to contaminate areas for neutralization or mass casualty effect without material destruction."[52] Admiral Leahy, who headed the JCS, supported studies on biological warfare, protection against attack, and coordination of intelligence about other countries' activities.[53] But he and the JCS were still struggling with service responsibilities, technological systems, and other implications, including the question of whether to include biological warfare under the rubric of "weapons of mass destruction." Thus far they had deferred judgment and certainly were not ready for a national policy on their use.[54]

Bush believed that the slowness could be solved by an integrated look at all three methods of nonfission weapons of mass destruction – chemical, biological, and radiological (which he and others called CBR). Seeing the reluctance of military authorities "to view these methods of warfare in

50 James Forrestal to the President, Mar. 16, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

51 Vannevar Bush to James Forrestal, May 17, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

52 W. G. Lalor to Chairman, Research and Development Board, July 6, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

53 William D. Leahy to Secretary of Defense, July 7, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

54 James Forrestal to the President, Mar. 16, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 6.

proper perspective in the complex of weapons systems," Bush tried to offer some tentative conclusions about CBR in August 1948. They were based on admittedly shaky foundations. Radiological warfare had little reliable information to recommend it – it was "still a matter principally of speculative thinking rather than experimental exploration." Biological warfare had received far more attention, but quantitative results were fragmentary at best. Only in chemical warfare were the data reasonably well established, but even so, the newer munitions presented an array of uncertainties. The end result was that the importance of these methods had become a matter of "random conjecture and to 'sales' efforts in behalf of one kind of warfare or another," with no framework for formulating actual war plans.[55]

Although he pointed at the military for slowness, Bush also was largely to blame because he had resisted explicit policy formulation. But here was an opportunity to get his and Conant's ideas out into the open again. Conveniently, there was already a panel in existence, sponsored by the Army Chemical Corps, that dealt with chemical and biological warfare and another, a joint undertaking of the AEC and the National Military Establishment, concerned with radiological warfare. Both were headed by the same man, W. A. Noyes, and Bush asked him to combine the groups so that their final product would report on the whole, integrated potential of all three kinds of warfare.[56] Ultimately, the Noyes group put a damper on the expectations for radiological warfare. Despite concluding that a radiological warfare program was essential, it stated that radiological weapons would not revolutionize war or even prove decisive in a large-scale conflict. Contamination of an area to prevent troop movements was not feasible; at least 50 percent death rate would be needed for psychological effect. Serious contamination was still possible, but offensive capabilities were at least two years away, and this would mean careful selection of just a few targets.[57]

With this information in hand, government consensus appeared to return to the skepticism favored by Bush and Conant during the war. This conclusion acted as a political salve at a time when fear of biological weapons was high. Forrestal was prepared to make a public statement to diffuse the public hubbub over these superweapons. The public statement did not occur in time for the election, but instead was issued in March 1949, just

55 Vannevar Bush to Joint Chiefs of Staff, Aug. 17, 1948, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 7.
56 Ibid.
57 Rainbow Team to Major General Alfred M. Gruenther, Jan. 7, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 7.

before Truman replaced Forrestal as secretary of defense. Because most of the apprehensions had been related to biological warfare, Forrestal addressed the issue head-on. "Biological warfare," he stated, "is an attempt to harness certain forces of nature for purposes of war." By this, he meant disease, to be used against the enemy's people, livestock, and crops. He pointed out that the armed forces of any democratic nation had the responsibility of informing the public of their activities, as long as it was consistent with national security. The Merck Report had been the first effort to do that, but it had sparked discussions that were "extravagant, inaccurate, and unduly spectacular in the light of present scientific knowledge." There were some specific impressions Forrestal hoped to correct:

> For example, it has been stated that a single plane with a small bomb filled with a biological agent would be capable of wiping out the population of an entire city with a single blow. . . . [I]n a recent article it was stated that one ounce of a particular biological material would be sufficient to kill 200,000,000 people. . . . One article stated that biological warfare makes it possible to kill the inhabitants of an entire continent very quickly. . . . Such claims are fantastic and have no basis in fact.

Forrestal went on to say that it would be folly to underestimate the potential of biological weapons, but presently there was no reason to make extravagant claims about the use of superweapons to spread diseases at will.[58]

Ironically, this effort to dispel fantastical rumors piqued the interest of those within government who believed that the rumors would not be so far off the mark if the weapons were more fully explored. As before, the views of Bush and Conant did not represent true consensus. A few days after making this statement, Forrestal appointed his own ad hoc committee, chaired by the entomologist Caryl Haskins, to examine the whole problem of biological warfare. The committee included leading civilian and military figures, such as Alfred L. Loomis and Alden H. Waitt. Forrestal originally had planned to limit their task to unconventional uses, such as sabotage; however, Forrestal wrote to Haskins, "I now believe that we should avail ourselves of this opportunity to undertake a full examination of all the technical and strategic possibilities of biological warfare." He encouraged the committee to be "highly imaginative" but realistic, taking into account all political, economic, and strategic implications.[59]

58 National Military Establishment, Office of the Secretary of Defense, "Secretary Forrestal Issues Statement on Biological Warfare Capabilities," press release, Mar. 12, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 8.

59 Secretary of Defense to Caryl Haskins, Mar. 16, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 8.

When Forrestal's successor, Louis Johnson, received the report, he found that a new concept had been created. Under Haskins's leadership, the committee had determined that all of these new weapons – unlike atomic bombs – had one thing in common; namely, their primary goal was to kill or cause disease in living organisms. "Radiological weapons and some of the newer chemical weapons," the committee reported, "are essentially 'biological' in effect and closely resemble biological weapons in the importance of their future capabilities and in respect to strategic employment, defensive requirements, and public relations." The committee thus invented a unitary concept – CEBAR (chemical, biological, and radiological) – that blended the three "as a new entity in national defense planning." These were the silent weapons, directed exclusively against man – directly as a biological entity or indirectly by diminishing humans' food and other living resources.[60]

In another about-face on the importance of environmental contamination, the Haskins group effectively reversed the tone of the Noyes committee and challenged reservations about incorporating CEBAR into military planning. In contrast with Forrestal's public statement playing down the likelihood of spreading epidemic diseases, the group pointed out that the foreseeable improvements would increase the potency of biological agents to a very large degree; indeed, they stated that the biological and medical fields were on the threshold of great advances comparable to atomic fission in physics, including the ability to spread epidemics or set off "other biological 'chain-reactions.'" This term was employed to reflect a parallel to atomic bombs, to be sure, but it also hinted at ecologic vulnerability – indirect causes and effects through the food chain. Although it was true that human epidemics were currently beyond their grasp, they explicitly stated that epidemics were quite possible in plants and animals, without any new knowledge. Thus, the present rudimentary state of knowledge should not impede the integration of CEBAR into national planning. These weapons' usefulness – in military operations, foreign affairs, economic policies, psychological warfare, "and perhaps even other more subtle applications of national power, can be as important as bold and imaginative planning sees fit to make it." The JCS thus far had seen the insufficient understanding of CEBAR as a reason to avoid integrating it into strategic plans. Haskins and his colleagues disagreed, recommending that strategic planning with CEBAR in mind should be undertaken without any further delay.[61]

60 Ad Hoc Committee on Biological Warfare of the Department of Defense, report, July 11, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 8.
61 Ibid.

"THE MOST CRUEL, DIABOLICAL WEAPONS OF MASS DESTRUCTION"

With this single foot forward, the Haskins group also acknowledged a possible reason to take two steps back. In his committee's report to the secretary of defense, Haskins pointed out that the United States needed to be very careful about the international implications of CEBAR weapons. The government already had implied, by referring in 1945 to atomic bombs and "other weapons of mass destruction," that these fell into a special moral category requiring international concern and control. Technically, only chemical weapons had been identified explicitly as requiring special rules. Biological weapons seemed to qualify, too, because of their close association with chemical weapons. No commitment at all had been made about radiological weapons. Some in government had suggested removing biological warfare and radiological warfare from the category. But although Haskins agreed that they might not be realistically classed this way, the potential was there. Changing national policy would invite dissent and criticism. The Soviet Union might offer to give up such weapons to embarrass the United States. Because such a propaganda stunt "might have considerable appeal to large sectors of the American public and world opinion," Haskins argued against any change to the concept that CEBAR weapons were in fact weapons of mass destruction.[62] In effect, American policy toward this apparent family of weapons was locked in by fear of successful propaganda.

Although Haskins had recommended research and integration into strategic plans, he directed this primarily toward human-centered defensive research and animal- and crop-centered offensive research. Haskins had visited the United Kingdom a few months earlier and had concluded that both countries had insufficient knowledge to tell whether epidemic human diseases could be started and controlled at will. It seemed to be a giant gamble. The only relevant experience, the great influenza epidemic of 1918–19, suggested that the damage from epidemics would likely be worldwide in scope. Only with more research on defending (i.e., immunizing) against these diseases could offensive warfare against humans be realistically contemplated. Antilivestock and anticrop weapons seemed the most logical choice for offensive use. These would have less of an effect on the United States because of its wide variety of foods and its surpluses of grains; but against countries like India or China, with their large populations and high reliance on single crops, anticrop agents could prove devastating.[63]

62 Ibid.

63 Ibid.

The real enemy, of course, was the Soviet Union. The constant Cold War tension in the years prior to the Korean War led the government's advisers to consider war likely, if not inevitable, and they believed that the Soviet Union was developing these same kinds of weapons. Haskins's committee guessed that the Soviet Union might be further along in offensive warfare against humans than the United States. They based their conclusion on the possibility that the Soviets might have engaged in human experimentation and the possibility, suggested by the Central Intelligence Agency, that they might view nonconforming communist satellites such as Yugoslavia as testing grounds.[64] It seemed clear to Haskins's committee that some kind of American human experiments would be necessary to prevent the possible disparity in expertise between the United States and the United Kingdom, on the one hand, and the Soviet Union, on the other, from growing even further. This would require human volunteers, the use of publicly acceptable methods of experimentation, and a vigilant awareness of public relations. The report emphasized that even if the dangers to these volunteers were great, the risk would be deemed necessary: "In no other way can the needed knowledge be obtained."[65] Given the catastrophic potential of war, such choices seemed morally justifiable to these men.

The secretary of defense continued to seek advice on the subject after Haskins's committee was dissolved, and he soon convened yet another committee under the leadership of Earl P. Stevenson. No stranger to unorthodox forms of warfare, Stevenson had suggested in 1942 that bats might be used to drop small incendiaries on the Japanese countryside.[66] Now Stevenson followed Haskins in embracing all three weapons systems, but he disagreed that they should be lumped together, thus abandoning the short-lived concept of CEBAR. Haskins had stated that the essentially biological effects of all three justified a unitary concept, but the new committee viewed them as different enough to warrant separate consideration. What Haskins had seen as a unified theme, Stevenson saw as a provocative question about the nature and direction of war toward the destruction of life – a question his

64 Haskins's report alludes to the communist satellite question briefly and refers to a document furnished to the committee by the Central Intelligence Agency titled "Report on Possible Recent Uses of BW within Yugoslavia," Nov. 23, 1948. See Ad Hoc Committee on Biological Warfare of the Department of Defense, report, July 11, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 8.

65 Ad Hoc Committee on Biological Warfare of the Department of Defense, report, July 11, 1949, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 8.

66 The letter describing this idea can be found in Andrew Carroll, *Behind the Lines: Powerful and Revealing American and Foreign War Letters, and One Man's Search to Find Them* (New York, 2005). The document itself is online, read by former *Batman* actor Adam West, at http://www.gilderlehrman.org/collection/battlelines/chapter4/chapter4_7a.html.

committee and the JCS's Joint Strategic Plans Group was content to put in abeyance for the time being:

> The so-called "larger problem" of determining the total effect on a nation's war effort of large-scale personnel destruction (such as might be potentially possible by BW [biological warfare]) as opposed to the presently accepted method of material destruction was discussed. It was generally agreed that a study . . . on this question would be helpful in determining the extent to which this nation should back large-scale anti-personnel weapons.

In the meantime, Stevenson acknowledged that their immediate obstacle was not this "larger problem"; instead, it was the inability to get the proverbial ball rolling on development, planning, and policy. He attributed this to the fact that few in government took the subject seriously enough. When he and members of the Joint Strategic Plans Group met to discuss his committee's forthcoming report, they agreed that the United States needed a strong program of development of biological weapons at the proving grounds in Dugway, Utah, to obtain planning data; in addition, they urged the creation of production facilities and serious efforts to integrate biological warfare and radiological warfare into strategic plans. But most significant of Stevenson's recommendations to the Department of Defense and the JCS was his strong argument for abandoning the "retaliation only" policy on the use of biological and radiological weapons.[67]

The attempt to overthrow the retaliation-only policy has elicited considerable comment from historians wishing to portray an eagerness on the part of the United States to use biological weapons. The aforementioned meeting took place on June 21, 1950, and four days later, North Korea invaded South Korea. Stevenson completed his committee's report by the end of the month. Thus, it is with this prelude – a clear desire to integrate both biological warfare and radiological warfare into strategic plans (chemical weapons were judged useful only tactically) and a definite recommendation that the United States stop swearing not to use them unless an enemy did so first – that we enter the first major controversy about the United States and biological warfare. During the Korean War, the North Koreans and the Chinese, backed by the Soviet Union, accused the United States of experimenting with biological warfare in Korea. The official protests came in February 1952 directly from Bak Hun Yung, the North Korean foreign minister, and Zhou Enlai, the Chinese foreign minister. These charges were supported

67 A. M. Prentiss Jr., Colonel (USAF), memorandum of conversation to Colonel Bayer, June 23, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9.

by the confessions of captured American airmen, who subsequently abjured their statements on their return to the United States.[68]

The U.S. government denied the charges, and Secretary of State Dean Acheson challenged the Chinese and the Koreans to allow the International Red Cross to enter the war zone and make an independent scientific assessment of the landscape and alleged victims. The Chinese forbade this, calling the International Red Cross untrustworthy for having collaborated with the Nazis during World War II. They also did not trust the World Health Organization, as it was a United Nations body and UN troops were fighting against North Korea. Kuo Mo-Jo, the president of the Chinese People's Commission for World Peace, appealed to the World Peace Council, whose founding president, Frédéric Joliot-Curie, was a communist, to send an international group of scientists to investigate. The scientists' lengthy report came to the conclusion that the United States had indeed engaged in biological warfare.[69] Because the members of the scientific team (including the illustrious British scientist Joseph Needham) all were sympathetic to communism, the conclusion convinced few skeptics. The London *Times* quoted British diplomat Selwyn Lloyd as saying, "never had so much been written by such confirmed fellow-travelers to prove so little."[70]

Several Western scientists were thoroughly persuaded that the Americans had employed biological weapons in Korea. From Britain, Needham proved a reluctant participant in the scientific team sent to China, but he returned with a renewed conviction, which he carried throughout his life.[71] The team included a Swede, two Italians, a Frenchman, a Brazilian, and a Russian, all of whom exchanged outraged letters with one another after the prisoners of war retracted their statements in 1953.[72] Their outrage was not one of embarrassment but rather of continued abhorrence at what they considered an atrocity by the Americans, now clearly being covered up with, as the Italian microbiologist Franco Graziosi put it, "ridiculous

68 The basic facts of these allegations can be found in a number of sources. Two that take opposite views about their plausibility are Stephen Endicott and Edward Hagerman, *The United States and Biological Warfare: Secrets from the Early Cold War and Korea* (Bloomington, Ind., 1998); and Kathryn Weathersby, "Deceiving the Deceivers: Moscow, Beijing, Pyongyang and the Allegations of Bacteriological Weapons Use in Korea," *Bulletin of the Cold War International History Project* 11 (1998): 176–85.

69 "Report of the International Scientific Commission for the Investigation of the Facts Concerning Bacterial Warfare in Korea and China," 1952, Archives, Institut Curie, Fonds Joliot-Curie, Box F-130.

70 "Virus Culture," *Times*, Oct. 30, 1953, Archives, Institut Curie, Fonds Joliot-Curie, Folder "Correspondence Jean Malterre."

71 Tom Buchanan, "The Courage of Galileo: Joseph Needham and the 'Germ Warfare' Allegations in the Korean War," *History* 86, no. 284 (2001): 503–22.

72 These letters are contained in Archives, Institut Curie, Fonds Joliot-Curie, Folder "Correspondence Jean Malterre."

retractions."[73] In France, the most famous figure to denounce the United States was Joliot-Curie, a Nobel Prize–winning physicist who had married Marie Curie's daughter Irène (also a Nobelist, like her mother, who had won two).

The Chinese showered Joliot-Curie with corroborating information, all of which is still held at the archives of the Institut Curie in Paris. He received copies of the handwritten confessions of American airmen, along with photographs of the alleged players: airmen, American spies sent to gather evidence, and the Chinese scientists who identified the infected animals and insects. He also received several photographs of flies, spiders, beetles, fungi, and other alleged carriers of pathogens.[74] The Chinese also drew heavily upon the slim public record of biological weapons. In addition to references to the Merck Report, Rosebury's 1947 paper and 1949 book, and statements by Forrestal, there were numerous newspaper clippings – from the *New York Times* and other major papers, to military-audience papers like *Stars and Stripes*, to communist-friendly venues such as the *Daily Worker*. All reported bits and pieces of evidence about research centers, projects, efforts to incorporate biological weapons into war plans, and the postwar use of Nazi and Japanese scientists by the United States.[75]

The allegations were not resolved in subsequent years, but two developments in 1998 complicated the question for historians. The first was the publication of a book by Stephen Endicott and Edward Hagerman amassing all of the circumstantial evidence that might imply that the United States had experimented with biological warfare in Korea. The book emphasized the prewar enthusiasm for biological warfare expressed by the Noyes, Haskins, and Stevenson committees.[76] However, despite their conviction that the United States was guilty, they produced no direct evidence. As one historian concluded, they relied on inference and innuendo: "Unfortunately, their book is full of smoke," Sheldon Harris wrote, "but they found no smoking gun."[77] The second development was the publication of materials from

73 Franco Graziosi to Jean Malterre, Nov. 25, 1953, Archives, Institut Curie, Fonds Joliot-Curie, Folder "Correspondence Jean Malterre."

74 Archives, Institut Curie, Fonds Joliot-Curie, Box F-130.

75 Ibid.

76 Endicott had been working on the subject for many years, including a 1979 article in the journal *Modern China* emphasizing the importance to the U.S. Joint Chiefs of Staff of the term *plausible denial*. Stephen Endicott and Edward Hagerman, *The United States and Biological Warfare: Secrets from the Early Cold War* (Bloomington, Ind., 1998); Stephen L. Endicott, "Germ Warfare and 'Plausible Denial': The Korean War, 1952–1953," *Modern China* 5, no. 1 (1979): 79–104.

77 Harris and other scholars, in reviewing the book, pointed out these biases while guardedly acknowledging that more information needs to be released by governments before making definitive statements one way or the other. Sheldon H. Harris, *Factories of Death: Japanese Biological Warfare, 1932–1945, and the American Cover-Up* (New York, 2002), 327. Harris's review is in the *Journal of American History* 87, no. 1 (2000): 285–6. See also John Ellis van Courtland Moon's review in the *Bulletin of the Atomic Scientists* 55, no. 3 (1999): 70–7.

Russian archives that document the post-Stalin power struggle in the Soviet Union, during which Lavrentiy Beria ousted a rival, Semen D. Ignatiev. One of the principal accusations against Ignatiev was that he knowingly concealed from his government the fact that the allegations were false, thus leading the Soviet Union into an embarrassing geopolitical predicament. These documents included statements about the creation of false contamination zones, the deliberate infection of condemned Korean prisoners with cholera and plague bacilli, and the manipulation of the foreign scientists visiting China.[78] Joseph Needham, who died in 1995, might have been chagrined to read these documents, which identify the Russian scientist on his international panel, the bacteriologist N. N. Zhukov-Verezhnikov, as an agent of the Soviet Union's Ministry of State Security.[79]

Although the internal debate about the retaliation-only policy is an intriguing entrée into the controversy over use of biological warfare in Korea, JCS archival documents suggest that the proposed leap to a new policy was intended to dislodge bureaucratic roadblocks to research, not to encourage actual use. The army, navy, and air force disagreed among themselves about whether to change the policy. Stevenson's original reason – supported by the army and air force – was that the retaliation-only policy hampered both offensive and defensive research, tending to relegate it to a low priority and stifle American efforts for war readiness. According to this view, radiological weapons and biological weapons were paper tigers, as Mao Zedong once said of the United States; even insiders did not think they would be used offensively, so why commit the funds? The strongest reason for the change was not an immediate military need but rather a perceived need to remove obstacles in their development. In this view, the retaliation-only policy encouraged indecision and insufficient financial support.[80]

78 The documents were published by the Japanese newspaper *Sankei Shimbun*, having been copied by hand by reporter Yasuo Naito. Because of archival access problems, the documents' provenance has not yet been confirmed. Two scholars writing for the Cold War International History Project, Kathryn Weathersby and Milton Leitenberg, each wrote analyses of the documents in 1998, acknowledging the problem of verifying their provenance, yet both found them persuasive. Weathersby particularly pointed out that the indirect nature of the evidence, through a different subject entirely – namely "the byzantine power struggle within the Soviet leadership in the first months after Stalin's death in March 1953" – gives them an added degree of credibility in laying to rest the allegations. See Kathryn Weathersby, "Deceiving the Deceivers: Moscow, Beijing, Pyongyang and the Allegations of Bacteriological Weapons Use in Korea," *Bulletin of the Cold War International History Project* 11 (1998): 176–85; Milton Leitenberg, "New Russian Evidence on the Korean War Biological Warfare Allegations: Background and Analysis," *Bulletin of the Cold War International History Project* 11 (1998): 185–99.

79 Explanatory note from Glukhov to the Ministry of Public Security of the DPRK, Apr. 1, 1953. This document is reproduced in Weathersby, "Deceiving the Deceivers," 180.

80 Joint Strategic Plans Committee, report to the Joint Chiefs of Staff, on "Chemical, Biological, and Radiological Warfare," Aug. 7, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9. The army view is contained in J. E. Hull to Secretary of Defense, Aug. 22, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9.

Opposition to the army and air force view was not due to any particular moral stand on the nature of war or a repugnance to targeting populations. Rather, as the navy pointed out, removing this restriction would horrify the American public and American allies, and it easily could be used as propaganda by the Soviet Union. The navy, also favoring a strong program, argued that the lack of preparedness was rooted elsewhere, and that the United States should look to the United Kingdom as a model of a strong development program that did not alter the policy on use.[81] Admiral Forrest P. Sherman, chief of naval operations, pointed out that trying to change the policy secretly would probably prove impossible, and in any event, it would get bogged down in the National Security Council, further impeding rather than increasing readiness. He wrote: "The current theme of the Soviet propaganda program . . . is aimed at proving that the USSR is the champion of peace and of the outlawing of weapons of mass destruction, while the United States is an imperialist nation, bent on conquering the world, and is preparing as rapidly as possible to use the most cruel, diabolical weapons of mass destruction to accomplish its purpose." Changing the policy, with this in mind, would be incredibly counterproductive for the United States.[82]

Ultimately, the change did not occur. The chair of the JCS, General Omar Bradley, tried to address the problem by emphasizing that a high priority should be given to the development of these new weapons despite their retaliation-only status. The navy's view – particularly because of its sensitivity to political ramifications – won the day. But Bradley did recommend, and Secretary of Defense George C. Marshall made it a directive, continuing strong programs in all three fields.[83]

This essay has attempted to illuminate the political and institutional dynamics influencing American decisions about radiological and biological warfare between World War II and the Korean War. These decisions would have ramifications for the development of other kinds of environmental warfare in subsequent years. The term *environmental warfare* now means any manipulation of the forces of nature for hostile purposes. It came into currency after the intensive use of chemical defoliants by American military

81 The disparity in army and navy views is evident in early drafts of Joint Strategic Plans Committee, report to the Joint Chiefs of Staff, on "Chemical, Biological, and Radiological Warfare." NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9.

82 Memorandum by the Chief of Naval Operations for the Joint Chiefs of Staff on "Chemical, Biological, and Radiological Warfare," Sept. 6, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9.

83 Omar N. Bradley (Chair, Joint Chiefs of Staff) to Secretary of Defense, Sept. 8, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 206, Folder 9. See also G. Marshall to Secretary of the Army, Secretary of the Navy, and additional recipients, Oct. 27, 1950, NARA RG 218, Central Decimal File, 1948–1950, Box 207, Folder "Chemical, Biological, and Radiological Warfare."

forces in Vietnam and during the negotiations for the Environmental Modification (Enmod) Convention of 1977. Environmental warfare should not be confused with the incidental effects of war on the natural environment. Although a number of outspoken scientists have linked large-scale military conflagration with environmental catastrophe, environmental warfare is different: it entails the purposeful use of the environment as a means of waging war. One aspect of environmental warfare is the manipulation of the earth's biota to harm one's enemy. Some scientists believed in the 1980s that they were on the threshold of even greater forms of environmental control – not just of biotic forces but of atmospheric and geotectonic ones as well.[84]

Since World War II, researchers and war planners have conceptualized weapons that exploit our knowledge of the land, the water, and the wind to harness their formidable powers.[85] The Enmod Convention of 1977 attempted to prohibit use of such weapons, though it allowed nations to possess them.[86] Today we typically conceptualize biological, radiological, and chemical weapons as "weapons of mass destruction," a label that not only allows us to lump them with nuclear weapons but also blurs their status as tools of environmental warfare. But it is worth remembering how the entomologist Caryl Haskins thought of them: as weapons that targeted living things rather than material infrastructure. They utilized the pathways of nature to spread disease, to kill livestock, and to starve the enemy by poisoning crops. Far from unintentional, this kind of environmental warfare was the ultimate expression of total war.

Vannevar Bush suggested that there was something holding people back from developing such weapons or planning wars based upon them – after all, even Hitler had found them repellent. The modest aim here is to show that enthusiasm was actually high, but that there were bureaucratic and political difficulties in integrating such weapons into war plans – for relatively pedestrian reasons when compared to the intrinsic moral question. Yet for historians, the moral question remains prominent because it is essential in evaluating how events might have unfolded within the moral climate of the time. It may be tempting to believe that American leaders uniformly found biological and radiological warfare abhorrent, but it would be wrong to presume that these weapons naturally fell outside the boundaries of war planning. Quite the opposite is true, and many considered the weapons

84 Westing, *Environmental Warfare*, 1.

85 Richard A. Falk, "Environmental Disruption by Military Means and International Law," in Westing, *Environmental Warfare*, 33–44.

86 Jozef Goldblat, "The Environmental Modification Convention of 1977: An Analysis," in Westing, *Environmental Warfare*, 53–64.

to be morally equivalent to existing weapon systems or even preferable because they could be used through the environment as tools of interdiction, to control the enemy's movements rather than kill soldiers or civilians outright. It is a curious fact, for example, that some American political leaders outspokenly saw radiological weapons as a potential solution to the Korean problem – as well as the problem of radioactive waste. In an article entitled "Atomic Death Belt Urged for Korea," the *New York Times* pointed out in 1951 that Congressman Albert Gore had advised President Truman to "dehumanize" a belt across the Korean peninsula. The dangerous wastes from plutonium processing could be put to good use, he said, and the president could avoid the political repercussions of using an atomic bomb:

> Just before this is accomplished, broadcast the fact to the enemy, with ample and particular notice that entrance into the belt would mean certain death or slow deformity to all foot soldiers; that all vehicles, weapons, food and apparel entering the belt would become poisoned with radioactivity, and, further, that the belt would be regularly re-contaminated until such time as a satisfactory solution to the whole Korean problem shall have been reached. This would differ from the use of the atomic bomb in several ways and would be, I believe, morally justifiable under the circumstances.[87]

Certainly, Gore was aware of a moral objection, but it did not constrain him.

The fact that such a plan did not materialize had little to do with moral or ethical constraints; rather, there would have been practical difficulties in making it work. The article juxtaposed Gore's suggestion with a reference to the AEC's report of August 1950, "The Effects of Atomic Weapons," which devoted considerable space to radiological warfare but played down its tactical value. Because physiological effects would be delayed, the AEC report stated, the weapons would have primarily a psychological effect.[88] Such weapons would contribute to an enemy's calculus of opportunities and risks, but they could not stop soldiers or tanks. The tactical advantage of using the weapons would not be worth the political consequences. Others reinforced this conclusion in the *New York Times* a day after the reporting of Gore's idea, including Senator Brien McMahon, chair of Congress's Joint Committee on Atomic Energy. One of the few comments on morality came from an army publication that stressed the humaneness of radiological weapons, on the basis of the fact that people could choose to avoid the accumulation of harmful radiation simply by evacuating the target areas. Thus, wars might be won without killing people at all, the author seemed

87 "Atomic Belt Urged for Korea," *New York Times*, Apr. 17, 1951, 3.
88 Ibid.

to suggest, simply by arming the countryside itself. Dead, contaminated landscapes could prove to be the mark of a more humane style of warfare.

Most of these comments suggest enthusiasm bridled by practical limitations – and political limitations as well. Korea, after all, was not a total war necessitating the expenditure of every ounce of strength. We must look to the efforts to integrate these weapons into strategic plans, for a global conflict with the Soviet Union, to understand how Americans thought they might fight sometime in the coming decade.[89] Is it safe to assume that, had World War III occurred in the early 1950s, these absolute weapons would have been used? It is tempting to say, "Absolutely." But the truth is that, for the reasons discussed here, environmental contamination was not fully integrated into war planning during the early Cold War. Given a short war, the answer may be "probably not." However, the United States was not betting on a short war with the Soviet Union. The conflict promised to be a long, protracted struggle, global in scope and total in its use of human and industrial resources. This would have been an ideal setting to make use of those radiological weapons with a short shelf life, as von Neumann suggested. And in a total war, biological weapons targeting humans and crops might have seemed strategically necessary. Military planners expected the Soviet Union to make use of the full range of weapons in its possession, particularly if its atomic arsenal was small, and that would have called for retaliation in kind. Had a long general war taken place, it appears likely that it would have involved the purposeful spread of disease among crops and humans, as well as widespread radioactive contamination with or without atomic bombs – a scale of environmental warfare that fortunately still lives only in the realm of fiction and speculation.

89 "Atomic Belt Plan Held Not Feasible," *New York Times*, Apr. 18, 1951, 16.

4

Environmental Diplomacy in the Cold War

Weather Control, the United States, and India, 1966–1967

KRISTINE C. HARPER AND RONALD E. DOEL

Weather control – not typically what springs to mind when considering the Cold War, science, and the environment. Coupling the terms *Cold War* and *science* generally suggests physics, which, after all, was behind rocketry, warheads, and the space race.[1] But no less important to government leaders trying to win the Cold War – militarily or diplomatically – were the physical environmental sciences, oceanography and meteorology in particular. Oceanography is an obvious Cold War science: antisubmarine warfare was critical to the United States' defense posture, and the ability to exploit the ocean environment to hide and find submarines was extremely important to military strategy. However, meteorology was equally important: not only because atmospheric conditions affected the performance of aircraft, missiles, and rockets and influenced the ability of ships at sea and troops on the battlefield to carry out their assigned missions, but also because weather had the potential to be used as a weapon.

1 Related literature is voluminous. See, e.g., Lawrence Badash, *Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty, 1939–1963* (Atlantic Highlands, N.J., 1995); Gregg Herken, *Cardinal Choices: Presidential Science Advising from the Atomic Bomb to SDI* (New York, 1992); Daniel J. Kevles, "Cold War and Hot Physics: Science, Security, and the American State, 1946–56," *Historical Studies in the Physical and Biological Sciences* 20 (1990): 239–64; Melvyn P. Leffler, *A Preponderance of Power: National Security, the Truman Administration, and the Cold War* (Stanford, Calif., 1992); and Spencer R. Weart, *Scientists in Power* (Cambridge, Mass., 1979).

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Indeed, for some military officials, weather control appeared to be an ideal tool. It could be used offensively to fog in an enemy runway to hamper air operations, to muddy up a field before a battle to ensnare tanks and troops, or to destroy enemy crops by inducing drought or hail. Alternatively, weather control could be used defensively by allowing runways to remain shrouded in fog and then cleared just in time to launch or recover a squadron of aircraft, to create fog in a battlefield to confuse the enemy and thus provide an advantage to allied forces, or to provide sufficient precipitation to ensure an adequate food supply on the home front. And unlike nuclear weapons, weather control did not produce undesirable side effects such as radioactive fallout.

The idea of weather control can almost be considered a natural outgrowth of the science-and-technology-can-fix-anything euphoria of the postwar era. Scientific research and planning in governmental and military policy had reached an unprecedented level of importance during World War II, as evidenced by the creation of the Office of Scientific Research and Development (OSRD). Instead of science being an afterthought in military tactical and strategic planning, it became a critical component in decision making. Scientific and technological undertakings during the war – the Manhattan Project, the development of radar and proximity fuses, advances in weather forecasting, the exploitation of acoustics in antisubmarine warfare, the production of penicillin – were believed by many, if not most, scientists, government officials, and average citizens to have been responsible for the Allied victory. If science could win the "hot" war, there was every reason to believe that it would win the Cold War, too.[2]

Although the U.S. military establishment was the first government body to jump on weather control's opportunities in the late 1940s and provide funding for scientific efforts to influence the weather over large areas, weather control as a weapon was not the only possibility American officials envisioned. The idea of using weather control as a diplomatic tool already was being broached by the early 1950s. By the mid-1960s, at the height of the Cold War, the administration of President Lyndon Baines Johnson embraced the idea of modifying India's environment as a viable – and secret – aspect of its South Asia foreign policy. Seeking to exploit the earth sciences – the physical environmental sciences – Johnson sought to mitigate

2 Included among the many works addressing the role of scientific research and planning during World War II are A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities* (Baltimore, 1986); Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (Cambridge, Mass., 1987); and David M. Hart, *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921–1953* (Princeton, N.J., 1998).

drought, prevent famine, and firmly anchor South Asia in the United States' sphere of influence by bringing precipitation to India's parched lands courtesy of weather control.

WEATHER MODIFICATION – MARGINAL TO MAINSTREAM SCIENCE

Although scientific weather control did not make its appearance until the mid-twentieth century, the U.S. government first sponsored rainmaking experiments in 1891 with a congressional appropriation of $2,000 to the Agriculture Department to "shock" rain out of the sky with explosives. An initial "successful" test led to another appropriation – for $10,000. However, two months of almost nonstop blasting led to no rain. The new agriculture secretary – who considered the entire project completely ludicrous – retrieved the money that had not been spent and returned it to the Treasury.[3]

Although the concussionists had been completely discredited in the eyes of the scientific community, the public remained keenly interested in rainmaking. Commercial rainmakers, most of whom were charlatans, used electrified sand, "secret" chemicals, dry ice, and other materials in an attempt to make rain. Public interest lasted through the Dust Bowl years, when it became apparent that rain would not be forthcoming despite promises to the contrary. The situation would change in the post–World War II era, when science and technology seemed to offer a fix for whatever ailed us.[4]

3 Jeff Townsend, *Making Rain in America: A History* (Lubbock, Tex., 1975), 11–13.

4 Ibid., 30. Limited critical studies have been undertaken on the history of weather control. Relevant works include Clark C. Spence, *The Rainmakers: American "Pluviculture" to World War II* (Lincoln, Neb., 1980). Spence provides a highly readable account of early rainmaking efforts in the United States, describing the many truly colorful characters who populated the field. For a popular account, see D. S. Halacy Jr., *The Weather Changers* (New York, 1968). Louis J. Battan's *Harvesting the Clouds: Advances in Weather Modification* (Garden City, N.Y., 1969) is a nontechnical discussion of the history and status of weather modification for secondary school students and general audiences. It was published in cooperation with the American Meteorological Society as an outgrowth of the Physical Science Study Committee. Robert G. Fleagle, ed., *Weather Modification: Science and Public Policy* (Seattle, 1969), addresses historical issues as well as technical, ecological, economic, and legal issues in weather modification. Wilmot N. Hess, ed., *Weather and Climate Modification* (New York, 1974), contains two historical articles: a general overview by the meteorologist Horace A. Byers and an overview of private meteorology by the consulting meteorologist and cloud modifier Robert Elliott. Other chapters in this book address technical issues. Books containing shorter sections on weather modification history include William R. Cotton and Roger A. Pielke, *Human Impacts on Weather and Climate* (Cambridge, 1995); and Clark A. Miller and Paul N. Edwards, eds., *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (Cambridge, Mass., 2001). For a historical look at climate modification in the United States with an alarmist conclusion, see James R. Fleming, "Fixing the Weather and Climate: Military and Civilian Schemes for Cloud Seeding and Climate Engineering," in *The Technological Fix: How People Use Technology to Create and Solve Problems*, ed. Lisa Rosner (New York, 2004). There are, unfortunately, very few works that address both the history of science and environmental history issues. Exceptions include Peter J. Bowler's *The Norton History of the Environmental Sciences* (New York, 1992), and Richard White's *The Organic Machine* (New York, 1995).

Modern weather modification emerged in 1946 from military-funded research on so-called smokes (for providing cover to ground troops) and aircraft icing conducted by General Electric's (GE) Nobel Prize–winning chemist Irving Langmuir and his assistant, Vincent Schaefer. Observing that some supercooled clouds (which have liquid water droplets with temperatures below freezing) did not produce snow, Langmuir and Schaefer concluded that the clouds were deficient in "snow nuclei" – extremely small attractive bits to which the supercooled droplets could cling and form flakes sufficiently heavy to fall. Over several months, Schaefer tried in vain to produce ice crystals by dropping in a variety of nuclei-imitating substances in the GE home-style freezer he had installed in their laboratory. He finally succeeded – accidentally – when he placed a large block of dry ice in the freezer one hot July day in 1946 while attempting to quickly reduce the freezer's temperature. Greeted by a flurry of ice crystals, Schaefer tried smaller and smaller particles of dry ice and was always rewarded with twinkling ice crystals. Indeed, he discovered that any object or substance chilled to negative forty degrees Celsius and dropped into the freezer full of supercooled droplets would yield ice crystals.[5] Moving the experiment from the freezer to clouds in November 1946, Schaefer and Langmuir artificially induced snowfall by "seeding" clouds with dry ice particles. Within the year, fellow GE meteorologist Bernard Vonnegut discovered that particles of silver iodide also induced precipitation in supercooled clouds. A few months later, Langmuir won Defense Department support for a now-famous five-year field study on weather modification called Project Cirrus. In the same period, the Weather Bureau also conducted more general cloud physics studies, and the navy and air force carried out their own seeding experiments.[6]

"Rainmaking," as weather control was colloquially labeled, had long held the interest of those desiring increased precipitation: farmers and ranchers in semiarid and arid regions; hydroelectric companies, for which deeper snowpacks guaranteed sufficient runoff to produce power throughout the summer; and municipalities that needed reliable domestic water supplies. The U.S. government, however, had other reasons for funding weather control quite apart from providing for the public welfare. Weather control, senior policy makers thought, would make the ideal Cold War weapon.

5 Barrington S. Havens, with italicized annotations by James E. Jiusto, Vincent Schaefer, and Bernard Vonnegut, *Early History of Cloud Seeding* (Socorro, N.M.; Albany, N.Y.; Schenectady, N.Y., 1978), 4–5.

6 Fleagle, *Weather Modification*, 9–10.

Although Langmuir and his colleagues publicly extolled the human benefits of bringing moisture to the desert, spawning regular pulses of gentle rain across the continent, and steering hurricanes harmlessly out to sea, his primary patron was the military establishment – and it was not concerned with humanitarian possibilities. By February 1947, just three months after Schaefer dropped dry ice particles out of a small plane and spawned a snow flurry, a secret memo directed the chair of the Pentagon's Joint Research and Development Board's Committee on Geophysical Sciences to "assume the initiative and responsibility within the JRDB for consideration of the technical aspects of [weather modification] from the strategical and tactical viewpoint."[7] The navy and air force provided funds and material for weather control research because of its potential as a weapon – a relatively inexpensive offensive and defensive weapon that produced neither pollution nor fallout and whose deployment could never be proved. After all, there was no proof that weather control worked.

Military departments were not the only interested high-level government agencies. Senator sponsors introduced three bills in 1951 that addressed the federal government's interest in weather control. One, Senate Bill 222, sought to license would-be modifiers and place all development and regulation under a Weather Control Commission, an independent agency modeled after the Atomic Energy Commission. Senate Bill 798 specifically authorized "the Secretary of Agriculture to conduct research and experiments with respect to methods of controlling and producing precipitation in moisture-deficient areas." And Senate Bill 5 provided for research into practical and economical desalinization techniques as well as "production from the atmosphere (including cloud formations) of water suitable for agricultural, industrial, municipal, and other beneficial consumptive uses."[8]

Behind closed doors, the science policy expert Vannevar Bush, the former director of the OSRD, also was discussing the possibilities of weather as a weapon. Testifying at the joint hearings on these Senate bills, he promoted weather control as a tool of U.S. foreign policy – a tool that offered the possibility of favorably altering growing conditions in allied countries where "climatical conditions are critical or difficult; and by so doing . . . extend[ing] our favorable influence over the free world."[9] Congress decided not

7 D. B. Langmuir, Director, Planning Division Memo to Chair, Committee on Geophysical Sciences [SECRET] of Feb. 21, 1947, National Archives and Records Administration (NARA) II, RG 330, Box 469, Folder 9.

8 Joint Hearings before Subcommittee of the Committees on Interior and Insular Affairs, Interstate and Foreign Commerce and Agriculture and Forestry, U.S. Senate, 82nd Cong., 1st sess., on S. 5, S. 222, and S. 798, Mar. 14, 1951, 11.

9 Ibid., 150.

to establish a Weather Control Commission but instead, acting on the recommendations of President Dwight D. Eisenhower's advisory Committee on Weather Control in 1957, directed the National Science Foundation to organize and direct a five-year, $5 million program to investigate the efficacy of weather modification.[10] By the mid-1960s, sufficient scientific and technical progress had been made that the failure of India's monsoon rains and the resulting collapse of the grain harvest presented an ideal opportunity to test Bush's claim that the United States could use weather control as a diplomatic tool.

SCIENCE AND THE ENVIRONMENT IN INTERNATIONAL RELATIONS

Compared with international issues provoked by nuclear testing throughout the 1950s and into the 1960s, it might appear that environmental concerns connected with the physical environmental sciences were of significantly lower priority. However, concern over widespread pollution from nuclear fallout, competing national claims for Antarctica, and intensified fishing in the world's oceans coupled with increasing interest in seafloor mining would lead to the Limited Test Ban Treaty of 1963, the Antarctic Treaty of 1959, and the first United Nations Conference on the Law of the Sea in 1958 – all of which highlighted the relevance of the physical environmental sciences for U.S. foreign policy.[11]

Indeed, the administration of President John F. Kennedy, embarrassed by *New York Times* reports that the United States had exploded a nuclear device in space above Hawaii and by the Atomic Energy Commission's Project Chariot, which was to create an artificial harbor in Alaska by detonating several nuclear weapons, sought to limit programs that would have a detrimental effect on the environment.[12] Kennedy issued the secret National Security Action Memorandum 235 on April 17, 1963, directing his cabinet secretaries to review in advance all potential large-scale scientific or

10 U.S. Advisory Committee on Weather Control, *Final Report* (Washington, D.C., 1957), 1:ix.

11 On nuclear testing, see Robert A. Divine, *Blowing in the Wind: The Nuclear Test Ban Debate, 1954–1960* (Oxford, 1978); Kai-Henrik Barth, "The Politics of Seismology: Nuclear Testing, Arms Control, and the Transformation of a Discipline," *Social Studies of Science* 33 (2003): 743–81. On the Antarctic Treaty, see Aant Elzinga, "Antarctica: The Construction of a Continent by and for Science," in *Denationalizing Science: The Contexts of International Scientific Practice*, ed. Elisabeth Crawford, Terry Shinn, and Sverker Sörlin (London, 1992), 73–106. On the role of oceanography, see Ann L. Holick, *U.S. Foreign Policy and the Law of the Sea* (Princeton, N.J., 1981), 144–59; and Jacob Darwin Hamblin, *Oceanographers and the Cold War: Disciples of Marine Science* (Seattle, 2005).

12 Divine, *Blowing in the Wind*; on Project Chariot, see Dan O'Neill, *The Firecracker Boys* (New York, 1995).

technological experiments that could possibly yield adverse environmental effects.[13] In a more public venue, just one month before his death, Kennedy spoke with members of the National Academy of Sciences about his concerns over deliberate environmental modification. He noted that for the first time science "could undertake experiments with premeditation which can irrevocably alter our physical and biological environment on a global scale." Kennedy brought up deliberate weather modification in connection with conservation and increasing scientific understanding as well as with exploiting the oceans and atmosphere. It was important, he noted, that the government – which by now was sinking millions of dollars annually into weather modification research – work to ensure that the benefits outweighed the potential risks.[14] As a *New York Times* editorial on this very subject had argued just a month before Kennedy's speech, ambitious projects to "improve the weather in one area" could come "at the expense of that in another area. When control of the weather actually becomes possible, arguments about who should gain and who should lose could become sources of international tension."[15] Indeed they could, but that was a risk that Lyndon Johnson was willing to take when he decided to use the science of meteorology and the tool of weather control to take aim at a very thorny problem: pulling nonaligned India into, and keeping it within, the Western sphere while maintaining cordial relations with its neighbor, Pakistan.

The decision to use weather control emerged from two distinct policy objectives. First, Johnson had an obsessive desire to see India – which had been dependent on grain imports from the United States since the mid-1950s – self-sufficient in food. This was particularly true because U.S. wheat supplies were insufficient to meet both domestic and foreign demand in the mid-1960s. Second, the State Department wanted to convince India not to pursue membership in the so-called nuclear club and the international prestige that would come with it. The State Department hoped to do so by focusing India on alternative scientific and technological pursuits that would likewise raise its prestige. Both objectives were ultimately tied to two broader aims of American foreign policy: first, to promote stable democracies in South Asia as a bulwark against both the Soviet Union and the People's Republic of China; second, to ensure that the unaligned Indians, who were

13 National Security Action Memorandum No. 235/1, Apr. 17, 1963, Foreign Relations of the United States (FRUS), *Organization of Foreign Policy; Information Policy; United Nations; Scientific Matters*, Vol. 25 (2001), item no. 352.

14 See "Text of Kennedy's Address to Academy of Sciences," *New York Times*, Oct. 23, 1963, 24.

15 "Controlling the Weather," editorial, *New York Times*, Sept. 25, 1963, 42.

seeking aid from both the United States and the Soviet Union, did not move into the Soviet camp.[16]

The geopolitical triangle of Pakistan, India, and China had become a serious concern of U.S. foreign policy in the early 1960s. Sporadic Indian-Pakistani and Indian-Chinese border disputes threatened to destabilize South Asia. Pakistan and India would have no hope of improving their devastatingly poor economies if they spent national budgets and brainpower on armaments. As the 1960s progressed, India and Pakistan sought more military aid. Furthermore, India's military aspirations were not just about defense. They were a matter of national pride – and international prestige.[17]

Johnson aides reviewing recent events in India, the world's most populous democracy and a vital linchpin in U.S. Asian policy, had much on their minds. The first jolt to India's national self-esteem came during the short, and for the Indians disastrous, October 1962 Sino-Indian War. The war over the disputed Aksai Chin Plateau had been prompted when Indian patrols crossed the disputed border and took up positions in land claimed by China. Prime Minister Jawaharlal Nehru had expected this move to strengthen India's hand in any future negotiated settlement with China. Instead, China routed the Indian forces.[18] The shocked nation felt betrayed and humiliated. Despite this bruising of national pride, India did not truly feel threatened until China exploded its first nuclear device some two years later, on October 16, 1964. By moving into the small group of nuclear nations, China had robbed India of what it had thought to be its superior position in science and technology – a position India needed to retain its influence with Asian and African nations. Domestic pressure built to begin an ambitious nuclear weapons program,[19] which was not the best use of limited funds.

Pakistan dealt the second major jolt to India, and by extension to the wider international community, in spring 1965. Moving its troops into the disputed territory of Rann of Kutch, Pakistan set up a series of outposts that invited an Indian response. The large tidal mudflat near the Arabian

16 Lyndon Baines Johnson, *The Vantage Point: Perspectives of the Presidency, 1963–1969* (New York, 1971), 223; Chester Bowles, "Are We Relevant to the Future?" in *To Heal and to Build: The Programs of President Lyndon B. Johnson*, ed. James MacGregor Burns (New York, 1968), 26.

17 W. E. Gathright to Garthoff, Schneider, Coon and Weiler, July 1, 1966, Box 15, Defense Affairs India 1966, Def 18–2 Reports and Data, Department of State Records, RG 59, Entry 5255, NARA II (hereafter cited as State 5255-NARA II). For discussions on the geopolitical situation in South Asia, see Dennis Kux, *India and the United States: Estranged Democracies* (Washington, D.C., 1992), 201–35; Itty Abraham, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State* (London, 1998), 124–6; and Robert J. McMahon, "Toward Disillusionment and Disengagement in South Asia," in *Lyndon Johnson Confronts the World*, ed. Warren I. Cohen and Nancy Bernkopf Tucker (New York, 1995), 135–71.

18 Kux, *Estranged Democracies*, 201–6.

19 Abraham, *Indian Atomic Bomb*, 124–5.

Sea had no economic or material value, but Indian forces swept in to expel the Pakistanis. However, the Indians were forced to withdraw when rising waters from monsoon rains threatened to cut them off. Humiliated once again – this time by a smaller and less powerful nation – the Indians were determined to strengthen their defensive positions. When Pakistani President Ayub Khan misjudged both the strength of his military and the weakness of India by trying to assume control of the contentious Kashmir area in fall 1965, India was ready. It had captured Pakistani forces on Indian territory and then moved across the border to capture Pakistani posts, which led Western diplomats to conclude that India was prepared to precipitate a major conflict over Kashmir. Electing to remain above the fray, the United States and the Soviet Union encouraged UN Secretary-General U. Thant to convince both countries to withdraw. In the end, the Soviets stepped in to broker an agreement between the two countries on January 11, 1966, at Tashkent.[20]

Unfortunately, just a few hours later, India's Prime Minister Lal Bahadur Shastri lay dying from a heart attack – less than two years after the death of Nehru. India needed a new leader. The choice: Nehru's daughter, Indira Gandhi.[21]

DROUGHT AND OPPORTUNITY

As India was dealing with military belligerency on its borders and political intrigue at home, the 1965 summer monsoon failed and with it the crops dependent on atmospheric water supply. The impoverished state of Bihar and its population of more than 50 million were hit particularly hard. Its primary crop – rice – needed a lot of water, and irrigation was little used. Without the rain, the paddies and the rice crop dried up.[22] India had depended upon grain shipments from the United States since the mid-1950s and, in most years, had received several million tons. With the United States and other foreign suppliers making up for grain shortages, India's push for modernity had led to an economic plan that concentrated on building a strong base of heavy industry in lieu of focusing on agriculture. Attempts

20 Kux, *Estranged Democracies*, 233–5.

21 Abraham, *Indian Atomic Bomb*, 126. Indira Gandhi was viewed as a transitional leader at the time. She went on to lead India as the prime minister until 1977, and then again from 1980 until her assassination in 1984.

22 Paul R. Brass, "The Political Uses of Crisis: The Bihar Famine of 1966–1967," *Journal of Asian Studies* 45 (1986): 250. Rice that is farmed dry, like wheat, does not require the same amount of water as rice that is grown in paddies and almost always requires irrigation. The former can be successfully grown if rainfall is sufficient.

to restructure the farm economy by using larger quantities of fertilizer and high-yield seeds and by privatizing the agricultural sector had, for the most part, been a failure. But even the best fertilizer and high-yield seeds will not increase the harvest without water, and in 1965, India had neither water nor grain. The government requested 7 million tons of wheat from the United States to stave off starvation.[23]

On the receiving end of the request, President Lyndon Johnson was already disillusioned with the situation in South Asia. India and Pakistan were fighting each other with weapons provided by the United States while people were suffering from famine. He questioned just how much military and economic aid should be provided.[24] It was easy enough to cut off military aid, but Johnson would not cut off food to starving people. "The first obligation of the community of man," Johnson would later tell Congress, "is to provide food for all of its members. This obligation overrides political differences and differences in social systems."[25] However, he was willing to exploit the drought-exacerbated crisis to compel India to raise the priority of agricultural reforms – and he did.

Johnson, who had become the de facto desk officer for food aid to India in 1964, had already determined that India should become self-sufficient in food so it did not have to depend on a good U.S. grain harvest to feed its people.[26] In June 1965, Johnson began executing his "short-tether" policy. India would get wheat, and its people would not starve, but the grain would be released only just in time. The U.S. government would not make long-term wheat deals. Monthly, Johnson personally analyzed weather, water, and crop information, and then, and only then, released the grain shipments. Indian government officials were both uneasy and resentful of Johnson's short-tether tactic, but it spurred them to invest heavily in agriculture.[27]

Indeed, in late November 1965, Agriculture Secretary Orville Freeman met with Indian Agricultural Minister C. Subramaniam in Rome during the Food and Agriculture Organization meeting. They worked out a secret agreement on agriculture reform – an agreement so secret that Johnson had required Freeman to send dispatches "For President's Eyes Only" and threatened to hang Freeman's "ass from a yardarm" if anyone got wind of it. The reason: Johnson did not want it to appear that the United States had

23 Johnson, *Vantage Point*, 224; McMahon, "Toward Disillusionment," 167.

24 Johnson, *Vantage Point*, 225.

25 Lyndon Baines Johnson recommending to Congress steps in an international effort in the War against Hunger, Feb. 2, 1967, qtd. in Burns, *Heal and Build*, 32.

26 Kux, *Estranged Democracies*, 243.

27 Carleton S. Coon Jr. to Carol Laise, Mar. 2, 1966, Box 15, Folder: Unlabeled, State 5255-NARA II.

pressured India to sign the agreement. Once signed, Johnson released the wheat.[28] What he could not release was water.

Taking over after Shastri's death in January 1966, Indira Gandhi found herself leading a troubled country. The drought was taking a heavy toll; there were calls to build nuclear weapons to counter the threat from China; and the Pakistanis were lurking on the other side of a disputed border.[29] She readily accepted Johnson's invitation to make her first state visit to the United States in March 1966.[30]

In preparation for that visit, the U.S. ambassador to India, Chester Bowles, wrote a detailed letter to the White House arguing that the United States needed a long-term strategy in South Asia. Ever the India booster, Bowles pointed out that the United States needed to carefully handle India so as to produce a "political and military counterweight to China." Toward that end, the United States should assist India in generating an economic growth rate sufficient to ensure political stability and economic self-reliance. Therefore, immediate assistance should be extended to make India self-sufficient in food – through expanded fertilizer production, irrigation, pesticides, improved seeds, and other agriculture-related efforts. Indeed, Bowles was convinced that if the Indians could be persuaded that China was a threat to them, they might even join forces with the Pakistanis and improve the security of the entire region.[31] It should not have been too difficult to do the former, but the latter would have been a tough argument for the Indians to accept.

Freeman was also helping Johnson to prepare for Gandhi's visit. He stressed to Johnson that India's food situation would most likely be desperate by the fall of 1966. To prevent a humanitarian catastrophe, Freeman wanted to ship more fertilizer to India. As he put it, "The weather for next year's crop cannot be controlled, but the amount of fertilizer to be used can be."[32] Freeman correctly assessed his ability to control the availability of high-quality fertilizers, but he was mistaken about the possibility of controlling the weather during the next summer monsoon season.

Although Johnson had never been comfortable around Gandhi's father, the cool and aloof Jawaharlal Nehru, he found himself totally charmed by Nehru's daughter. Declaring that there was a "complete atmosphere of trust and confidence between India and the United States," Johnson worked

28 Kux, *Estranged Democracies*, 240–3.

29 Abraham, *Indian Atomic Bomb*, 226.

30 Kux, *Estranged Democracies*, 249.

31 Chester Bowles to Jack Valenti, Mar. 1, 1966, CF, Box 45, FO Foreign Affairs (1996), LBJ.

32 Orville Freeman to Lyndon B. Johnson, Mar. 22, 1966, WHCF CO 113, Box 38, CO 121 India 3/19/66–3/29/66, LBJ.

out a deal with Gandhi. If she devalued the rupee, the United States would provide additional aid. Although her standing within her own political party suffered, Gandhi did devalue the rupee upon her return and Johnson freed up the aid. Without making it a condition for aid, Johnson had also hoped for some support on Vietnam, which with the war's escalation in 1966 was rapidly becoming an all-consuming obsession. His hopes were dashed when Gandhi spoke out about the "aggressive actions of imperialist and other reactionary forces against Vietnam" while on a state visit to Moscow in July, thus breaking India's previous neutrality on the issue. Johnson was livid.[33] His anger over Gandhi's statements led many in the United States to believe that relations between the two countries were so strained that further support would be jeopardized.[34] That may have been true in regard to arms sales to India, but Johnson's commitment to the betterment of living conditions – including having enough food – for all people, overrode all other considerations.

Johnson kept almost constant track of India's agricultural and weather conditions during April 1966, poring over detailed rainfall maps.[35] He would later claim that he was "an authority on the climate of India. I knew exactly where the rain fell and where it failed to fall in India."[36] Meanwhile, across town in Foggy Bottom, Secretary of State Dean Rusk was digesting a point paper outlining possible foreign policy implications of weather control that had been prepared by Howard Wiedemann of State's Bureau of Intelligence and Research. Wiedemann argued that, although no nation was as yet able to threaten another nation's economy or security via weather control, given enough time, the capability would surely exist. In view of the "substantial increase" in weather modification efforts planned by the United States, it was vital that the State Department develop a policy vis-à-vis other nations because new research would be large-scale and would have an impact beyond national borders. Wiedemann continued, "Further research may lead to opportunities for using weather modification techniques for common benefit, including technical assistance to less developed countries." Alternatively, it could be used to inflict massive damage on enemies. He thought small-scale programs, such as those that increased normally expected rainfall by a few percentage points, could be a "meaningful way" to assist less developed countries. In fact, Wiedemann argued that "in attempting to assist less developed countries, it may be essential to stress the limits of weather modification in order to keep their hopes

33 Kux, *Estranged Democracies*, 253.
34 Ibid., 259.
35 Ibid., 255.
36 Johnson, *Vantage Point*, 226.

within reasonable bounds; in collaborating with other countries on international projects, it may be difficult to strike a neat balance between healthy skepticism and an imaginative approach."[37]

Although the connection between India and weather control was not yet on the State Department's horizon, the possibility of using a variety of scientific projects to prop up India's scientific and technological self-esteem in the face of yet another Chinese nuclear weapons test was. Science was clearly important to India: it had a rich tradition of research institutions begun under British colonial rule, and Nehru had publicly argued that science and technology were more important to the modern world than ideology.[38] Personnel from the State Department's Office of South Asian Affairs and the Bureau of Intelligence and Research explored India's motivation for "going nuclear" in the hope of deterring it from doing so. In May 1966, it appeared that prestige issues had been overshadowed by security issues. However, it was still possible that focusing Indian attention – and U.S. support – on orbiting satellites that would serve a variety of needs, including weather, could be an option. Another might be to offer joint Soviet and American assurances of protection against China and assistance with nonmilitary nuclear technology.[39] However, State Department officials did not think that Gandhi, despite heavy pressure in an election year, would abandon her no-bomb stance.[40] Further analysis concluded that, unless the Chinese persisted in nuclear testing, India was not likely to go nuclear. Furthermore, going nuclear would be a burden to India's fragile economy. Because the United States had already forced India to change its economic structure, withholding aid might send it into the Soviet camp – a nightmarish outcome from the perspective of the U.S. government. An official from State's Policy Planning Council concluded that they needed to convince the Indian government that financial considerations were only part of the equation. If they sought to build a bomb, it would remove some of their brightest minds from economic development. The final recommendation to the White House: make a special examination of "more specific steps

37 Thomas L. Hughes to the Secretary of State, Apr. 14, 1966, (State Department Records, Entry 3008D, Box 21, NARA II (hereafter cited as State 3008D-NARA II). The Bureau of Intelligence and Research (designated INR) is part of the U.S. intelligence community, providing analysis to State Department policy makers on issues of importance to foreign policy.

38 Nehru, "The Tragic Paradox of our Age," Sept. 7, 1958, *New York Times Magazine*; untitled notes by Eugene G. Kovach, Science and Technology, Basic Materials series, Box 7, Folder 23, Records of the President's Committee on International Scientific Activities Abroad (Sprague Committee), Eisenhower Presidential Library, Abilene, Kan.

39 Susan Tait to David Schneider, May 18, 1966, Box 15, Folder: Def 12 Armaments – Nuclear, State 5255-NARA II.

40 William J. Handley to Secretary of State, May 17, 1966, Box 15, Folder: Def 12 Armaments – Nuclear, State 5255-NARA II.

that might be taken to enhance India's political prestige, including scientific and technical projects of possible value from this standpoint."[41] Johnson accepted that recommendation. In National Security Action Memoranda 351 and 355, he directed the State Department to investigate what could be done. That task landed back on the India desk and in the science office.[42]

State Department officials became more specific about the need for scientific projects in a point paper on Indian Nuclear policy written in September. "Of particular relevance to India's prestige," a member of the Bureau of Near Eastern Affairs pointed out to the Science Office, "would be dramatic uses of modern technology to attack India's basic problems of food, population, health and education, such as the direct broadcast satellite project."[43] In particular, noting that India already had good meteorological capability, it would help to have a geosynchronous satellite stationed over the Indian Ocean.[44] Science Office officials also realized that less developed countries, India among them, were convinced that U.S. prosperity owed to its advanced position in science and technology. Therefore, good scientific relations were important to good foreign relations.[45] As the chief of India's Atomic Energy Commission, Vikram Sarabhai, pointed out, to narrow the economic gap between rich and poor nations, the poor nations would need to move directly to the applications of advanced scientific techniques.[46]

Aware of the growing dismay in India over China's continued nuclear tests, the presidential science adviser Donald Hornig, with State Department science office leaders, also had sought to identify additional ways that U.S. scientific programs could aid India and bolster U.S. foreign policy.[47] In India – where a science attaché had been stationed since 1958 – Hornig backed ongoing efforts to promote further cooperation on nuclear research, an undertaking made more difficult by the death of India's leading scientist,

41 W. E. Gathright to Garthoff, Schneider, Coon and Weiler, July 1, 1966, Box 15, Folder: Def 18–2 Reports and Data, State 5255-NARA II.

42 Carleton S. Coon Jr., to Joseph N. Greene Jr., Aug. 30, 1966, Box 14, Folder: Correspondence: New Delhi, State 5255-NARA II; see also NSAM 351, June 10, 1966, and NSAM 355, Aug. 1, 1966, at http://www.lbjlib.utexas.edu/johnson/archives.hom/NSAMs/nsamhom.asp.

43 Raymond A. Hare to Pollack, Sept. 7, 1966, Box 15, Folder: Def 18–1 USG Policy (Bilateral), State 5255-NARA II.

44 J. Wallace Joyce to Hare, Oct. 10, 1966, Box 17, State 3008D-NARA II.

45 Herman Pollack to Ambassador Kohler, Nov. 26, 1966, Box 17, State 3008D-NARA II.

46 Memo of Conversation: Science in India; Indo-US and Indo-Pak Relations, Oct. 17, 1966, Box 17, State 3008D-NARA II.

47 Hornig, memorandum for the President, Mar. 11, 1966, Box 3, Mar.-May 1966, Hornig papers; Department of State science officer J. Wallace Joyce specifically invoked NSAM 351 (which encouraged new approaches to the problem of Indian nuclear weapons development) in developing new approaches to the "Indian Nuclear Weapons problem"; see J. Wallace Joyce to Mr. Hare, Oct. 10, 1966, Box 17, 3008D, RG 59 (State) NARA II.

the atomic physicist Homi Bhahba, in a plane crash in January 1966.[48] In May 1966, Hornig had also flown to India to attend a major conference on science education.[49] Mindful of Johnson's insistence that Indian overtures not antagonize Pakistan, Hornig also secured Johnson's permission to visit Ayub Khan on this same trip. In Pakistan, he encouraged further U.S.-Pakistani cooperation on population control (an issue that both Khan and Johnson supported) and promised support for medical school training and a heart clinic.[50] He also conferred in advance of his trip with the physicist Abdus Salam, Pakistan's best-known scientist.[51] Although these efforts ultimately may have aided American relations with Pakistan, they seemed to have done little to boost India's morale.

All of these issues, coupled with Johnson's intense desire for India to feed itself and a second straight year without significant summer monsoon rains, set the stage for a possible scientific and technological fix for India's worsening drought: weather modification.

PROJECT GROMET

Researchers at the Naval Ordnance Test Station in China Lake, California, had been perfecting weather control techniques for several years. Undertaking the unclassified Project Stormfury, they attempted to disrupt – and hence "kill" or steer "safely out to sea" – Caribbean hurricanes by seeding them with aircraft-dispensed silver iodide. The classified version, dubbed "Popeye," also used silver iodide and involved an advanced pyrotechnic dispensing technique.[52] But instead of testing the seeding technique on

48 See, e.g., Hornig, Memorandum for the President, Dec. 13, 1965, Box 3, Oct-Dec. 1965, Hornig; and Joyce to Hare, Oct. 10, 1966, Box 17, 3008D, RG 59 (State) NARA II.

49 "Agenda – Programme of Discussions between the NSF Delegation and the Indian Delegation Regarding Development of Scientific and Technological Education and Research in India," NARA RG 59 Entry 3008E, Box 2, Folder: Report of Indo-American Conference on Science and Technological Education in India.

50 Ayub Khan had been particularly concerned about the high rate of cardiac disease among elite Pakistanis; see W. Rostow to the President, Apr. 25, 1966, NSF Agency File, Apr. 25, 1966, OST Vol. 1, 1966, Container 42, Johnson Library. On Hornig's views toward Pakistani science, see Hornig, Memorandum to Marvin Watson, Feb. 8, 1966, Box 3, Jan.-Feb. 1966, Hornig, LBJ. A science attaché had been stationed in Karachi, Pakistan, since 1962; see Arthur E. Pardee Jr. to Manch (NEA/EX), May 10, 1965, and John M. Tinker to Eugene G. Kovach, Sept. 15, 1964, both NARA RG 59 Dept of State records, Entry 3008E, Box 6, Folders: Karachi correspondence 1964 and 1965.

51 Hornig to Salam, Nov. 1, 1965, Hornig to Philip M. Kaiser, Feb. 24, 1966, and Hornig to Kaiser, Apr. 15, 1966, all Box 3, Hornig papers, Johnson Presidential Library. On Abdus Salam and his influence during the Cold War, see Alexis De Greiff, "The Tale of Two Peripheries: The Creation of the International Centre for Theoretical Physics in Trieste," *Historical Studies in the Physical and Biological Sciences* 33, no. 1 (2002): 33–59.

52 John K. Rouleau to Pollack via Joyce, Dec. 16, 1966, Box 21, State 3008D-NARA II.

hurricanes approaching the United States, the Popeye test area was Laos and Vietnam. As the war escalated, the Pentagon sought to step up its efforts to disrupt North Vietnam's supply lines that snaked through the Laotian panhandle and into South Vietnam. By prolonging the rainy monsoon season, scientific researchers and military planners hoped to make roads and trails impassable for a longer period. This new technique was created to target large, high-altitude clouds that had temperatures of less than twenty-five degrees Fahrenheit with specially formulated silver iodide. Once hit by these seeds, the clouds would distinctively "blow up" and subsequently drop large amounts of rain.[53] This advanced, classified method was proposed for use in India under the unclassified code name "Gromet."

In late 1966, after another poor monsoon season, Defense Secretary Robert McNamara asked Bowles if India might be interested in participating in a "Joint U.S.-India Precipitation Experiment." Without telling Bowles just where or under what circumstances this new rainmaking technique had been previously tested, McNamara cautioned him not to raise the Indian government's expectations until the method proved workable in the proposed target states: Bihar and Uttar Pradesh. However, the Defense Department was willing to start the project in January 1967 and thus attempt to improve winter and spring crop yields despite the largely unfavorable conditions of the winter monsoon – limited cloud cover. (Seeding works only when clouds are present; as hygroscopic [water attractive] as the seeds are, they do not create clouds where none exist.) As the summer (May–October) monsoon regime with moisture-laden air streaming in from the Indian Ocean kicked in, the seeding would have a greater effect and augment the normal rainfall. McNamara requested that Bowles contact Prime Minister Gandhi about the rain enhancement project. With her concurrence, a team of technical experts would develop a plan of attack with Indian scientists.[54]

State Department wariness was matched by Pentagon enthusiasm. The State Department's Science Office staffers discussed the contents of a memo that had been prepared for Rusk titled "Study of International Law and Politics of Weather Modification," the second part of which discussed the necessity of studying related legal issues "within six months." The State Department did not have six months – weather modification work was

53 Donald Hornig to LBJ, Feb. 20, 1967, NSF Country File Vietnam, Box 41, Vietnam Memos (B), Vol. 66, 2/17–28/67, LBJ.

54 Robert McNamara to Chester Bowles, 091624Z Dec. 1966, India Memos-LBJ. The estimated resources: three contract seeding aircraft, one weather reconnaissance aircraft provided by the navy, and seventeen people, for a total cost of $300,000.

already slated for India, a fact apparently unknown to the author.[55] The Science Office, concerned about being evenhanded in extending the possibility of increased rain to equally dry West Pakistan, queried Defense Department officers about extending the project beyond India's borders. The Defense Department representative thought West Pakistan would have even fewer clouds to seed than the target areas in India but promised to check it out.[56] The next day, Science Office members advised Bowles of their concerns: the silver iodide crystal production method was classified, the project was being funded and operated by the military, they could be raising false hopes among Indian government officials in an adverse climatological environment, and significant legal problems could ensue if the effects of seeding crossed an international border. Although the Pentagon's enthusiasm remained undimmed, the State Department's Science Office hoped that it was well founded.[57]

Within a week of this exchange, Hornig received word that Project Popeye had come to a successful conclusion. Passing this information on to National Security Adviser Walt Rostow, Hornig told Rostow that the Defense Department was ready to proceed with the rainmaking project in India and needed Johnson's approval.[58] In the closing days of 1966, Rostow told the president that Gromet was scheduled to move forward on a "highly classified basis." If successful, enhanced rainfall would "materially improve the chances that [the] spring's crop will produce something in the worst affected areas." The seeding aircraft would carry commercial markings and everyone involved would wear civilian clothes to reduce the chances of observers making a connection to the U.S. military. In case the media started asking questions, they had already prepared a press release explaining that an "agro-meteorological survey" was under way. Rostow closed with a spirited "May the rain makers succeed!"[59]

According to the memo of understanding, Gromet would be classified as secret while under way. The Indian government would be fully responsible for anything that happened during the project, including claims for injury

55 Rouleau to Joyce, Dec. 14, 1966, Box 21, State 3008D-NARA II.
56 John K. Rouleau to Pollack via Joyce, Dec. 16, 1966, Box 21, State 3008D-NARA II.
57 Pollack to Bowles, Dec. 17, 1966, India Memos-LBJ; Hornig to U. Alexis Johnson, June 13, 1966, Hornig chronological files, June-Aug. 1966, Box 4, LBJ.
58 Donald Hornig to Walt Rostow, Dec. 22, 1966, NSF Country File Vietnam, Box 41, Vietnam Memos (B), Vol. 66, 2/17–28/67, LBJ.
59 Rostow to Johnson, Dec. 29, 1966, NSF Country File India, Box 131, India Memos and Misc. 1 of 2, Vol. 8, 9/66–2/67, Lyndon Baines Johnson Presidential Library, Austin, Tex. (hereafter cited as India Memos–LBJ).

to persons or damage to property. Neither country would issue a public statement without the agreement of the other.[60]

Working in secrecy, Bowles planned for the experiments. The Indians did not want U.S. military involvement to become known, and the participants did not want the region's population to know exactly what they were doing.[61] The U.S. team was concerned that people living in the seeding area might conclude that the Americans were experimenting in India because it was illegal at home. Indeed, the Defense Department was the only U.S. government agency that did not have to notify Congress before undertaking weather modification experiments.[62] However, India and the United States agreed to keep Gromet secret to avoid raising false hopes for rainfall that might never materialize.[63] Some Indian officials argued that the potential political fallout was so great that if someone leaked the experiment's military connection and they had to take "defensive action," that secrecy should be abandoned. However, Bowles and others in the Indian government successfully convinced the others that they needed to see positive – and firm – results first.[64] The agreed-upon statement read:

> Scientists from the United States and India are cooperating in a joint agro-meteorological research project, localized in the Eastern Uttar Pradesh and Bihar to study the cloud physics and rain producing mechanism over these areas of India which have incurred several droughts during the last few years.[65]

In the event of public comment, the Indian government made clear that the project had to be tied to agricultural, not military, objectives.[66] In this high-stakes diplomatic game, the government of India would take credit for the scientific and agricultural breakthrough if the rains came and the harvest was good – and presumably would raise its stature with its own people and those in other Third-World nations. However, if the rain did not come and the public discovered that the "agro-meteorological survey" was really a classified U.S. military project that, in every other sense, had nothing to do with agriculture and crop yields, the United States and India could be left red faced.

60 Departments of State and Defense to Bowles, Dec. 29, 1966, India Memos–LBJ.

61 Bowles to State Department, 240512Z Jan. 1966, India Memos–LBJ.

62 John K. Rouleau to Pollack via Joyce, Dec. 16, 1966, Box 21, State 30008D-NARA II. Senate Bill 2916, which addressed weather modification experiments, had passed on October 13, 1966. It specifically excluded Defense Department activities while requiring all other government agencies (Commerce, Interior, Agriculture, Health, Education and Welfare, and the Federal Aviation Administration) to notify Congress before undertaking any weather modification operations.

63 Bowles to State Department, 240521Z Jan. 1967, India Memos–LBJ.

64 Bowles to State Department, 071255Z Feb. 1967, India Memos–LBJ.

65 Ibid.

66 American Embassy New Delhi to State Department, 301340Z Jan. 1967, India Memos–LBJ.

THE CLOUD SEEDERS ARRIVE TO CLOUDLESS SKIES

Roaring out of a cloudless sky onto an airstrip just outside of New Delhi in the early morning darkness on Monday, January 23, 1967, a large unmarked U.S. military transport plane rolled to a stop. It carried several disassembled aircraft in its belly, along with the atmospheric scientist Dr. Pierre St. Amand and his colleagues from the Naval Ordnance Test Station. The Gromet team had arrived.[67]

Unfortunately for the eager St. Amand and his associates, the weather did not cooperate. Clouds failed to appear in the project area even as they started popping up in the northern Punjab. However, because of the recent shooting down of a Pakistani aircraft in the border region, the State Department was lukewarm to the idea of extending the target area.[68] As cloudless weeks passed, the Indian government proposed other target areas.[69] The State Department remained unconvinced and wanted the final say over seeding targets, given the "sensitivity of the Gromet team activity." If the team wanted to seed outside of the previously agreed-on areas, it would need to get the State Department's concurrence.[70] Bowles and Indian officials argued for the flexibility to pursue every opportunity that would not risk diplomatic problems. Above all, they needed to demonstrate the efficacy of the new rain-enhancing technique. "Both we and the Indians want to demonstrate that if we can [make rain] that India's food and agriculture need not be entirely at the mercy of weather vagaries," Bowles wrote. Gromet was taking place in Bihar and Uttar Pradesh because those states desperately needed rain. If the cloudless conditions broke, they were ready to seed. If they did not, then the team needed to move the project somewhere that had clouds.[71] Beaten down by the arguments, the State Department approved the target shift while continuing to insist that any seeding had to have "some legitimate agricultural use beyond demonstration of the Gromet technique."[72] Furthermore, even if the seeding were successful, there would be no publicity until the military members had departed and civilian agencies were in firm control.[73]

67 American Embassy New Delhi to U.S. Naval Ordnance Test Station, China Lake, Calif. (Code 50), 270425Z JAN 67 [i.e., 27 January 4:25 AM Zulu or Greenwich time], India Memos–LBJ.

68 State Department to American Embassy New Delhi, Feb. 8, 1967, India Memos–LBJ.

69 American Embassy New Delhi to State Department, 091256Z Feb. 1967, India Memos–LBJ.

70 State Department to American Embassy New Delhi, Feb. 10, 1967, India Memos–LBJ.

71 Bowles to Rusk, 131300Z Feb. 1967, India Memos–LBJ.

72 State Department to American Embassy New Delhi, Feb. 14, 1967, India Memos–LBJ.

73 Ibid.

Seedable clouds appeared in mid-February, but there was no discernable pattern in the results of seeding. Seeded clouds were just as likely to produce heavy rain as light rain, although larger clouds tended to respond better than small clouds – probably because the former contained more moisture than the latter. Despite results from seeding projects in the early 1950s that indicated that cloud seeding worked best when the clouds would have produced precipitation anyway, the Gromet team thought that "economically valuable amounts of rain" could be induced to fall from nonraining cloud cover outside of the summer monsoon season.[74] The embassy reported that agencies throughout India were now aware of the project and had expressed great enthusiasm.[75] But the enthusiasm does not appear to have been based on solid data. The Gromet team never reported rainfall amounts – the only real measure of success. The atmosphere was so dry that any precipitation triggered by the seeds evaporated before it landed on the parched rice, which eliminated its value as an aid to plant growth. The project was not a success by any definition of the term.[76] Rostow's memo to Johnson concluded, "State and the scientists are sorting out what kind of statement to issue – if any."[77] Because the Gromet project does not appear in later books on weather control written by Indian authors, it is highly doubtful that government officials issued any public statements.[78]

Successful or not, the State Department wanted to extend the program to Pakistan to maintain the appearance of equitable foreign aid. Its prime concern – one that had existed since widespread commercial seeding had begun in the United States in the early 1950s – was that the seeding might cause water to fall in India and thereby deprive Pakistan of needed precipitation as the air moved northwest. If Pakistani leaders became convinced that the Indians were "stealing" their water, tensions between the two countries could worsen.[79] With the summer monsoon – and its significantly greater

74 Robert D. Elliott, North American Weather Consultants, "Methods of Evaluation in Cloud Seeding," presented at the Western Snow Conference, Sacramento, Calif., Apr. 22, 1952 (University of Washington Archives, Philemon Church Papers, Box 2, Folder: Cloud Seeding).

75 American Embassy New Delhi to State Department, 201254Z Feb. 1967; American Embassy New Delhi to State Department, 270916Z Feb. 1967, India Memos–LBJ.

76 American Embassy New Delhi to State Department, 281256Z Feb. 1967, India Memos–LBJ.

77 Rostow to Johnson, Feb. 28, 1967, India Memos–LBJ.

78 Neither P. Koteswaram, *Water from Weather* (Waltair, India, 1976), nor N. Seshagiri, *The Weather Weapon* (New Delhi, 1977), mention governmental rainmaking efforts in India in 1967. Kux, in *Estranged Democracies*, discusses grain shipments to India during the 1966–7 drought years but not rainmaking efforts.

79 Walter P. McConaughy, U.S. Ambassador to Pakistan, quoted in McMahon, "Toward Disillusionment," 140.

cloud cover – arriving in two months, Bowles needed to arrange for the next round of seeding.[80]

Although it made overtures to both governments, this plan hit a snag.[81] By mid-May, a frantic Bowles was still awaiting a green light from the State Department or the White House to continue Gromet. He had invested an enormous amount of time and personal capital shuttling between the State Department, the Pentagon, and the Indian government as they negotiated the terms of deploying weather modification and creating a believable cover story. Furthermore, Bowles thought he had a solid agreement with McNamara that the seeding efforts would continue through the summer monsoon months – when they were more likely to be effective – and had convinced Prime Minister Gandhi to agree to the project with that guarantee. Bowles was convinced that the "hour for Indian democracy was late," and that if the crops failed for a third straight summer and contributed to civil unrest, the "fragile Indian democracy" could be jeopardized. As the weather pattern shifted from the dry winter to the wet summer monsoon, Bowles turned to Hornig for help.[82]

Unknown to Bowles, the problem lay not with U.S. foreign policy goals in India but with the use of the "weather weapon" in Laos. In a memorandum, a clearly uneasy Rostow spelled out the problems for Johnson. Although a leak that would expose the agro-meteorological survey as a cover story for a military undertaking was unlikely, Gromet was taking place in a public venue. Someone would likely connect the distinct seed-induced cloud morphology and enhanced monsoon rainfall in India with similar phenomena in Laos.[83]

Ethical and moral issues – which had apparently not bothered Rostow when the plan first went into effect – were also now at stake. "The fact that we are going ahead with the Indian program on the basis of apparently flimsy backup evidence," Rostow wrote to Johnson, "has led to speculation that we 'know something' which has not yet appeared." He further warned that they should not underestimate the "degree of revulsion to be expected in domestic and international meteorological circles."[84] That was an understatement. Domestic meteorological circles, including the National

80 State Department to American Embassies New Delhi, Rawalpindi, Mar. 8, 1967, NSF Country File India, Box 31, India Cables Vol. IX, 3/67–7/67, LBJ (hereafter cited as India Cables–LBJ).

81 State Department to American Embassies New Delhi, Rawalpindi, Mar. 15, 1967, India Cables–LBJ.

82 Bowles to Hornig, May 11, 1967, India Cables–LBJ.

83 Rostow to Johnson, May 22, 1967, NSF Country File Vietnam, Box 88, Vietnam 3P, Project COMPATRIOT, 5/67–7/67, LBJ.

84 Ibid.

Academy of Sciences' Committee on Atmospheric Science, had condemned cloud seeding for military purposes. When the atomic bomb physicist Edward Teller had argued for using cloud seeding in Vietnam – relating that personnel from the Naval Ordnance Test Station at China Lake had claimed that they could muddy up the Ho Chi Minh trail – several committee members challenged him. The Massachusetts Institute of Technology's Jule Charney, a pioneer in numerical weather prediction, had spoken out strongly against it.[85] Despite the academy members' opposition to weather control on moral, ethical, and scientific grounds, Johnson used it anyway.

THE OUTCOME

In early June 1967, Hornig informed Johnson that a U.S. Agency for International Development team would be establishing a permanent weather modification program in India despite possible legal and international complications,[86] but archival evidence suggests that the program never went forward. Abundant summer monsoon rains – unaided by cloud seeding – quenched the drought in 1967. The combination of abundant water, more fertilizer, and improved seeds resulted in Indian farmers' harvesting a bumper grain crop. As the specter of famine faded away, so did the "agro-meteorological survey." On the diplomatic front, the State Department was no longer worried about the harvest. Defense did not need its cover blown in Laos. Gromet quietly died, and with it the chance for India to make a big splash in weather control for agricultural purposes.

In the end, the secret "agro-meteorological survey" was doomed by the effects of unsuccessful cloud seeding combined with the perceived risk of exposing weather control's use as a weapon. But Johnson's willingness to use advanced weather control techniques to solve India's water and food problems was part of his larger desire to control the environment to improve people's lives – even though he was simultaneously using the same tool to hamper North Vietnam's supply lines.[87]

Although disagreements over Vietnam and tightened food shipments may have led to a public appearance of bad relations between the United States and India, behind the scenes, environmental diplomacy was at work. Gromet gave Johnson another tool to bolster the Indian government through an

85 Robert G. Fleagle, *Eyewitness: Evolution of the Atmospheric Sciences* (Boston, 2001), 76.

86 Hornig to Johnson, June 5, 1967, CF Box 85, Folder: SC Sciences, LBJ. In this memo, Hornig warned Johnson that the international implications were severe – adding that the state of Maryland had declared any form of weather modification to be a crime.

87 Walt Rostow, qtd. in Kux, *Estranged Democracies*, 243.

improved agricultural outcome. It gave the State Department a tool that it hoped would increase the confidence of Indian science and technology – and lead away from building nuclear capability. And, of course, for the U.S. military, Gromet provided an ideal opportunity to test its secret weather modification techniques away from the prying eyes of those who might be able to connect military personnel and aircraft with enhanced precipitation during the rainy monsoon season. Furthermore, it gave the Defense Department yet another opportunity to try out its new weapon in a very different weather regime – potentially valuable information that it could use in the future if environmental diplomacy failed and South Asia turned out to be the perfect spot to exercise the weather weapon.

And today? After a lapse of a couple of decades, weather control is on the public scientific agenda again – the changing global climate affects the distribution and amounts of precipitation, and freshwater availability is becoming an increasing problem for millions of people – despite increased public concern over using technological fixes to resolve challenges of this sort.[88] The scientific opinions of National Academy of Sciences members on weather control did not hold sway with the Johnson administration in the mid-1960s. Forty years later, this same body has proposed additional research as one part of the complex water problem facing the world.[89] Will atmospheric scientists embrace weather control this time? And will it matter to policy makers and the public whether they do? It will be important to examine whether this technological fix, which crosses international boundaries, enhances diplomatic efforts or leads to increased conflict as we consider the elements that will contribute to environmental history in the twenty-first century.

88 On the latter, see Edward J. Tenner, *Why Things Bite Back: Technology and the Revenge of Unintended Consequences* (New York, 1996).

89 National Research Council, *Critical Issues in Weather Modification Research* (Washington, D.C., 2003).

5

Containing Communism by Impounding Rivers

American Strategic Interests and the Global Spread of High Dams in the Early Cold War

RICHARD P. TUCKER

The most direct environmental impacts of the Cold War were caused by the massive military industry complexes of the two blocs dominated by Washington and Moscow. The supporting substructures of modern military machines include sustained mobilization of civilian populations and exploitation of natural resources. And beyond the borders of the two blocs, in the setting of East–West ideological competition, the competing superpowers devised broad economic and social development programs designed to convince formally neutral elites in the Third World that either communism or free enterprise carried the key to future prosperity and political control. The industrialization of nature accelerated enormously in the contested geographical zone of nonaligned countries and in the shadow zone between peacetime and conflict that characterized the Cold War era. The most massive projects for transforming nature to suit Cold War strategies were river basin development programs centering on high dams.

From the 1940s onward, hundreds of rivers throughout the world submitted to construction of high dams, with their attendant man-made reservoirs, irrigation networks, expansion of arable land, power grids, and industrial complexes. Entire populations were relocated or reorganized, as mountain watersheds were brought under logging regimes and soil-rich valleys were flooded or tuned to intensive market-oriented agriculture.[1] Cold War geopolitical strategies were a driving motivation for the locations of a series of these dams. Indeed, much of the map of the world's dammed rivers reflects Cold War zones of competition, and the concentration of fiscal and industrial resources at many dam sites in remote locations cannot be fully explained outside the framework of Cold War rivalries.

1 See the survey in Patrick McCully, *Silenced Rivers: The Ecology and Politics of Large Dams*, rev. ed. (London, 2001).

During the first two decades of the Cold War, the United States played a dominant role in the domestication of major river systems. American hydrological engineering was in some instances vital to the development of sustainable river management systems; in many others, however, it resulted in the ecological degradation of freshwater ecosystems. American engineers' experience with river control had begun in the 1820s with the Army Corps of Engineers (COE), which managed eastern and midwestern rivers for flood control and river navigation.[2] By the late 1800s, as the arid western states were being settled, the need for massive irrigation systems led to the creation of the Bureau of Reclamation (BOR) in 1902.[3] Between them, the two agencies provided the world's largest cadre of experienced river basin managers by the 1930s. In the aftermath of World War II, senior figures in both agencies, working in tandem with State Department Cold War strategists, were well positioned to become development advisers to governments around the world.

American preparation for the leading role in global river basin domestication was completed during the Great Depression of the 1930s by dramatic breakthroughs, first in the design and construction of high dams and then in basinwide development projects. First came a major breakthrough in the design of dams in the 1920s: until the Hoover Dam was built on the Colorado River in the early 1930s, no society had ever achieved engineering skills and organizational coordination on such a massive scale.[4] Hoover Dam towers 726 feet above the bottom of its gorge. It was made technically possible only when six major engineering corporations formed a consortium, the famous "Six Companies," to work hand in hand with federal agencies. Two of them, Morrison-Knudsen and Bechtel, used the experience and profits generated by the project to become among the most powerful global construction firms after 1945.[5]

Even more innovative was coordination of economic and social development throughout an entire river basin around the key points of major dams. This was achieved in the form of the New Deal's showpiece, the Tennessee Valley Authority (TVA). David Lilienthal and his close friend Gordon Clapp, successive heads of the TVA, later played highly visible roles in domesticating the world's rivers.

From the early 1940s onward, leading hydro-engineers and heads of state from around the world went on pilgrimage to Hoover Dam, the TVA, the

2 For a brief history, see *The History of the US Army Corps of Engineers* (Washington, D.C., 1978).
3 William Warne, *The Bureau of Reclamation* (New York, 1973).
4 Donald Worster, *Rivers of Empire: Water, Aridity and the Growth of the American West* (New York, 1985).
5 Peter Wiley and Robert Gottlieb, *Empires in the Sun* (New York, 1982).

Corps of Engineers, and the Bureau of Reclamation, studying these beacons of development and adapting them to the circumstances of their own river basins at home. In addition, after the war, many Third-World engineers and planners took training courses at BOR headquarters in Denver. In this way, American agencies achieved growing influence over the international professional subculture's worldview.[6]

Organization on the scale of entire river basins provided one of the headiest challenges for the competing political systems of the Cold War. Each sought to satisfy the resource demands of its military and, with an eye toward the global ideological competition, to demonstrate its technocratic prowess. On one side of the Iron Curtain, as Paul Josephson describes in this volume, Soviet authorities strove to demonstrate the superiority of command economies for this Herculean task, whatever the social and ecological costs might be.[7] Their dams and river basin transformations penetrated even the vast, ecologically fragile reaches of Siberia. They focused on industrial development within the boundaries of the Soviet Union, much of that for military or adjunct purposes.[8] But geopolitical realities meant that Soviet dam builders operated, for the most part, within the limits of the Soviet bloc; with a few exceptions, they did not play important roles in domesticating river basins around the Third World.

Soviet central planning's competitor was the American model of cooperation between government and private enterprise that had developed under the New Deal during the 1930s. No New Dealer was more eloquent than David Lilienthal in offering a vision of democracy with voluntary participation by local communities linked with government agencies' planners and private-sector engineering firms. Lilienthal saw the TVA as a model to be adapted throughout the world. In his 1944 book *TVA: Democracy on the March*, he wrote, "Our foreign visitors see with particular clarity that TVA speaks in a tongue that is universal, a language of things close to the lives of people: soil fertility, forests, electricity, phosphate, factories, minerals, rivers."[9]

6 For one major example from India, see Kanwar Sain, *Reminiscences of an Engineer* (New Delhi, 1958), chap. 5. The Bureau of Reclamation hosted both the 1948 Inter-American Conference on Natural Resources and a major international hydro-engineering conference in 1954, which hundreds of foreign engineers attended.

7 Paul Josephson, Chapter 1 in this volume.

8 During the same years, older European empires were also using strategies of rapid agricultural expansion to strengthen their hold on overseas territories. The French in North Africa were a case in point. In Morocco, for example, dam projects helped the French to maintain political control and European-settler dominance during the 1950s. See Will D. Swearingen, *Moroccan Mirages: Agrarian Dreams and Deceptions, 1912–1986* (Princeton, N.J., 1987).

9 David Lilienthal, *TVA: Democracy on the March* (Chicago, 1944).

From the late 1940s, as Europe's colonies were gaining independence and Latin America was moving toward rapid industrialization and economic growth, American planners added to this vision a sense of urgency to keep Third-World countries voluntarily aligned with the West. They shared the fervent anticommunism of the early Cold War with nearly all other Americans. This story has been told innumerable times, but the earthshaking dimension of ecological change that it created has been largely ignored in the political and diplomatic literature.

In the first two decades of the Cold War, a loose alliance of American engineers, managers, and diplomats was a driving force behind the construction of hydro-projects in nearly every country on or near the southern periphery of the Soviet Union, along an arc stretching from Egypt to the Philippines. U.S. Cold War priorities thus help to explain the locations, timing, beneficiaries, and social and environmental costs of those projects. A survey of these projects demonstrates the decisive American role in the domestication of river basins throughout that wide region.

DEVELOPMENT AID AGENCIES AS CHANNELS FOR AMERICAN HYDRO-TECHNOCRACY AFTER WORLD WAR II

The era of massive infrastructure construction began immediately after 1945. This construction was facilitated by new U.S. governmental agencies and international institutions designed to mobilize capital, engineering skills, and organizational expertise. One new agency to oversee foreign economic aid had already been created during the war. First named Point 4, it was soon remodeled as the International Cooperation Agency (ICA), the forerunner of the U.S. Agency for International Development (USAID). Another important agency was the Export-Import Bank (Eximbank), which had its origins in the Depression. Founded in 1934 to stimulate American foreign investment, it was rapidly expanded after the war; by 1958, its lending capital had reached $7 billion.[10] The Eximbank functioned explicitly as a promoter of U.S. strategic and commercial interests abroad. It cooperated closely with the Department of State, the Department of Commerce, and the ICA, all of which were represented on its board, along with the American executive director of the World Bank. The Eximbank favored loans for capital projects, especially power, transportation, and public utilities, giving long-term credits to U.S. investors. Criteria for support included the

10 Raymond F. Mikesell, "The Export–Import Bank of Washington," in *U.S. Private and Government Investment Abroad*, ed. Raymond F. Mikesell (Eugene, Ore., 1962), 459–82; Raymond F. Mikesell, *Foreign Investments in Latin America* (Washington, D.C., 1955), 5, 121–3.

stipulation that projects "must be in the national interests of the United States; there must be no interference with private capital; there must be reasonable assurance of repayment; and the loan will promote the foreign trade of the United States."[11] Many of the loans were for the export of U.S.-made components of hydroelectric dams, power grids, and irrigation systems; funding included the considerable costs of hiring American consultants. For purposes of long-term profitability and repayment, Eximbank was intended to finance hydroelectric dams only if industries and transmission lines were being developed to use the power generated and only if irrigation works were maximized. But because the bank was perennially understaffed, reviews were generally limited to brief visits by Eximbank officers to recipient countries.

United Nations agencies were equally central to the global spread of large-scale development projects. From its inception, the United Nations was a major conduit for the Americans as well as for their competitors and collaborators from other industrialized countries. The year 1949 marked a culmination of global development planning, in the UN Scientific Conference on the Conservation and Utilization of Resources, held that September at the temporary UN headquarters in Lake Success, New York. One of the most important sessions of the conference was titled "The Integrated Development of River Basins: The Experience of the Tennessee Valley Authority." Gordon Clapp, David Lilienthal's close friend and successor as chair of TVA, gave the keynote speech. Outlining its objectives and projects, he described TVA as a social crusade designed to raise masses of rural poor out of perennial degradation by uniting modern science under highly trained technocrats with participation by local people in a voluntary process that was a model of democracy – a model far more effective and attractive than any authoritarian route to development. This model also envisioned a modern multidimensional conservation: more efficient, less wasteful utilization of soil, water, and crop resources of entire river basins than under either uncoordinated previous conditions or authoritarian systems.[12] This was an early appeal to integrated resource management, but in subsequent years, the urgent race for development relegated careful conservation of water and soil resources to the periphery until the late 1960s and beyond.

American hydro-engineers already had channels to well-paid consultancies and development influence in many countries through the World

11 Mikesell, "The Export-Input Bank of Washington," 477.

12 Gordon Clapp, "The Integrated Development of River Basins: The Experience of the Tennessee Valley Authority," *United Nations Scientific Conference on the Conservation and Utilization of Resources* (New York, 1948).

Bank and the UN Development Programme, the major multilateral agencies working on high dams and integrated river management. In the postwar years, senior officials of the Corps of Engineers and Bureau of Reclamation were available to lead feasibility and preinvestment surveys.[13] Shortly after taking office in 1953, President Dwight Eisenhower made major cutbacks in federal agencies' budgets, which caused many COE and BOR engineers to look for work in international agencies.[14] Michael Straus, the head of BOR, observed, "In contrast to the United States, which in 1953 started on an era of federal 'economy' with a reduction of national government contribution to water development, other lands are increasing the economic and financial support of central governments to all forms of water development – domestic, industrial, irrigation, and hydroelectric."[15] Chafing at Eisenhower's negativity toward federal agencies, he and colleagues were happier in other countries that were more committed to government-led and publicly funded expansion.

There were many opportunities for international consultancies, for the engineers' interests were linked with the State Department's priorities under Secretary of State John Foster Dulles. Through these channels, Hoover Dam and TVA became the dominant models for hydro-engineers and economic planners worldwide, as symbols of dynamic resource development to alleviate poverty and outcompete communism. Significantly, in the 1953 revised edition of *TVA*, Lilienthal, quoting Justice William O. Douglas's 1951 lecture, added the argument that only this people-oriented democratic technology could stop the "Red Tide":

> If we are bold enough to make this device an instrument of our Asiatic foreign policy, we can take the political initiative away from Soviet Russia, turn the tide and win country after country for the democratic cause. . . . TVA represents an idea that can be utilized as one of the major influences to turn back the tide of Communism which today threatens to engulf Asia.[16]

American construction firms became deeply involved in this work as well, though they were never publicized beyond professional circles in the way that Lilienthal and the official planners were. The six companies that had built Hoover Dam were prime competitors for lucrative contracts on one project after another. In tandem with the hydro-planners from TVA,

13 For the bank's views on their role, see Eugene R. Black, *The Diplomacy of Economic Development* (Cambridge, Mass., 1960).

14 Michael W. Straus, *Why Not Survive?* (New York, 1955), 78.

15 Ibid.

16 See Lilienthal, *TVA*. For a balanced assessment of his career, see Steven M. Neuse, *David E. Lilienthal: The Journey of an American Liberal* (Knoxville, Tenn., 1996).

they served the strategic interests of both Washington and the national elites of host countries.

The result of this collaboration was a series of major hydro-engineering projects that ranged from the Aswan Dam on the Nile, across the arc of the Middle East and southern Asia, to the elaborate Mekong Basin project and the Ambuklao Dam in the northern Philippines.

LEVERAGE AGAINST SOCIALISM IN THE ARAB WORLD: THE ASWAN DAM ON THE NILE

The most controversial of them all, and probably the most politically momentous, was the High Dam at Aswan on the Nile River in southern Egypt. The unpredictable annual flow of the Nile from upriver seasonal rains flooded downstream farmlands in high-water years, covering fields with fresh, fertile silt, but caused severe deprivation in years of low flow. It was the perennial dream of governments throughout Egypt's long history to control the Nile and regulate its annual flow.[17]

In the nineteenth century, British agronomists and hydrologists created the great Gezira market agriculture zone upriver in Sudan, producing cotton and grains for international markets. Colonial engineers looked downriver to the greater challenge of storing water and managing flooding in the lower Nile Basin. The British engineering firm Sir Alexander Gibb and Partners built a low dam at Aswan in three stages (1901, 1912, and 1933) primarily to store water for expanding and stabilizing irrigation.[18] By the mid-1930s, Hoover Dam had demonstrated that a far more massive structure, equal to the challenge of the Nile, was possible. Gibb and others conducted a series of hydrological and engineering studies in the 1930s and continuing after the war, for massive floodwater storage and also for hydroelectric power generation. The Nile had probably become the world's most carefully studied river.

Moreover, the lower Nile, centering in Cairo, was one of the world's most strategic crossroads, offering control of the Suez Canal. The effete pro-Western regime of King Farouk was overthrown in 1952 by army officers led by Gamal Abdel Nasser, an impassioned Egyptian nationalist and neutralist in the Cold War. Nasser was eager for a historically momentous

17 See Karl W. Butzer, *Early Hydraulic Civilization in Egypt: A Study in Cultural Ecology* (Chicago, 1976).
18 Robert L. Tignor, "British Agricultural and Hydraulic Policy in Egypt, 1882–1892," *Agricultural History* 37, no. 2 (1963): 63–74; M. A. Selim, "High Aswan Dam," *Proceedings of the Fifth Congress of Large Dams* (Paris, 1955), 1–2.

showpiece project, and the High Dam at Aswan was waiting to be built.[19] The new revolutionary government in Cairo first relied on a West German consortium, Hochtief and Dortmund Union, to complete plans and then convened an international board of consultants to assess the Germans' approach.

Politics quickly took command, however. Nasser, resentful of the history of British overlordship in Egypt, opened negotiations with Moscow to build the dam. British Prime Minister Anthony Eden was eager for the United States to join him in counternegotiations, hoping to retain British control over the dam project and thus restrain Nasser from moving too far into the Soviet orbit. Dulles agreed in December 1955, suspicious that Nasser was using Aswan as a trump card in Cold War maneuvering. Hoping to gain greater American influence in that linchpin of the Middle East, Dulles offered $400 million in loans and grants from the United States, Britain, and the World Bank to begin the project.

In preparation for this move, the World Bank had sent experts led by Gail Hathaway, head of the Bureau of Reclamation, in December 1954 to review earlier technical studies for the dam. With minor reservations, they approved the plans.[20] At the same time, an Egyptian team gave quick and optimistic cost-benefit estimates for the project, emphasizing flood control, irrigation, and hydroelectric power but ignoring knottier issues such as disrupting the cycle of siltation, disease vectors in the future reservoir, and other environmental risks.[21] This estimate stood virtually unchanged for a decade and longer, politically insulated by Nasser's inner circle from other scientists' questions about evaporation and seepage of water in the system – to say nothing of the many other environmental changes that would be catalyzed.

The World Bank's experts also conformed to the Egyptian government's determination to move ahead. They failed to raise any questions about sedimentation, including the ending of silt deposition downriver from the dam, erosion of the Mediterranean coastline, or waterlogging irrigated fields. One incisive commentary points up "the primacy of politics; the technological dimension, even when disaggregated, was clearly secondary

19 For the most thorough survey of the project's history, see John Waterbury, *Hydropolitics of the Nile Valley* (Syracuse, N.Y., 1979). An excellent summary of the issues is in Arun P. Elhance, *Hydropolitics in the Third World* (Washington, D.C., 1999).

20 See Hathaway Papers, Folder 53: Aswan, Personal Notes, 1954–55, University of Wyoming Archives.

21 Robert W. Rycroft and Joseph S. Szyliowicz, "The Technological Dimension of Decision Making: The Case of the Aswan High Dam," *World Politics* 33, no. 1 (October 1980): 33–61; here, 47–8.

to political considerations. . . . Only on the narrowest issues did technical concerns reign supreme."[22]

In May 1956, Nasser recognized the People's Republic of China; that move provoked massive political pressure in the United States for Washington to cancel the loan, which Dulles did in July, despite the likelihood that doing so would end American involvement on the Nile. A week later, Nasser nationalized the Anglo-French Suez Canal Company. War between Egypt and Britain and France soon followed.[23]

In the aftermath of his military defeat, Nasser turned to Moscow to build the dam, using Soviet engineers and equipment, but he also granted the Gibb firm a ten-year design contract. The great dam was designed to be 365 feet high and to impound 100 million acre-feet, three times the capacity of Lake Mead behind Hoover Dam. It was projected to irrigate more than 2 million acres of land. Warnings of severe siltation in the reservoir were largely dismissed. The fact that the downstream flow of silt would be ended was countered with arguments that it would be replaced by a more modern alternative, chemical fertilizer produced with Aswan electric power. By the early 1960s, sixty-five Soviet engineers and two hundred Egyptian engineers and technicians were on-site, using mostly prewar heavy equipment.[24]

The dam was completed in 1968 and formally opened in 1971, triggering an immediate storm of criticism from Western environmental engineers and journalists. Claire Sterling concluded in *National Parks and Conservation Magazine* in 1971 that the dam "made [Nasser's] political fortunes, but spread such ecological havoc that his country may never get over it. . . . The blame must be shared by the West German engineers who designed the High Dam, the World Bank which approved it, the American State Department which agreed to finance it and backed out only for political reasons, the Russians who finally let Nasser have it – in short, an entire generation distracted by politics and bemused by technology."[25]

In response to the controversy, Khalil Mancy, an Egyptian-born environmental chemist at the University of Michigan, organized a joint Egyptian-U.S. team in 1975 to conduct the River Nile and Lake Nasser Research

22 Ibid, 61.

23 Richard H. Immerman, *John Foster Dulles: Piety, Pragmatism and Power in U.S. Foreign Policy* (Wilmington, Del., 1999), 147–9; William Roger Louis, "Dulles, Suez, and the British," in *John Foster Dulles and the Diplomacy of the Cold War: A Reappraisal*, ed. Richard H. Immerman (Princeton, N.J., 1990), 144–7.

24 Waldo G. Bowman, "Construction Begins on Aswan," *Engineering News-Record*, February 23, 1961, 32–8.

25 Claire Sterling, "The Aswan Disaster," *National Parks and Conservation Magazine*, August 1971, 10.

Project.[26] Mancy concluded in 1981, "Early prognostications of the damaging side effects of the Dam have been greatly exaggerated. Taking into consideration the pressing economic needs of the country, the transformation of the Nile into a placid and fully controlled year-round source of water and energy has been a valuable asset for Egypt's development."[27]

Environmental critics were not reassured, and controversy has remained heated to this day. The most balanced conclusions were asserted in 1988 by the American Gilbert White, who was widely acknowledged to be the most eminent international specialist in the field. White wrote, "There has been sufficient time to permit a first approximation of what is known about the dam's environmental effects and how they compare to what was anticipated when engineers and politicians decided to undertake the massive project."[28] In a careful review of the existing monitoring, White concluded that channel erosion north of the dam and along the delta shores had increased significantly, that newly irrigated land reclamation projects had produced serious problems of salinity and waterlogging, that fisheries had increased in Lake Nasser but had declined downriver, that waterborne diseases plagued the reservoir, and that many thousands of Nubian villagers had been forced from the riverbanks as the waters rose. Power generation at the dam site had not yet reached its projected peak but had added some 30 percent to Egypt's energy supplies. The annual flooding had indeed been largely controlled, for the first time in Egypt's history, but at a high and complex cost.

The geopolitical dimension of Aswan Dam had its own ironies. Within five years of the inauguration of Moscow's showpiece on the Nile, all Soviet advisers were expelled from Egypt. Neither the Americans in the 1950s nor the Russians a few years later succeeded in using the Aswan project to penetrate the political power structures of that crucial country.

CHECKING STALINISM: THE DEZ DAM IN IRAN

The American political and technical involvement in transforming the Nile was carried on in an intricate international web of interests. Elsewhere, the American presence was dominant. Across the southern skirts of the Soviet Union, a garland of new hydro-projects in the 1950s cemented

26 Susan Walton, "Egypt after the Aswan Dam," *Environment* 23, no. 4 (May 1981): 31–6.

27 Khalil H. Mancy, "The Environmental and Ecological Impacts of the Aswan High Dam," *Developments in Arid Zone Ecology and Environmental Quality* (1981): 83.

28 Gilbert White, "The Environmental Effects of the High Dam at Aswan," *Environment* 30, no. 7 (September 1988): 5–40.

America's ties with its new allies. One was built on the Dez River, which flows from the Zagros Mountains in western Iran through the plains of Khuzistan down to the Persian Gulf. The Zagros Mountains were home to Bakhtiari and Qashqai transhumant pastoralists descended from Scythian tribes that had migrated there three thousand years earlier. During winter snows, they migrated downward to winter grazing lands in mountain valleys and south into Khuzistan. These people had largely evaded the authority of central governments in modern times. From the early 1920s, Reza Shah Pahlavi had attempted to pin them down, just as central governments have struggled to control pastoralists around the world. Depriving them of their winter grazing grounds promised to disrupt their age-old migrations and bring them under control at last. The heartland of the Achaemenid Empire twenty-five centuries before, the dry but fertile Khuzistan lowlands awaited irrigation water and power to become a regional agricultural heartland once again. Khuzistan also held one of the world's largest oil reserves, around the Shatt al Arab, waiting for water and power for exploitation. So the shah had every reason to be interested in a massive showpiece project designed in the industrial West.

The feasibility of a dam in the gorges of the Dez was first studied by German engineering surveyors in the 1930s. After the war, the Germans (both reconstructed private-sector engineering firms and the West German government) were in no position to compete with the Americans. In March 1956, after a Central Intelligence Agency–engineered coup overthrew Mohammed Mossadegh's anti-Western regime in 1953, the old shah's heir, Mohammad Reza Shah Pahlavi, approached the Development and Resources Corporation (DRC) of New York, which Lilienthal and Clapp had formed in the previous year, to plan and supervise the construction of the dam.[29]

American economic aid missions had been operating in Iran since 1951. In what one leading journalist called an "effort to boost the standard of life in a country that came close to being overwhelmed by Communism,"[30] William Warne and his Point 4 team built roads and village schools, dug rural sewage systems, and sprayed DDT over large agricultural areas and wetlands to control widespread malaria.[31] But the plains of Khuzistan demanded a larger scale of work to harness upstream water. Following the shah's

29 Gordon R. Clapp, "Iran: A TVA for the Khuzestan Region," *Middle East Journal* 11, no. 1 (Winter 1957): 1–11; David E. Lilienthal, *The Journals of David E. Lilienthal*, vols. 4–5 (New York, 1969, 1971).

30 Marquis Childs, in *St. Louis Post-Dispatch*, August 4, 1957.

31 See William E. Warne, *Mission for Peace: Point 4 in Iran* (New York, 1957), for an overview of its agenda and ideology.

invitation, the DRC surveyed the region's water resources, and an aerial reconnaissance in 1956 discovered an ideal but challenging site for a high dam, in a 1,200-foot-deep canyon previously known only to shepherds. In the following year, the DRC proposed building a dam such as had never before been seen in that part of the world.

Morrison-Knudsen won the contract to build the access roads, diversion tunnel, and construction camp in 1958–9 but surprisingly lost the primary contract to construct the dam and spillways to an international consortium led by the Italian civil engineering firm Impresit, with the United States and United Nations providing technical oversight.[32] Completed in 1963, the Dez Dam was the highest in the Middle East (and seventh highest in the world at the time), at 203 meters. It was projected to supply electricity to villages, cities, and industries throughout the region, as well as irrigation water to 145,000 hectares in the Khuzistan plains, including a massive new sugarcane plantation. Moreover, it guaranteed a more reliable supply of power and water for the Abadan oil refinery, the world's largest until it was crippled in 1980 during the Iran-Iraq War. The stakes for this project were high; the planning and implementation of all technical aspects were tied so closely to American experts in those years that the experts were virtually indispensable.

William Warne revisited Khuzistan and the Dez Dam in 1967. In a privately circulated report, he noted that twenty thousand hectares were newly irrigated or being prepared, and power was flowing to the rapidly expanding petroleum complex as well as to an aluminum refinery built by Reynolds Metal. Only implicit were two strategic realities: the United States was a major customer for the oil of Khuzistan, and the shah's regime was using the area's development as a key to its rivalry with Iraq.[33]

In 1957, Gordon Clapp had written that the experience of the TVA in linking ordinary people with their governments could be carefully adapted to the very different "culture, traditions, skills and aspirations of local people" in Iran and elsewhere around the Middle East, where traditions of open democracy were extremely fragile. He knew that politics was both the context and the ultimate purpose of multipurpose economic and social development. He hoped that the Khuzistan project could answer the

32 Details are in Khuzestan Water and Power Authority, "A Commemorative Booklet," typescript, October 1961; and "For Many Tomorrows: A Progress Report on the Activities of the Kuzestan Water and Power Authority, 1960–1964," typescript, both in William Warne Papers, University of Wyoming.

33 William E. Warne, "Report on Iran, Fifteen Years Later," January 10, 1967, typescript in William Warne Papers, University of Wyoming.

challenge: "How the industrialized Western countries can make their experience available to the newly awakened countries of the East, on a basis which is both acceptable and workable. The program in the Khuzestan region . . . could far outweigh its immediate aim of helping the farmers and townspeople of Iran build their own version of a better life."[34]

But implementation of the project's downstream possibilities was disastrous. By the 1970s, only one-fifth of the originally projected irrigated acreage downstream had actually been watered, and most of that was claimed by foreign investors and agribusiness corporations, including Chase Manhattan Bank, Bank of America, and John Deere, for export cropping rather than for food production for the farming and urban population of Khuzistan.[35] Men in Clapp's position, however politically influential they might be, could not prevent the shah's regime from sliding into an authoritarianism so brutal that the regime was ousted from power in the revolution of 1979 and replaced by a fundamentalist Shiite religious establishment that had no place for Western advisers. In the 1980s, the Khuzistan lowlands and oil industries were battered by the protracted war with Iraq, and even today it is difficult to know what the longer-range environmental consequences of the Dez Dam on its region have been.

INTRODUCING MODERNITY: THE HELMAND VALLEY PROJECT IN AFGHANISTAN

Across the eastern frontier of Iran lay Afghanistan, where in 1929, King Zahir Shah's father had established a state dominated by ethnic Pashtuns. Zahir Shah and his Western-educated royal relatives faced the task of extending Kabul's hegemony over the ethnic Tajiks, Hazaras, and other groups that together were a majority inside the artificial boundaries of the young country. Economic modernization along Western lines emerged as a centerpiece of their strategy. In the 1930s, the young king hired Europeans, primarily Germans, to begin building modern road and communications systems for central Afghanistan, but that effort collapsed when war engulfed Europe and beyond in 1939. Immediately after the war, Zahir Shah turned to the United States, contacting Morrison-Knudsen in 1946 about the feasibility of a major development scheme for Afghanistan's largest lowland area, the Helmand River valley, along the lines of the TVA.[36] Contracts were quickly signed, and Morrison-Knudsen assumed the primary role in

34 Clapp, "Iran: A TVA for the Khuzestan Region," 8, 11.
35 See http://www.ilisu.org.uk/impregilo.html.
36 For the political setting, see Louis Dupree, *Afghanistan* (Princeton, N.J., 1973).

creating an elaborate series of dams, canals, supporting roads, and other basic infrastructure for the region west of Kandahar, far to the southwest of Kabul.

For Americans, this was an entirely new venture in a part of the world where they had no experience, and in conjunction with a regime that had few previous links to the United States. They had to overcome great logistical challenges as well as political difficulties in working with their Afghan hosts. But they shared, or at least acquiesced in, some social assumptions of the rulers in Kabul. Among those assumptions was the view that migratory herdsmen should be settled on newly irrigated lands, for purposes of both political control and economic growth. Here, as in a steadily lengthening list of societies, American power was to be put at the disposal of a development strategy that aimed to produce nations of settled farmers and urban consumers under regimes dedicated to anticommunist political stability.

The Helmand Valley and its extension, the Arghandab lowlands, constitute by far the largest relatively flat region of Afghanistan. Their joint river system flows slowly southwestward through arid land, draining into wide marshlands on both sides of the Iranian border. Before the 1940s, the region had supported some small irrigated-farming settlements along rivers and streams but was dominated by the wide pasture lands spreading into mountainous hinterlands. Although the migratory pastoralists were largely Pashtun, they resisted urban authority like shepherds worldwide. A multipurpose river basin project might provide Kabul with the social engineering and dominance over the Kandahar region it wanted as well as a dramatic increase in wheat production for urban consumers from vastly expanded irrigated lands.

The project began rapidly. Morrison-Knudsen dispensed with its usual soil and drainage studies and built the first small diversion dam in 1949.[37] Environmental troubles were immediately evident when the water table rose to within inches of the soil's surface, and salts began to poison irrigated farmlands.

But no one in political authority was in a mood for caution. Point 4 was newly launched in Washington, designed to outcompete the Soviets in world development; and the Afghan regime was determined to pursue its development goals aggressively. In 1950, the U.S. government granted its first Eximbank loan, $12 million, to Afghanistan, the start of a fund that grew to $80 million by the mid-1960s. In 1952, in response, the Kabul

37 This and subsequent details are taken from Nick Cullather, "Damming Afghanistan: Modernization in a Buffer State," *Journal of American History* (September 2002): 512–37.

regime created the Helmand and Arghandab Valley Authority (HAVA), modeled in some respects after TVA. But like adaptations of TVA elsewhere in the Third World, HAVA was much more authoritarian than TVA was. It quickly centralized control of the region, commandeering 1,800 square miles of land from farmers who lacked clear legal title to their traditional lands. Before the decade was over, two large dams had been built: the 200-foot Arghandab Dam, which stretched a third of a mile, and the 320-foot Kajakai Dam, along with smaller diversion dams, drainage systems, and irrigation canals. These projects displaced many farmers and herdsmen and caused waterlogging and weedy growth on former fields, as well as salination of soils throughout the system.

The Helmand project became an internationally notorious example of failures of development aid. One participant, Aloys Michel (later the author of the impressive study *The Indus Rivers*), wrote a sharp critique of the project from the inside, describing serious salination of the valley's arable lands, erosion problems, rural social stress, and corruption among Afghan officials, a catalog that was to become grimly familiar.[38] Other later critiques were equally emphatic.

Morrison-Knudsen's employees were becoming disenchanted with the Helmand project. But political pressure to expand the development process intensified. Mohammed Daoud, a close relative of the king, became prime minister in 1953. In 1956, he began playing Cold War politics, recruiting Soviet aid under Nikita Khrushchev's newly expanded aid programs. The Soviets' strategic interests centered on northern Afghanistan, separating them geographically from the Americans. Moscow quickly granted $100 million in credits for airports, roads, and factories, as well as for the Jalalabad Dam near Kabul.

In response, Dulles pressured Morrison-Knudsen and its subsidiary firms to remain, as a major commitment of American prestige was at stake. The Eximbank continued to finance the Helmand project into the 1960s. Under Presidents Kennedy and Johnson, American aid expanded, much of it administered by USAID. From 1967 on, the green revolution, with its emphasis on large-scale wheat production, seemed at first to promise an agricultural technology that might overcome existing environmental problems. But the new seeds required increased applications of chemical

38 A. A. Michel, *The Kabul, Kunduz and Helmand Valleys and the National Economy of Afghanistan* (Washington, D.C., 1959). See also Aloys A. Michel, "The Impact of Modern Irrigation Technology in the Indus and Helmand Basins of Southwest Asia," in *The Careless Technology*, ed. M. Taghi Farvar and John Milton (Garden City, N.Y., 1972), 257–75.

fertilizer and water. An extended drought in 1971–3 dried up the Arghandab Reservoir entirely and undercut green revolution hopes.

By the early 1970s, the project's management, plagued by political interference and corruption, was crumbling. Most American advisers and technicians were gone from the Helmand Valley by the time of the leftist military coup that sent the king into exile in 1973. A year later, USAID announced its opposition to any further American involvement, but Henry Kissinger accepted Kabul's pressure to keep a few discouraged land-reclamation officers there, until the Soviet invasion of 1979 sent them all packing. During the Soviet war, all sides in the fighting took turns in further damaging the region's agricultural infrastructure. The Taliban, which emerged there in the early 1990s, derives its income from harvesting the opium poppies that thrive in the Helmand Valley's alkaline and saline soil. As Nick Cullather observes, the Taliban had finished linking the Kajakai Dam's hydropower turbines with urban Kandahar just months before American bombers destroyed it.[39]

DAMS FOR PEACE: DAVID LILIENTHAL AND THE INDUS BASIN

It is only a short distance down from Afghanistan into the westernmost of the great rivers of the Indian subcontinent, the Indus. Draining a portion of western Tibet and the northwestern Himalayas, the five main branches of the Indus flow down through the plains of Punjab and Sind into the Arabian Sea. Summer monsoon rains from the south are usually weak in the basin, and winter storms out of central Asia provide massive amounts of moisture in the high mountains but little precipitation in the lowlands. Soils in the lower basin have great potential for food production but require irrigation, except close to the banks of the river.[40]

Local small-scale irrigation systems had been a hallmark of local kings' development efforts in the Punjab plains in the eighteenth century. After the British conquered northwestern India in 1849, they constructed massive irrigation systems as part of the upper Indus and upper Ganges system, the most ambitious and sophisticated on the planet.[41] Some U.S. officials took an early interest in this system as a possible model for irrigating the dry lands of the American West; in the following century, the transfer of technology

39 Cullather, "Damming Afghanistan," 535–6.
40 Aloys A. Michel, *The Indus Rivers* (New Haven, Conn., 1967), chap. 2.
41 Michel, *Indus Rivers*, chap. 3.

would flow in the other direction. Thus, the origins of the U.S. Bureau of Reclamation were linked to the irrigation experience of the British in the monsoon climate of the northwestern Indian subcontinent. But these systems were designed in flat lands; the storage of large amounts of water in deep canyons was an altogether different task. It remained for the Americans to design the high dams that, linked with webs of irrigation canals in the lowlands, could domesticate entire river basins.

In the 1920s, British engineers turned their eyes toward the Himalayan watersheds as they began planning for more ambitious flood control, steadier irrigation flow in the demanding monsoon climate, and hydroelectric power to supply rapid urbanization and industrialization. When Hoover Dam and TVA were constructed, they became twin meccas for planners of the first of British India's high dam projects in the Himalayas. By then, no other colonial country had as highly developed a cadre of scientists and engineers as the Indians did in British India. India's top hydro-engineers went to the United States in the late 1930s to study the great new operations, because England had nothing remotely resembling the scale of the Himalayan challenge. They were led by Kanwar Sain, who later became India's leading representative on World Bank projects and worked closely with his American and European counterparts.[42]

When independence came to the subcontinent in 1947, these scientists and engineers were able to take over technical services from the British in a smooth professional transition.[43] But nothing could prepare them for the tectonic political shudder that year, and the Indus Basin was an epicenter. The departing British created Pakistan, whose western segment divided the Indus down the middle. India and Pakistan fought a war of skirmishes into 1948 over control of Kashmir and the waters of the Indus. Pakistan felt threatened by India's control of the watersheds of its eastern branches, especially the Sutlej, which India began to dam in 1950. Indeed, the river's waters were one of the points of dispute that nearly sparked a major war between the two countries in 1949.

David Lilienthal saw an opportunity to develop a TVA-style regional water authority that would promise such prosperity to both countries' segments of the river that both would find it irresistible to cooperate and would overcome their political hostility. Lilienthal was closely connected to the New York law firm that represented Pakistan at the United Nations

42 Kanwar Sain, *Reminiscences of an Engineer* (New Delhi, 1978).

43 See the extended treatment of these developments in Daniel Klingensmith, *"One Valley and a Thousand": Dams, Nationalism and Development* (New Delhi, 2007), chaps. 5–6.

and to key members of the Truman administration in Washington. He was also on speaking terms with both Indus countries' heads of state.[44] He often spoke of this effort as the United States' major bulwark against communism in South Asia, describing it as even more important than the Helmand project in Afghanistan. He proudly quoted M. R. Masani, the former mayor of Bombay and a personal friend of Prime Minister Nehru, as saying, "The United States has no better ambassador-at-large in Asia than the one which bears the initials T.V.A."[45]

In 1949, Lilienthal began a series of shuttle diplomacy trips to Pakistan and India. On one of his first trips, he met a half dozen young Indian hydrologists who had spent months training in Tennessee. They showed him "through hundreds of miles of the back country of that huge subcontinent, on foot, in pony carts, by automobile, and on airplane flights up the winding course of the Indus, or into the Himalayas, at more than 20,000 feet . . . circling over dam sites these young men intend to transform, in years to come, into the largest source of hydroelectric energy in the world."[46]

A decade of intensive diplomatic and technical negotiations produced a triumph: the 1960 Indus Waters Treaty between India and Pakistan, which became the acknowledged model of international cooperation over a shared river basin. This binational administrative structure has functioned well and has helped restrain the often-intense military confrontations between India and Pakistan. The environmental results, in contrast, were rapidly rising problems of waterlogging and salination in Pakistan's basin, as well as reduction of wetlands in the Indus Delta. Soon Pakistan requested American specialists' help in designing remedial measures. In 1961–2, Roger Revelle of Harvard University headed a thorough review of the accelerating problems.[47] Hydro-engineers were by then well aware of the consequences of carelessly racing to maximize irrigation in dry flatlands. But the strategic alliance among Pakistan, the World Bank, and the United States had produced rapid construction of massive irrigation and power works. The costs of repairing downstream environmental damage have been massive ever since.

44 David E. Lilienthal, *The Journals of David E. Lilienthal*, vol. 3, "Venturesome Years, 1950–55," (New York, 1966).

45 Lilienthal, *TVA*, 210.

46 Ibid., 212.

47 President's Science Advisory Committee, *White House – Interior Panel on Waterlogging and Salinity in West Pakistan, First Draft.* (Washington, D.C., 1962) (known as Revelle I); White House, Department of Interior Panel on Waterlogging and Salinity in West Pakistan, *Report on Land and Water Development in the Indus Plain* (Washington, D.C., 1964) (known as Revelle II). Its work and conclusions are summarized in Michel, *Indus Rivers*, 476–89.

THE MEKONG RIVER: DEVELOPMENT VISIONS AND ENVIRONMENTAL CRITICS

As the Cold War intensified, the Indus experiment in binational cooperation indicated that South Asian cooperation with the United States (rather than with the Soviet Union, India's cautious ally in military matters) could yield great benefits. In turn, the Eisenhower administration could be well pleased with its anchor in the region. The hydrological realities of the Indus Basin itself had coerced humans into cooperation across hot political boundaries.

Another great river, the Mekong, flowed down from the Tibetan highlands, through several Southeast Asian countries to the South China Sea. Could those countries cooperate in a similar way? Could international organizations play effective roles in developing hydropower in one of the hottest regions of the Cold War? And could the United States use its leverage to bend all this to its perceived strategic interests?

All of the projects with American involvement in the Middle East and South Asia were developed in arid regions of the tropics. U.S. and international agencies were slower to embark on multipurpose river projects in the moist tropics. This included the monsoon belt of Southeast Asia, where intensive summer rains alternate with long dry seasons. Here, the irrigation function of dams took a backseat to flood control and hydropower development, but the environmental stakes were just as high as in any arid setting.

Undoubtedly, the most ambitious and complex project of that era was the plan to build a series of dams and related infrastructure on the Mekong River, both on the main stream and on several of its tributaries. The Mekong Basin is the world's most multinational river. It rises in the eastern Tibet Plateau, runs for one thousand miles through the mountains of Yunnan Province in southern China, then defines the border between Burma and Laos. From that point, it flows 1,700 miles southeastward into the South China Sea in southern Vietnam. The lower basin includes Laos, Thailand, Cambodia, and Vietnam. Over the centuries, perennially heavy monsoon rains have caused severe erosion in the deep mountain gorges, and just as in the Nile Valley, during the annual floods, great amounts of sediment enriched the lowland soils of Cambodia and the delta southwest of Saigon, the rice bowl of the entire region. For many centuries, the Khmer kingdom of Cambodia had maintained irrigation canals to manage the annual hydrological cycle. In contrast, farther upriver in northeastern Thailand, in the Korat Plateau, large areas of poor soils are flooded during the rainy season. But during the dry season, evaporation is high and total rainfall relatively low, so most of the plateau is semiarid. This region had been persistently poverty stricken and socially turbulent. To development planners after 1945, it cried out for ambitious development of its water and soil resources.

French colonial engineers in Indochina had begun to collect river-flow data for the Mekong in 1897. But severely limited budgets constrained their work in the 1920s, and then they were entirely stalled by the Depression. World War II put an end to their work, and they left for good in 1942. From then on, war between the great powers and their local client states was almost incessant until the end of the Vietnam War in 1975. The French continued fighting against Ho Chi Minh and his nationalist communist forces in Vietnam until 1954. For two decades after that, the United States controlled Western strategic, financial, and development roles in the region and played the dominant opposition to the Soviet Union and China.

By 1950, the United Nations began to take an aggressive role in development planning for mainland Southeast Asia, setting up the Economic Commission for Asia and the Far East (ECAFE). Its first survey of the region, carried out in 1952 (a moment of cautious hope for political stability in the region), concluded that the natural resources of the Mekong Basin were almost entirely undeveloped and held great promise for regionwide planning. Behind this study lay a sense of urgency to alleviate mass poverty and its resulting political turmoil for the 40 million people of the lower basin.

To concentrate human and fiscal resources on coordinated planning for the Mekong Basin, the United Nations set up the Bangkok-based Mekong Commission. Its charter required that Thai administrators be hired for key positions and that the director be Japanese. But the world's specialists on river development were largely from Western Europe, the British Commonwealth, and the United States. So ECAFE and the Mekong Commission turned to the Americans for more detailed planning, hiring development planners from the ICA and the Bureau of Reclamation to survey the region. Its concluding report in 1956 marked a major step forward in the planning process but revealed the weakness of social and environmental analysis available at the time.[48] The report recommended an ambitious, multifaceted program of surveys: hydrographic and topographic, as well as water quality and sediment sampling. Reflecting the caution of careful scientists, the report warned that major channel dredging and port construction should be postponed until better data could be amassed. It also proposed a program of technical training of local people. But it included no other discussion of the

48 C. H. Schaaf and Russell Fifield, *The Lower Mekong* (Princeton, N.J., 1963), 85–6.

social setting of the work, for (in the manner of the times) the committee included no social or environmental scientists.

The ECAFE team proposed a regionwide version of TVA: major dams along the highly variable flow of the main river, which at no point had both banks in the same country, plus smaller projects on several tributaries, all of them within the boundaries of individual countries. The centerpiece of the entire project was a proposed dam at Pa Mong, between Thailand and Laos. This visionary dam was to be more than seven hundred feet high. It would flood nearly four hundred thousand acres of rich bottomlands but, in return, stabilize water levels throughout the year and provide massive irrigation water and power for the delta.

The anticommunist political motivation behind the ECAFE plan was explicit: "The entire project area is susceptible to outside subversive influence because it lies in close proximity to areas controlled or infected by Communist forces. . . . Strenuous efforts on the part of the governments have recently exposed the situation and corrective policing measures have been instituted in addition to the social and economic programs. It is hoped that alert effective police action plus successful implementation of the economic and education improvement measures will stabilize the area and will forestall the expansion of subversion and chaos."[49] This reinforced a sense of urgency to develop the basin in a centralized and, at crucial points, authoritarian manner.

Many other technical studies followed. Throughout those years, both U.S. and UN agencies remained steadfastly resistant to assessing the full impacts of urgently desired megaprojects. Social and environmental critiques of the projects began to appear only when they were initiated by American nongovernmental research institutes. In Asia, the first such project was in the Philippines, still the Americans' backyard even after gaining independence in 1946. The dam at Ambuklao, east of Baguio in the mountains of Luzon north of Manila, was built as a symbol of national pride and prestige in early postindependence years. But as early as 1953, American conservationists had raised serious worries about soil erosion, displacement of villagers, and deforestation. Harold Coolidge, a key figure in the International Union for the Protection of Nature, the global network of wildlife biologists and national parks managers, first challenged the lack of concern about the dam's social and environmental impacts in the rural cordillera. He made it the focus of the Pacific Science Congress field trip when the congress met in

49 ECAFE, *Final Report of the Mekong Planning Study* (Bangkok, 1956), 1–2.

Manila in 1954.[50] Environmental warnings had little impact on that project, but a network of eminent environmental critics was being assembled. That network came to play a prominent role in the evolution of the Mekong project.

In 1962, the Ford Foundation in New York funded an independent social and environmental survey of the Mekong Basin and appointed Gilbert White to head the work. By then, White was established as the preeminent American expert on river basin development worldwide in the generation after Lilienthal and Clapp. His committee raised the first major warnings about how intricate and unpredictable the social and economic consequences of major projects would be.[51] In several other studies as well, White urged the Mekong Commission to add social scientists to its top planning staff and suggested that environmental changes resulting from dams on the main river would be major. His studies were reinforced by the National Academy of Sciences as a result of internal lobbying by Harold Coolidge, the most distinguished international conservationist of those years. Coolidge coordinated liaisons between the National Academy of Sciences and the International Union for the Conservation of Nature.

The conservationists were backed up by academic social scientists who specialized in Southeast Asia. Closely associated with the Ford Foundation project was the Southeast Asia Development Advisory Group (SEADAG) formed at the University of Michigan's Center for Southeast Asian Studies. A team of geographers, anthropologists, and natural resources specialists carried out extensive field studies to determine the social costs of relocation schemes, pointing up the complex social and ecological consequences of the resettlement schemes. In an important report, they warned that the dam builders had a repeated history of failing to implement resettlement plans in many countries, including smaller projects in both northeast Thailand and Laos. If Pa Mong Dam were to be built to its planned height, they wrote, it would displace four hundred thousand people. Instead, they proposed an alternative, reducing the dam's height by eighty feet, in which case it would flood only 16,800 acres and displace only 76,000 people. The SEADAG noted that vacant forestland still existed in both Laos and northeastern Thailand, if governments wanted to sacrifice it to resettlement, but the cost in terms of deforestation would be high.[52]

50 See *Proceedings of the Pacific Science Congress 1953*, vol. 6 (Honolulu, 1954).
51 Gilbert F. White, *Economic and Social Aspects of Lower Mekong Development* (Bangkok, 1962).
52 L. A. Peter Gosling et al., *Final Report, Pa Mong Resettlement Research Project* (Ann Arbor, Mich., 1977).

In response, the Mekong Commission in Bangkok authorized the production of a new and more ambitious basinwide master plan under a committee that would include social scientists for the first time. A full draft of this report was completed in 1970, but it languished under conditions of intensified warfare throughout the lower Mekong Basin.

By the end of the 1960s, as a broad-based nongovernmental environmental movement was emerging, the alliance of social and environmental experts was beginning to have impacts in government and international agencies. In 1970, the World Bank commissioned an independent research institute in Washington, Resources for the Future (RFF), to review the entire pattern of the Mekong Project. RFF had a highly regarded twenty-year record of research and assessment of natural resources, though largely in the United States. Marion Clawson and Hans Landsberg, two of its senior staff members, organized the Mekong review. (Clawson had been a member of the White team for the Ford Foundation in 1961–2.) They added an anthropologist specializing on the Mekong to their new team.

By that time, the Mekong project's envisioned scale was bigger than ever. There were dreams of a hydro-station with a generation capacity of 4–5 million kilowatts and a reservoir that would irrigate 2–5 million acres of farmland. Although the RFF team agreed with the draft master plan's commitment to transform the basin's agriculture into green revolution energy – intensive systems with heavy fertilizer and pesticide use – it challenged the plan's centralization of initiative and urged far greater environmental caution. Echoing the early experience of TVA, it urged decentralized administration, starting with small-scale local projects and relying on local networks of voluntary organizations.[53]

The RFF committee also warned of the environmental impacts of high dam projects, such as schistosomiasis in big new reservoirs and canals, and "indirect impacts – the movement of farmers displaced by reservoirs to highlands with soils vulnerable to erosion, and the still insufficiently known effects of irrigation on Basin soils."[54] Massive power from Pa Mong and the other high dams would not be fully needed or price competitive for years to come, and their irrigation potential would also take intricate, expensive development. The hydrological system of the river was still poorly understood. In the view of the committee, the entire development system, especially major mainstream works, should be constructed only with constant,

53 Marion Clawson and Hans Landsberg, *Agricultural Development in the Mekong Basin* (Washington, D.C., 1971).
54 Gosling et al., *Final Report*, 10.

full-spectrum monitoring of its impacts. "The effects of the whole system of dams would be markedly greater than the sum of isolated, individual parts. . . . The social, institutional, and ecological difficulties of constructing such a system are so formidable that economic results will probably be more fully achieved by prior concentration on sub-area development" on tributaries, local watersheds, and agricultural basins.[55]

The skeptics finally had their way. Although officials at the Bangkok headquarters of the Mekong Commission were reluctant to change direction on such a centerpiece project, they finally vetoed a high dam at Pa Mong, the first such veto anywhere in the developing world. This entire debate had revealed the struggle among experts to control construction of megaprojects in the Third World and to insulate their work from politically motivated Cold War interests. But the administrative history of the unconstructed Pa Mong Dam became a moot point. Through the end of the century, it remained politically impossible to coordinate financing, construction, and management of hydro-projects across the main run of the Mekong. The region thus experienced neither the benefits nor the environmental damage associated with high dams, though tributaries in Thailand were dammed in those years. In any case, American involvement on the east bank of the Mekong, in Laos and Vietnam, ended with the U.S. withdrawal in 1975.

CONCLUSIONS

In the longer run, it became clear that the planning and construction of these projects had ignored or grossly underestimated both their social dislocations and their environmental impacts. The planners and social engineers were pursuing a utopian and anticommunist vision of a brighter U.S.-led future for humanity. The civil engineers were carrying out their assignments as competently and as efficiently as they could. At the top, the strategic planners in Washington were forging political coalitions, driven by a sense of urgency as the Cold War intensified. Together with host regimes around the entire periphery of the Soviet Union, they moved too fast toward economic growth and political control to apply adequate environmental safeguards. The planning teams for the dams of this era included virtually no social or environmental scientists, to say nothing of any voice of local communities or any nongovernmental organization in the process.

David Lilienthal's compatriots and successors had made a great gamble. The viability of their gargantuan projects, and beyond that, both American

55 Ibid., 16.

hegemony and open-society development, depended on effective cooperation with local elites, even when their own priorities were often different. Sustainable management of the new civil works required political stability, administrative continuity, and effective training of local engineers and managers. When these conditions went unfulfilled, severe dislocations of rural populations and ecosystems resulted. Even on the Mekong, though construction of high dams was prevented through the end of the century, the planning processes of the 1950s and 1960s became the baseline for the region's efforts today to accelerate and harness its natural resources. The ecological dislocations will continue to accelerate.

PART II

Geopolitics and the Environment

6

Environmental Impacts of Nuclear Testing in Remote Oceania, 1946–1996

MARK D. MERLIN AND RICARDO M. GONZALEZ

> We both had a strange feeling. We noticed no flies, no movement of lizards and no booby birds. We found several burnt and dead pigs, and in the distance we heard one of the three wild pigs. It was badly burnt and going around in circles, blind. I said, "[T]his bloody place is contaminated, and what the hell are we doing here?"
>
> – Ken Cox, on the conditions he observed on Malden Island shortly after an aboveground nuclear bomb test in 1957[1]

The testing of atomic and thermonuclear bombs can provide various types of information, including how these extremely destructive weapons work, how they perform under different conditions, and how natural and man-made structures, as well as organisms, react when subjected to nuclear explosions. Atomic and thermonuclear bomb testing has been used frequently to manifest both military and scientific power, especially during the Cold War. In fact, most, if not all, tests were initiated with explicit political intention, often with little regard for the ecological consequences.

Here, for the first time, we present an up-to-date regional review of the main direct and indirect atmospheric, geological, and ecological effects of nuclear testing in Remote Oceania. In the process, we draw attention to short- and long-term environmental consequences of this testing as well as the human motivations and mistakes involved in these nuclear experiments. Some of the related environmental impacts in the region are not discussed or discussed only briefly in this study; these include, for example, the relocation of local atoll residents to other islands, the engineering and construction development of some atoll islets for support systems, the disposal of nuclear and other wastes produced by the preparation and execution of the tests, the incidence and rate of ciguatera disease, and electromagnetic effects such

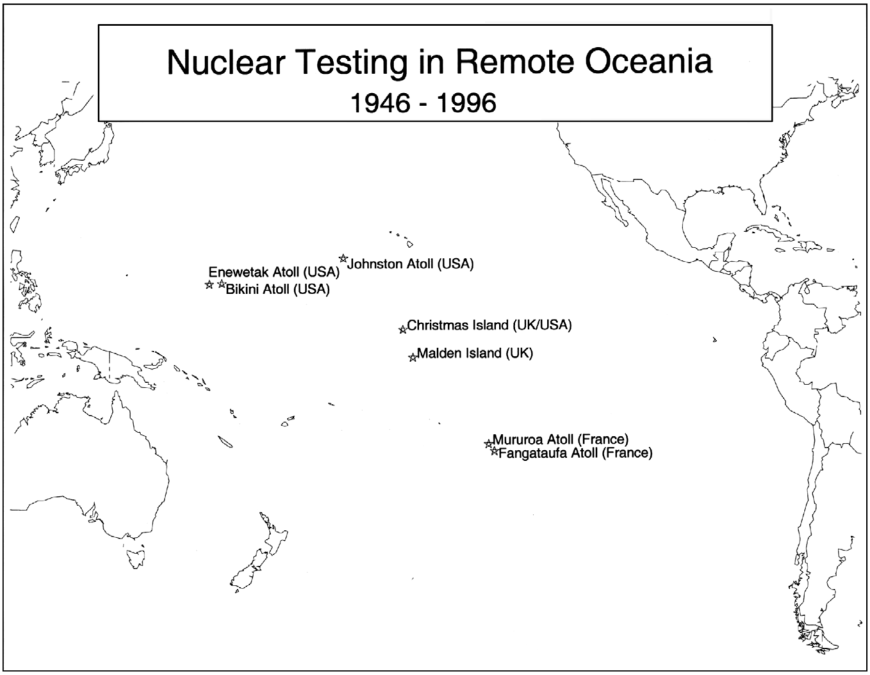
1 Pacific Concerns Resource Centre (hereafter PCRC), *Kirisimasi: Fijian Troops at Britain's Christmas Island Nuclear Tests* (Suva, Fiji, 1999), 12.

as the disruption of radio communications. These impacts, along with the ones we address in more detail, need to be researched further so that we can have a more complete understanding of the physical and biological effects of nuclear bomb testing in Remote Oceania in the twentieth century. This chapter presents a comprehensive regional survey that invites comparison with investigation of nuclear testing in other areas of the world.

After the first American military tests and actual wartime use of nuclear weapons during the middle of the last century, officials in the United States and other countries thought that they understood the requirements for future field tests. Tests would have to be conducted in areas with few, if any, human residents and on small landmasses where, it was assumed, the ocean could efficiently and safely absorb radioactive debris. Most importantly, the preparations for test detonations had to be kept as secret as possible. The pressure of Cold War political tensions strongly affected the more or less openly admitted nuclear bomb testing programs of the United States, the United Kingdom, France, the Soviet Union, and China. Testing became a major national security issue for these nations as they sought to develop effective nuclear deterrents. The leaders of the United States, the United Kingdom, and France came to the conclusion that extremely isolated small islands in Remote Oceania were the best places to test their nuclear devices (Map 6.1).

Remote Oceania is a region of the world that derives its name from both cultural and physical factors. It encompasses a huge expanse of the Pacific Ocean that contains hundreds of atolls and many generally small, often highly volcanic islands. It includes many of the islands of Melanesia (essentially Eastern Melanesia) and all the islands generally referred to as Micronesia and Polynesia. The inaccessibility of the islands of Remote Oceania increased the probability that the testing programs and technology could be kept as secret as the governments involved deemed necessary.

A series of political and social factors influenced the decisions of the United States, the United Kingdom, and France to locate their test sites in Remote Oceania, not the least of which was their political control over the islands where the detonations would take place. The testing programs were planned and carried out without the consent of the native peoples who lived on or used the islands. For many years, the governments of the nations involved in nuclear testing in this region avoided questions about the environmental impact of their test detonations or simply denied that there had been any impact. The perceived strategic necessities of the Cold War power balance outweighed many environmental concerns that now seem absolutely essential. There can be no doubt that the preparations for



Map 6.1. Nuclear testing in Remote Oceania, 1946–96.

the tests, the detonations themselves, and subsequent cleanup of radioactive waste and other debris all resulted in ecological disturbances.

The testing programs in Remote Oceania produced a wide range of environmental impacts, some with only short-term effects and others that created long-term problems. Unfortunately, the extent of the environmental impact of the tests has been very difficult to assess because of the secrecy surrounding the participating countries' nuclear programs. Over the past decade, the United States, the United Kingdom, and France have declassified considerable portions of their nuclear archives. Although this data has been used extensively here, the completeness and validity of much of this unclassified information has not been fully verified.

In 1946, the United States began conducting atomic bomb tests on some of the secluded atolls of the Marshall Islands, which had recently come under American control under a United Nations mandate. In 1957, the United Kingdom moved its nuclear weapons testing from Australia, where it had conducted tests during the five previous years, to isolated island colonies in Remote Oceania. The French government was forced to move its nuclear-bomb-testing program out of the Sahara Desert of Algeria after that country gained independence in 1962. The French chose to relocate their testing activities to remote atolls under their control in French Polynesia.

NUCLEAR TESTING IN REMOTE OCEANIA BY THE UNITED STATES, 1946–62

Between 1946 and 1962, the United States tested nuclear weapons at the Pacific Proving Grounds, which encompassed the Bikini and Enewetak atolls in the Marshall Islands, Christmas Island, and the Johnston Atoll. The fact that the U.S. government referred to these test sites as "proving grounds" indicates clearly that it wanted the world, especially communist-controlled nations such as the Soviet Union and China, to know that it had extremely devastating weapons at its disposal. Although the United States surrounded the development and testing of its atomic weapons in secrecy, it also wanted the world to be aware of the effectiveness of its massive deterrent nuclear force. In the period 1946–62, the United States conducted 110 atomic bomb tests in Remote Oceania that generated a total yield of approximately 151 megatons (Mt), accounting for about three-quarters of the total yield generated by the 1,054 nuclear tests carried out in the U.S. mainland, Alaska, the Atlantic Ocean, and the Pacific Ocean between 1945 and 1992.[2]

The American government's decision to conduct atomic tests in Remote Oceania stemmed primarily from the lack of sites in the continental United States where large-scale atmosphere testing would not affect urban areas. Through its control of the Trust Territory of the Pacific Islands, the United States had access to a number of isolated sites that were deemed suitable for atomic tests on account of their location, mild climate, and sparse human populations.

The Bikini (six square kilometers) and Enewetak (six square kilometers) atolls in the Marshall Islands were selected by U.S. government and military officials primarily because of two factors. First, the remoteness of Bikini and Enewetak from other areas of human habitation, shipping lanes, airways, and fishing grounds served the security needs of the nuclear testing program. Second, the proximity of the two atolls to Kwajalein Atoll was strategically advantageous. This large Marshallese atoll, administratively part of the Republic of the Marshall Islands, was – and is still – the site of a

2 The Nuclear Weapon Archive, http://nuclearweaponarchive.org/Usa/Tests/index.html (last visited June 10, 2008).

tactical U.S. military air base and ship anchorage, and a key testing range is located in the atoll's huge lagoon. Another argument for the choice of Bikini and Enewetak was that they were downwind from human-populated islands and the prevailing trade winds would carry radioactive debris out to sea.

The first atoll chosen by the Americans as a testing site was Bikini. Two tests at Bikini Atoll, code-named Able (July 1, 1946) and Baker (July 23, 1946) and collectively referred to as Operation Crossroads, inaugurated the American atomic testing program in Remote Oceania. Two years later, the United States resumed testing with Operation Sandstone at Enewetak Atoll. In all, twenty-four atomic tests were conducted at Bikini (1946–58, total yield of approximately 79 Mt) and forty-three at Enewetak (1948–58, total yield approximately 29 Mt).

In 1958, Johnston Atoll was incorporated into the testing program. This small atoll has a total land area of 2.8 square kilometers. During Operations Hardtack I (1958) and Dominic (1962), thirteen high-altitude tests were conducted over Johnston Atoll or in the vicinity (total yield approximately 21Mt). An agreement with the British government allowed the U.S. military to use Christmas Atoll to undertake 30 nuclear tests during Operation Dominic in 1962 (total yield approximately 23 Mt). In exchange for the use of Christmas Atoll, the British were allowed to use the Nevada Testing Grounds on the U.S. mainland for some of their nuclear tests.

NUCLEAR TESTING IN REMOTE OCEANIA BY THE UNITED KINGDOM, 1957–8

The United Kingdom's atomic tests in Remote Oceania were referred to collectively as Operation Grapple. They were conducted in the atmosphere above Malden Island and Christmas Island during 1957 and 1958. Malden is a flat, triangular coral island approximately seven kilometers long and six and a half kilometers wide at its greatest width. Christmas Island (135 square kilometers), known today as Kiritimati, is an atoll now belonging to the Republic of Kiribati, formerly the Gilbert Islands. It is the largest atoll in the Pacific, measuring about fifty-six kilometers from east to west and thirty-eight kilometers at its greatest width. Operation Grapple consisted of nine tests (total yield approximately 12 Mt). The first three (total yield approximately 1 Mt) were carried out on Malden Island in 1957; the testing program was then relocated to Christmas Island, where six tests were conducted (total yield approximately 11 Mt).

NUCLEAR TESTING IN REMOTE OCEANIA BY FRANCE, 1966–96

In 1962, the government of France decided to move its tests to French Polynesia, to Mururoa and Fangataufa atolls. The French military conducted 193 nuclear tests in the Pacific region between 1966 and 1996 (total yield approximately 13.5 Mt). Mururoa Atoll is located about 1,200 kilometers southeast of Tahiti. The islets and lagoon cover an area about nine and a half kilometers long and twenty-nine kilometers wide, with a perimeter of sixty kilometers. Although uninhabited in the years before France began testing atomic weapons in the region, the residents of some French Polynesian islands used the atoll as a place to vacation and fish. Fangataufa Atoll is located forty-two kilometers south of Mururoa. It is approximately eight kilometers long and seven kilometers wide, and it is the most southern of the atolls of the Tuamotu Archipelago. It also was uninhabited prior to the testing operations. In addition, Hao Atoll, located about 450 kilometers northwest of Mururoa was utilized as a support base for the French South Pacific testing operations. Considerable construction was thus carried out there, and the atoll experienced general economic modernization.

Between 1966 and 1974, France conducted forty-four atmospheric test detonations, thirty-nine at Mururoa and five at Fangataufa. The French government stopped ground-level and aboveground testing in 1974 in response to many years of international protests. In 1975, underground testing began on Mururoa and Fangataufa. A total of 149 underground tests were conducted in these atolls. In early April 1992, the French government indicated that it would suspend its nuclear testing. The moratorium was extended several times until June 1995, when President Jacques Chirac announced a final series of eight tests that would take place between September 1995 and May 1996. The French government maintained that the tests would allow for the development of simulation technology that would make further testing unnecessary. The last French nuclear test took place on January 27, 1996. In March 1996, France finally signed the protocols of the Rarotonga Treaty that established a nuclear-free zone in the Pacific.

ATMOSPHERIC EFFECTS OF NUCLEAR WEAPONS TESTING IN REMOTE OCEANIA

There are two main effects of nuclear weapons testing within the atmosphere itself: (1) harm to the ozone layer and (2) the potential creation of so-called nuclear-winter conditions. There was no attempt at the time of the test detonations to measure the effects of atomic testing on the ozone layer, but it is almost certain that some damage was done.[3] Evidence from the American tests indicated, though, that the cloud produced by a nuclear test detonation with a yield of a megaton or more would probably go right through the tropopause and on up to reach a height of thirty thousand meters or more.[4] Such clouds could carry radioactive materials up into the stratosphere, which might result in their dispersal over huge areas.

The effects of nuclear testing on the atmosphere over Remote Oceania are not as clear and almost certainly nowhere near as important as those resulting from the potentially deadly fallout of irradiated particulate matter. Such material directly affects the soil and living organisms on which it lands, and it can be systemically absorbed or inhaled directly out of the air by animals, including humans. One study of the consequences of atomic testing concluded, "Fallout and other residual radioactivity from atmospheric nuclear testing conducted by all nations have caused or will cause through infinity an estimated 3 million cancer fatalities."[5]

Some authors have argued that, because of abnormal winds, the Bravo test (15 Mt) at Bikini Atoll in March 1954 resulted in a human and non-site-specific environmental catastrophe that could have been avoided. The Bravo test involved what was then the most powerful bomb ever exploded (Figure 6.1). The combination of unfavorable wind conditions and the unexpectedly high yield of the bomb caused the worst radiological disaster in U.S. history – a catastrophe that some Micronesians are still dealing with today. The Marshallese people living on Rongerik, Rongelap, Ailinginae, and Utirik atolls were blanketed with radioactive fallout, as were some U.S. military personnel and the crew of a Japanese commercial fishing boat. The ongoing medical and compensation problems associated with the Bravo test are compounded by indications that other human-populated atolls were also affected significantly by dangerous fallout.[6]

Another dangerous accident was reported during the British atmospheric test of Grapple Y (2.8 Mt) at Christmas Island in April 1958. Large quantities of irradiated water and debris were sucked up into the mushroom cloud created by the huge blast and were carried off by the winds, only to fall eventually over an area estimated at between 130 and 260 square kilometers. Christmas Island was within the contamination area. So, too, was the HMS

3 Carey Sublette, "Effects of Nuclear Explosions," http://nuclearweaponarchive.org/Nwfaq/Nfaq5.html (last visited June 10, 2008) (hereafter "Effects" A).

4 Wilfrid Oulton, *Christmas Island Cracker: An Account of the Planning and Execution of the British Thermo-Nuclear Bomb Tests, 1957* (London, 1987), 114–15.

5 Arjun Makhijani and Stephen I. Schwartz, *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons since 1940* (New York, 1998).

6 Sublette, "Effects" A; Giff Johnson, *Nuclear Past, Unclear Future* (Majuro, 2009), 6–19.

Figure 6.1. The Castle Bravo test blast, Bikini Atoll, March 1, 1954.

Narvik, a Royal New Zealand naval support frigate. The crew members were not wearing any protective clothing, and "hot rain" fell on them.[7]

A combination of unfavorable weather and bad judgment during a number of French tests during the 1960s and 1970s resulted in significant ecological and human-related problems. In September 1966, for example, President Charles de Gaulle traveled to French Polynesia so that he could personally observe a nuclear test from a warship off Mururoa Atoll. After two days of unfavorable wind conditions, de Gaulle had reached the limit of his patience. He "insisted that the test take place as he was a busy man!"[8] The New Zealand National Radiation Laboratory registered heavy radioactive fallout immediately after the 0.12 Mt detonation at its stations in the Cook Islands, Niue, Samoa, Tonga, Fiji, and Tuvalu.[9]

GEOLOGICAL IMPACTS OF NUCLEAR TESTING IN REMOTE OCEANIA

The numerous detonations of nuclear bombs that the United States conducted at the Bikini and Enewetak atolls before shifting its testing program

7 PCRC, *Kirisimasi*, 17.
8 Greenpeace, *French Polynesia: The Nuclear Tests 1967–1980: A Chronology* (Amsterdam, 1980), 3.
9 Ibid.; Bengt Danielsson and Marie-Therese Danielsson, *Poisoned Reign: French Nuclear Colonialism in the Pacific* (Victoria, 1986).

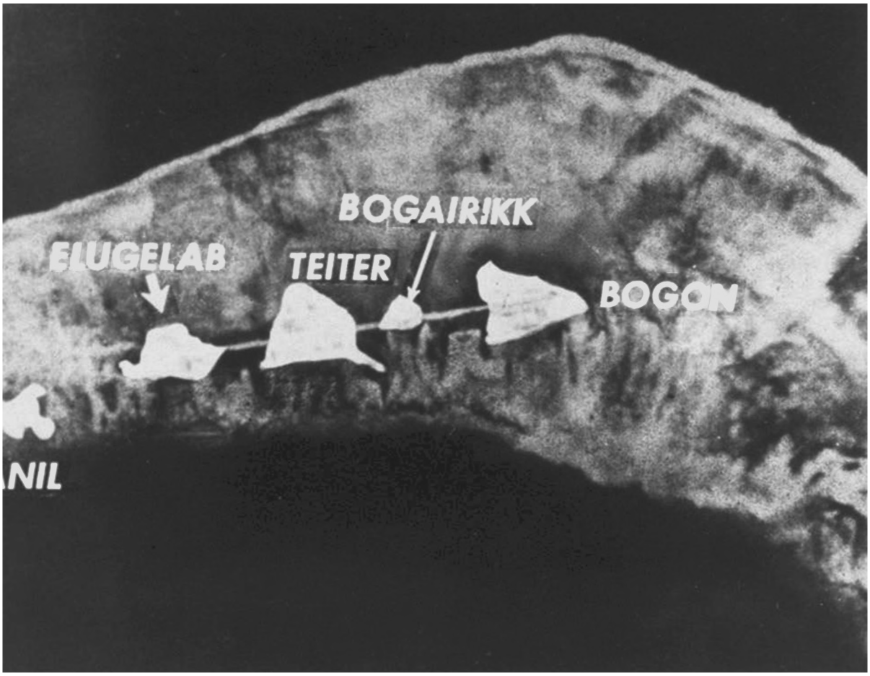


Figure 6.2. Aerial photograph of Elugelap Island, Enewetak Atoll, before the Ivy Mike test blast, November 1, 1952.

to the Nevada Proving Grounds (NPG) had significant geological impact. Surface and underwater detonations created craters and, in some cases, vaporized islets partially or entirely. Indeed, the most dramatic geological impact event in the Pacific Proving Grounds was the vaporization of Elugelap Island on Enewetak Atoll in November 1952 during the Ivy Mike test (10.4 Mt), the first hydrogen bomb detonation in history (Figures 6.2–6.3). This test left an underwater crater almost two kilometers wide and fifty-six meters deep. It is estimated that 80 million tons of soil were lifted into the air by the blast. The even-larger blast (15 Mt) of Bravo in March 1954 created a crater 1,828 meters wide and 73 meters deep.[10] Table 6.1 gives an overview of the craters produced by U.S. nuclear bomb testing.

10 Jane Dibblin, *Day of Two Suns: US Nuclear Testing and the Pacific Islanders* (New York, 1990); Beverly Keever, "Fallout: Enewetak Atoll, 50 Years Ago This Week," http://www.honoluluweekly.com/archives/coverstory 2002/10–30–02 Bomb/10–30–02 Bomb.gif (last visited March 11, 2004); Carey Sublette, "Effects of Nuclear Explosions," http://nuclearweaponarchive.org/Nwfaq/Nfaq8.html (last visited June 10, 2008) (hereafter, "Effects" B); Patrick Colin, "Physiography of Enewetak Atoll," in *The Natural History of Enewetak Atoll* (Washington, D.C., 1987), 1:27–35.

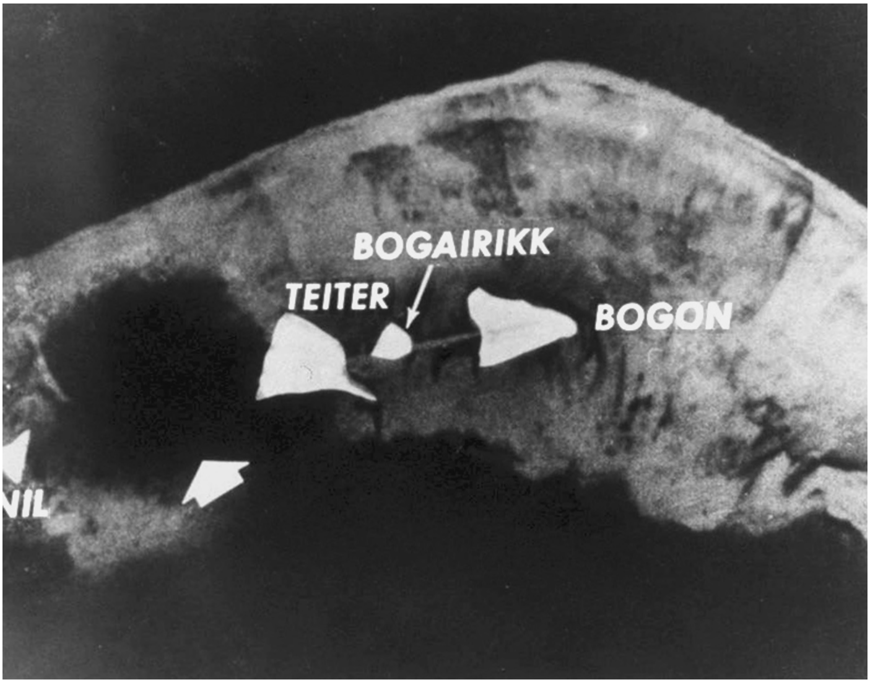


Figure 6.3. Aerial photograph of Elugelap Island, Enewetak Atoll, after the Ivy Mike test blast.

Sometime between 1952 and 1958, a massive piece of coralline reef flat, part of the seaward reef face of Enewetak approximately three hundred meters long and sixty meters wide broke off in the area north of Mike Crater. This huge submarine erosion event was almost certainly precipitated by the substrate destabilization caused by the earlier bomb testing, and it left an exceptionally large area of the underlying reef structure exposed.[11] A number of other geological effects of the testing can also be seen at Enewetak, including the tracks left by coralline rock thrown up onto the reef flats and a series of depressions on the reef flats that were most likely produced by blocks of the reef that were hurled up into the air by the detonations and then came crashing back down.

The preparations for nuclear bomb testing on Enewetak Atoll did provide some important evidence supporting a theory originally developed by Charles Darwin.[12] On the basis of the observations he made during his

11 Colin, "Physiography," 34; John Harrison, personal communication, March 13, 2004.
12 Charles Darwin, *The Structure and Distribution of Coral Reefs: Being the First Part of the Geology of the Voyage of Beagle Under the Command of Capt. Fitzroy R.N. during the Years 1832–1836* (London, 1842).

Table 6.1. *Geological Impacts of U.S. Nuclear Bomb Testing in Bikini and Enewetak Atolls, 1951–8*

Operation-Test	Location	Date	Yield	Type	Impacts
Greenhouse-Dog	Runit Is., Enewetak	Apr. 1951	0.081 Mt	Tower shot	250,000 tons of soil lifted to altitude of approx. 10,700 m. Crater: 120 m wide, 10 m deep.
Greenhouse-George	Eberiru Is., Enewetak	May 1951	0.225 Mt	Tower shot	Crater: 347 m wide, 3 m deep.
Ivy-Mike	Elugelap Is., Enewetak	Nov. 1952	10.4 Mt	Surface burst	Elugelap Island vaporized; 80 million tons of soil lifted into the air. Crater: approx. 1,800 m wide, 56 m deep.
Castle-Bravo	Off Nam Is., Bikini	Mar. 1954	15 Mt	Surface burst	Crater: 1,828 m wide, 73 m depth.
Castle-Romeo	Bravo Crater, Bikini	Mar. 1954	11 Mt	Barge shot	Enlargement of Bravo Crater.
Castle-Koon	Eneman Is., Bikini	Apr. 1954	0.11 Mt	Surface burst	Crater: 301 m wide, 22.9 m deep.
Castle-Union	Bikini Lagoon	Apr. 1954	6.9 Mt	Barge shot	Crater: 91 m wide, 27 m deep.
Castle-Yankee	Bikini Lagoon	May 1954	13.5 Mt	Barge shot	Unknown geological impact
Redwing-Lacrosse	Off Runit Is., Enewetak	May 1956	0.040 Mt	Surface burst	Crater: 120 m wide, 10 m deep.
Redwing-Zuni	Eneman Is., Bikini	May 1956	3.5 Mt	Surface burst	Eneman Island vaporized. Crater: 710 m wide, 34 m deep.
Redwing-Seminole	Boken Is., Enewetak	June 1956	0.0013 Mt	Surface burst	Crater: 200 m wide, 10 m deep.
Redwing-Mohawk	Eberiru Is., Enewetak	July 1956	0.36 Mt	Tower shot	Crater: 408 m wide, 2.5 m deep.
Redwing-Tewa	Reef between Namu and Yurochi Is., Bikini	July 1956	5 Mt	Barge shot	Crater 1,219 m wide, 39 m deep.
Hardtack I-Cactus	Runit Is., Enewetak	May 1958	0.018 Mt	Surface	Crater: 120 m wide, 10 m depth.
Hardtack I-Koa	Enewetak Lagoon	May 1958	1.37 Mt	Surface	Crater: 1.5 km wide, 10 m depth.
Hardtack I-Umbrella	Enewetak Lagoon	June 1958	0.008 Mt	Underwater	Underwater crater: 914 m wide, 6 m deep.
Hardtack I-Oak	Enewetak Lagoon	June 1958	8.9 Mt	Barge	Underwater crater: 1,750 m wide, 62 m deep.

Source: Patrick Colin, "Physiography of Enewetak Atoll," in *The Natural History of Enewetak Atoll* (Washington, D.C., 1987) and Carey Sublette, "Effects of Nuclear Explosions," http://nuclearweaponarchive.org/Nwfaq/Nfaq8.html (last visited June 10, 2008).

voyage on the HMS *Beagle* (1832–6), Darwin argued that an atoll develops as an oceanic volcano sinks back into the crust and is gradually covered over by innumerable generations of colonial coral growth at the ocean surface in warm water. In the 1950s, four boreholes were drilled on Engebi Island as American scientists tried to locate a suitable rock pit for a nuclear detonation. The excavations found a basaltic foundation beneath the coral cap of Enewetak Atoll, a finding that strongly supported Darwin's subsidence theory of atoll formation.[13]

In April 2000, an investigative committee established by the Marshallese and American governments determined that the effects of forty-three nuclear tests in Enewetak Atoll had rendered 49 percent of its original landmass uninhabitable by humans (384.4 of 776.8 total hectares). Only 43 percent of its earlier land area was still habitable (330 hectares), and fully 8 percent had been vaporized (62.5 hectares).[14] In other words, more than half of the terrestrial area of the atoll was either blown away or poisoned with radiation by the nuclear bomb detonations.

On Bikini Atoll, three of the original twenty-five islets were destroyed by nuclear bomb detonations between 1946 and 1958. The two largest underwater craters created by the testing on this atoll are Eneman Crater, located where Eneman Island used to exist, and Bravo Crater located off Nam Island. Other smaller craters are situated on the fringing reefs of the northern and southern lagoons.[15] It should be noted that the American military decided to carry out the Castle Romeo test shortly after the Bravo test in March 1954 in the man-made Bravo Crater because the high yield thermonuclear tests were blowing vast holes in the reefs at Bikini and Enewetak; using the Bravo Crater was deemed necessary because the test program was running out of islets on which to test surface explosions of nuclear devices.[16]

Neither the British tests near Malden nor the British and American tests near Christmas Island produced significant geological effects. All atomic tests undertaken by the British military involved bombs that exploded in the atmosphere at relatively high altitudes, and as a consequence, no geological impacts have been reported. Nevertheless, minor impacts may have occurred from such testing.

13 Byron Ristvet, "Geology and Geohydrology of Enewetak Atoll," in *Natural History of Enewetak Atoll*, 1:39.

14 Keever, "Fallout."

15 Bikini Atoll Rehabilitation Committee, *Interim Draft Environmental Impact Statement for the Rehabilitation of Soil at Bikini Atoll, Republic of the Marshall Islands, Supplementary Document No. 2* (Berkeley, Calif., 1987), D-1.

16 Sublette, "Effects" B.

Documenting the geological impact of the French atmospheric atomic tests performed between 1966 and 1974 above Mururoa and Fangataufa atolls is somewhat problematic. Although the tests before 1975 were carried out in the atmosphere, the proximity of at least some of the explosions to the surface probably had significant impact on the atoll. Indeed, some of the tests were actually conducted on the surface or on a barge anchored in the lagoon. In 1975, the French government decided to move its nuclear testing program underground. The decision had nothing to do with the possible geological impact of atmospheric testing but was rather a response to concerns about the large quantities of radioactive fallout produced by atmospheric testing and international political pressure to end such tests.[17]

By 1981, Mururoa Atoll had subsided approximately one and a half meters from the elevation recorded only six years earlier. This anthropogenic subsidence is an indicator of the impact of underground nuclear detonations on the atoll's coralline limestone cap during the early years of the testing program. Furthermore, it is reported that the base of Mururoa had been so badly damaged by the underground tests during the late 1970s and early 1980s that the army engineers jokingly compared it to Swiss cheese. Some of this geological alteration and collapse was visible on the surface in the form of vast depressions and faults several kilometers long.[18] Apparently, French engineers and military officials did not concur with or acknowledge the U.S. decision not to carry out underground tests in the Marshall Islands atolls because of their geological impact. In response to the physical impact on the limestone substrate, French engineers, probably relying on evidence from the Enewetak borehole excavations by the United States, erected oil rigs on the narrow coral reef of Mururoa and drilled down between 800 and 1,200 meters to the underlying basaltic rock foundation. It should also be noted that, in one case, a nuclear bomb being lowered in the deep-drilled shaft became stuck at about four hundred meters. The French test team plugged the artificial vertical duct with concrete, as was normally done in this type of underground detonation. However, this particular plugging effort proved unsuccessful to prevent the venting of gaseous fission products such as krypton and xenon.[19]

17 Ben Lewis, *Blowing Up Paradise* (Icarus Films, 2005); Gabrielle Hecht, *H-France Review* 7, no. 10 (2007), www.h-france.net/vol7reviews/hecht.html (last visited June 12, 2008).

18 Bruce Barnes, *The French Nuclear Tests in the South Pacific: Case Study of an International Environmental Dispute*, Program Conflict Resolution, University of Hawaii at Manoa, PCR Working Series: 1987–07 (Honolulu, 1987); Bengt Danielsson, "Under the Cloud of Secrecy: The French Nuclear Tests in the Southeastern Pacific," *AMBIO* 13 (1984): 336–41; Bengt Danielsson, "Poisoned Pacific: The Legacy of French Nuclear Testing," http://www.thebulletin.org/issues/1990/mar90/mar90danielsson.html (last visited March 14, 2004).

19 Danielsson, "Poisoned Pacific."

Despite preventive measures such as the use of concrete, a detonation underground in the coralline substrate of an atoll almost instantaneously vaporizes the surrounding rock and a large cavity quickly forms. Rocks outside the vaporized center melt and puddle at the bottom of the cavity. Eventually, the weight of the overload causes the cavity roof to collapse, producing a rubble chimney. The artificial vents generally extend to the ground surface, forming "sinks," or subsidence craters, that can measure from 55 to 550 meters in diameter and as much as 55 meters in depth. The French engineers claimed that all radioactivity released from their underground tests would be trapped and sealed in the artificial cavities created when the enormous heat from the blasts melted the surrounding rocks. On the contrary, venting, leakage, and seepage regularly followed in the wake of the French underground nuclear bomb tests in the Tuamotu Archipelago.[20]

Geological alteration also occurred in the outer wall of Mururoa Atoll as enormous chunks of rock were torn out by test detonations. A bomb with a yield of 0.15 Mt detonated on July 25, 1979, for example, and broke loose an estimated 1 million square meters of coral and rock.[21] Underwater landslides produced by tests sometimes generated tsunamis that raced through the Tuamotu Archipelago. For example, the 1979 underground detonation of a bomb that became stuck halfway down a shaft eight hundred meters deep, generated a tsunami that destroyed buildings and wharfs in various locations in the Tuamotu Archipelago and injured people on the southern part of Mururoa Atoll.[22]

In 1988, France acknowledged that it could not continue to test all of its nuclear weapons underground at Mururoa because of the geological damage inflicted to the atoll by the previous tests. Consequently, it decided to conduct large blasts at Fangataufa Atoll.[23]

A residual geological impact of French testing was the production of crushed rock rubble excavated from the bomb shafts drilled in the reef. By June 1984, more than sixty shafts had been drilled, and each produced about 1,500 metric tons of rubble. Roughly ninety thousand metric tons of at least partially polluted material must thus have been dumped into either the Mururoa Atoll lagoon or the surrounding sea. A related environmental

20 Ibid.

21 Haroun Tazieff, *Rapport Sur l'Emsemble de la Mission Scientifique en Polynesie Francaise*, mimeographed report published by the French Ministry of Defense (Paris, 1983).

22 Greenpeace, *French Polynesia*; Danielsson, "Under the Cloud of Secrecy" and "Poisoned Pacific"; International Commission to Investigate the Health and Environmental Effects of Nuclear Weapons Production (IPPNW) and Institute for Energy and Environmental Research (IEER), *Radioactive Heaven and Earth: The Health and Environmental Effects of Nuclear Weapons Testing in, on, and above the Earth* (New York, 1991).

23 Danielsson, "Poisoned Pacific"; Greenpeace International, http://archive.greenpeace.org/comms/vrml/rw/text/def/fangataufa.html (last visited March 12, 2004).

impact issue involves the extraction and relocation of massive amounts of local sand from atolls where testing took place. The extracted sand was used in mixing the huge amounts of cement required to plug bomb shafts. The locations where the sand was extracted or dredged from Mururoa and other atolls in the region need to be critically evaluated.[24]

Another important geological impact of the nuclear testing program in French Polynesia involved large-scale excavation of a reef section at Fangataufa Atoll to help facilitate maritime traffic and the transfer of heavy equipment to the atoll. Unlike Mururoa, which has open passes through the reef surrounding the lagoon, Fangataufa was a naturally closed atoll. The French military therefore deemed it necessary to open up a four-hundred-meter gap in the reef rim to allow ships to enter the lagoon.[25]

NUCLEAR TESTING IMPACTS ON THE BIOTA

> The first bomb was placed on a barge anchored in the lagoon and detonated. The result was a catastrophe – all the water contained in the shallow reef basin was sucked up into the air and then rained down, covering all islets with heaps of irradiated fish and clams, whose slowly rotting flesh continued to stink for weeks.[26]

Living organisms in the marine and terrestrial environments affected by nuclear testing have suffered from a variety of short-term and long-term impacts. The blast areas were, of course, devastated, and regions beyond the blast areas, sometimes at great distances from them, also experienced the ecological consequences of radioactive fallout. Table 6.2 outlines the fallout contamination resulting from the five U.S. nuclear bomb tests that took place in the Marshall Islands during the period from 1952 to 1958. Unfortunately, the contamination levels of radioactive fallout from these tests, as well as their effects on native people and U.S. government personnel, are not yet fully disclosed for public scrutiny. Unfortunately, the U.S. government has still not declassified all the records concerning the radioactive contamination resulting from these tests or its effects on the native peoples and military personnel in the region.[27]

The radioactive fallout generated by the subsurface Baker test (0.023 Mt, Operation Crossroads) in the Bikini Lagoon on July 23, 1946, serves as an

24 Danielsson, "Under the Cloud of Secrecy" and "Poisoned Pacific."

25 IPPNW and IEER, *Radioactive Heaven and Earth*, 135; H. R. Atkinson et al., *Report of a New Zealand, Australian, and Papua New Guinea Scientific Mission to Moruroa Atoll, October-November 1983* (Wellington, 1984); Cousteau Foundation, *Scientific Mission of the Calypso at the Moruroa Nuclear Test Site* (Wellington, 1988); Andrew Burrows et al., *French Nuclear Testing, 1960–1988* (Washington, D.C., 1989).

26 Danielsson, "Under the Cloud of Secrecy," 336.

27 Dibblin, *Day of Two Suns*, 256–7.

Table 6.2. *Radioactive Contamination for Five U.S. Nuclear Bomb Tests in Remote Oceania Where Fallout Fell on Islands Beyond the Atoll Where the Detonations Took Place*

Operation-Test	Location	Date	Yield	Impacts
Ivy-King	Enewetak	Nov. 1952	0.5 Mt	Contaminated Ujelang Atoll.
Castle-Bravo	Bikini	Mar. 1954	15 Mt	Contaminated Bikini, Rongelap, Rongerik, Utrik and other atolls or single islets which were inhabited or used for food collection.
Castle-Union	Bikini	Apr. 1954	6.9 Mt	Contaminated Rongerik, Rongelap, and Ailinginae atolls.
Castle-Yankee	Bikini	May 1954	13.5 Mt	Contaminated Rongerik, Rongelap, Ailinginae, and Bikar atolls.
Hardtack I Operation	Bikini and Enewetak	May 1958		Contaminated Ujelang, Rongelap, Ailinginae and Wotho atolls.

example of the serious short-term effects of an atomic blast. This detonation produced severe radioactive contamination of the land as well as the marine environments nearby. Radiation on the surface near the point of the blast reached a lethal 730 roentgens within the first twenty-four hours after the blast, and consequently, Bikini Island, located about five kilometers from the lagoon detonation site, "could not be safely landed on until a week had passed."[28]

The greatest immediate impact of the Baker test on marine biota in the area was the massive die-off of fish and other organisms as the blast turned ocean water to steam in a matter of seconds. Nevertheless, a high-ranking military witness to the test reported twenty-five years later that this extreme heating effect was felt only inside the lagoon and that the test has almost no effect on marine life outside the atoll. He also referred to a survey conducted a year following the Baker test in Bikini that showed slight radiation in some marine life, but no evidence of mutation or other effects on the reproductive system of these organisms.[29]

More than decade after huge blasts had created two submarine craters (Lacrosse and Cactus) on Bikini, a scientific team was sent to survey the newly formed seafloors of these man-made depressions. According to the

28 Sublette, "Effects" B.

29 Kenneth Moll, "The Bikini A-bomb Tests – 1946, *Air Force Magazine*, July 1971, 62–9.

researchers, the mollusks, crustaceans, polychaetes, zooplankton, algae, and phytoplankton found in the craters seemed typical of the fauna and flora occurring in the adjacent lagoon or on the reef flat, suggesting an apparent resilience of marine biota.[30]

However, the first posttest survey carried out at Bikini Atoll in July 1947 found traces of radioactivity in organisms from all areas of the lagoon. The source of radioactivity was the mud in the target area. Biological and physical dispersion were effectively transferring radionuclides throughout the marine environment.[31] Moreover, additional nuclear bomb explosions further contributed to the radioactive conditions. Studies carried out in the 1970s and 1990s indicate that much of the radioactive waste in the marine environment of Bikini Atoll is still in need of earnest attention; for example, Nevissi and Nevissi reported the following:

> After about 16 years, since the last nuclear test on the Atoll, the radionuclides are neither buried totally in the lagoon sediments nor have they been discharged completely to the ocean. There is a constant circulation and redistribution of the materials in the lagoon enforced by prevailing lagoon currents.[32]

Studies conducted on Rongelap, where serious fallout from the Bravo test occurred, have shown the differences in the partitioning of fission products among marine and terrestrial ecosystems. Radioactive cesium 137, which behaves chemically like potassium and therefore is extracted from soils or sediments by plant root tips, tends to concentrate in terrestrial food webs. Organisms living in environments with low potassium levels are thus at risk of accumulating more cesium 137 in their tissues than they might otherwise. Marine organisms can also accumulate considerable amounts of cerium 144, which mimics phosphorus in its ability to be absorbed biologically.[33] Fish species were found to accumulate especially high levels of radioactivity in their digestive tracts, livers, and muscle tissues.[34] In 1955, one year after the Operation Castle fallout, the Naval Radiation Defense Laboratory found significant concentrations of internally deposited activity in marine specimens taken from the Rongelap Lagoon. The majority of

30 Colin, "Physiography"; R. S. Nolan, R. R. McConnaughy, and C. R. Stearns, "Fishes Inhabiting Two Small Nuclear Test Craters at Enewetak Atoll, Marshall Islands, Micronesia," *Micronesica* 11 (1975): 205–17.

31 Bikini Atoll Rehabilitation Committee, *Interim Draft*, Aii.

32 Ahmad Nevissi and William Schell Nevissi, "Distribution of Plutonium and Americium in Bikini Atoll Lagoon," *Health Physics* 28 (May 1975): 539–47.

33 Bikini Atoll Rehabilitation Committee, *Interim Draft*, Aiv. See also S. Duffy, S. L. Simon, and F. W. Whicker "137 Cs Contamination of Plants Used for Traditional Medicine and Implications for Human Exposure," *Journal of Environmental Radioactivity* 46 (1999): 27–44.

34 Keever, "Fallout."

the radioactivity was contributed by ruthenium 106–rhodium 106 and zirconium 95–niobium 95.[35]

An unusual and tragic situation affects the natural removal of the radioactivity that occurs within the soil of the islets in the Marshall Islands. The natural leaching of cesium 137 out of the ecosystem is inhibited because of the long-distance dispersal and fallout of dust blown from arid areas in East Asia and the subsequent sequestering of this mica-rich dust into the soil and other sediments of the Marshall Islands over very long periods of time. There appears to be very effective long-term bonding of the radioactive material and the far-flung dust in a distinct subsurface layer, and this combination of the mica dust and cesium 137 is most seriously stabilized in the drier atolls of the Marshall Islands, including Rongelap. Consequently, the radioactive materials are not effectively removed from the soil of some islets over time.[36] This has serious consequences in terms of consumption of locally cultivated food crops on some atolls such as Bikini and Rongelap.

On Enewetak Atoll, the marine ecosystem was notably altered as a result of human migration. First, the native Marshallese population was removed during the preparations for the bomb testing. With the removal of the residents, who catch and consume seabirds, the atoll's bird population grew rapidly. As the seabirds' numbers increased, the reef and lagoon fish populations declined as a result of greatly increased predation by the birds. In response to the decreases in the herbivorous and carnivorous fish, the algae population of the reefs and other marine substrates increased substantially. On land, the large coconut crabs (*Birgus latro*) also increased in numbers as a result of reduced human predation.

The native residents of Enewetak were eventually allowed to return after the cleanup efforts following the test detonations. The reintroduction of a keystone predator – humans – brought about rapid changes in the distribution and behavior of seabird populations. The birds either left the reoccupied areas of human settlement and use or were caught and eaten. Other animal populations in high demand, such as coconut crabs and lobsters, also experienced dramatic declines. Although the nearshore fishes initially increased

35 R. W. Rinehart, S. H. Cohn, J. A. Seiler, W. H. Shipman, and J. K. Gong, *Residual Contamination of Plants, Animals, Soil, and Water of the Marshall Islands One Year following Operation Castle Fall-o*ut, U.S. Naval Radiological Defense Laboratory, Report 454, August 12, 1955, San Francisco, Department of Energy Archives, iii.

36 Will McClatchey and Kent Bridges, Botany Department, University of Hawaii at Manoa, personal communication, January 15, 2005. See also W. Robison, C. Conrado, and M. Stuart, "Radiological Conditions at Bikini Atoll: Radionuclide Concentrations in Vegetation, Soil, Animals, Cistern Water, and Ground Water," Lawrence Livermore National Laboratory, Livermore, California, UCRL-53840 (1988), and R. Whitcomb, "Reconstruction and Analysis of Cesium-137 Fallout Deposition in the Marshall Islands" (PhD diss., University of Florida, 2000).

with the drop in the seabird population, resulting in the decrease of some seaweed populations, eventually people exploited the desirable fish species very heavily. Overfishing, in turn, led to the development of extensive algal communities on surfaces that had previously been grazed clean by fish.[37]

In some situations, the nuclear testing programs in Remote Oceania had both positive and negative consequences for the native organisms. During the preparation of Operation Crossroads at Bikini Atoll in July 1946, for example, the U.S. military gathered more than ninety expendable commercial and naval vessels and anchored them at various distances from the point of the detonation in the lagoon of the atoll. Many of the ships that sank in the lagoon as a result of the nuclear test were in battle-ready condition and thus loaded with fuel and ammunition. Unfortunately, leakage of fuel and oil from some of these ships has been observed, and this negative environmental impact needs to be monitored regularly. However, the sunken ships also had a positive, though unintended, impact for some marine organisms – the inadvertent creation of artificial reefs in the lagoon around and on which native marine organisms tend to congregate. According to many recreational diving experts, the shipwrecks and the increased fish populations now associated with them in Bikini Lagoon constitute one of the most spectacular diving sites of the world.[38]

Early examples of biotic disturbances on land produced by U.S. military can be observed in the government-produced film *U.S. Army Engineers in Operation Sandstone*.[39] That massive operation, involving 10,200 personnel on Enewetak in 1948, was the first test of new weapons designed after World War II. One of the proud accomplishments of the operation, according to the Corps of Engineers, was the removal of "hundreds of acres of palm trees" to obtain better photographs of the various detonations. The film documents the stabilization of soil using thick oil or cement. The construction, often with the use of local materials, of roads, airfields, and other facilities related to the tests greatly altered areas of the terrestrial environments at Enewetak and other islands in the region.

In 1954, as noted earlier, a thermonuclear detonation during the Bravo test at Bikini Atoll had disastrous consequences. It was, unintentionally, the

37 Bikini Rehabilitation Commission, *Interim Draft*, Axiii; John Harrison, former director, Environmental Center, University of Hawaii at Manoa, personal communication, March 13, 2004.

38 Jim Church, "The Incomparable Wrecks of Bikini Atoll," *Skin Diver*, December 1998, http://www.bikiniatoll.com/SkinDiverMagazine.html (last visited June 10, 2008); Eric Hanauer, "Return to Bikini," *eScuba*, http://www.escuba.com/articles/index.asp?WCI=Article1&WCE=75 (last visited February 4, 2005).

39 U.S. Air Force, *U.S. Army Engineers in Operation Sandstone*, Lookout Mountain Laboratory for the Chiefs of Engineers, Department of Army and the Atomic Energy Commission (Albuquerque, 1996), videocassette.

largest explosion ever carried out by the U.S. government. It should be pointed out here that the Soviet Union detonated a thermonuclear bomb with a much higher yield on October 30, 1961, at the Mityushikha Bay test range on Novaya Zemlya Island, located in the Arctic Sea. Dubbed the "Tsar Bomba" in the West, this device had a yield, according to the Soviets, of 50 Mt, by far the largest man-made explosion in history.[40] The willingness of the nuclear rivals to test weapons of such magnitude attests to both the intensity of the Cold War and the superpowers' lack of environmental sensitivity.

The Bravo test at Bikini spread radioactive fallout well beyond the announced danger zone. The fallout eventually reached Rongerik, Rongelap, and Utirik atolls, as mentioned earlier. The Atomic Energy Commission (AEC) announced that the atolls "were contaminated by radioactive fallout because of an unexpected shift in wind conditions."[41] One year after the Bravo test, another survey was conducted by personnel from the Naval Radiological Defense Laboratory and the University of Washington Applied Fisheries Laboratory to assess the residual contamination in the Marshall Islands. It found that the animals, food plants, water, and soil samples of Rongelap Atoll contained "significant amounts of radioactive contamination."[42]

Twenty years later, in August 1975, the AEC's Energy Research and Development Administration issued preliminary results of a study of Bikini Atoll carried out earlier that year to determine the kinds and amounts of radionuclides found in food, plants, animals, and soil there. The report cautiously concluded that houses on Bikini Island's islet built before the Bravo test could be reoccupied. But it also recommended that all new residential construction take place on Eneu Island. The study found that radioactivity levels in the interior of Bikini Island were beyond safe levels, and it therefore recommended that no more houses should be built in that

40 It should be pointed out here that the Soviet Union detonated a much-higher-yield thermonuclear bomb on October 30, 1961, at the Mityushikha Bay test range on Novaya Zemlya Island, located in the Arctic Sea. This utterly frightening device is referred to in the Western nations as "Tsar Bomba." The Soviets claimed that it produced a yield of 50 Mt, by far the largest man-made explosion in history. As terrifying as this hugely destructive device must have been, it was designed originally to produce a yield of 100 Mt! Its yield, however, was consciously reduced because of the much more dangerous fallout potential it would have posed at higher yield. A full accounting of the environmental effects of Tsar Bomba blast is still needed. See Vitaly I. Khalturin, Tatyana G. Rautian, Paul G. Richards, and William S. Leith, "A Review of Nuclear Testing by the Soviet Union at Novaya Zemlya, 1955–1990," *Science and Global Security* 13 (2005): 1–42.

41 K. D. Nichols, Letter to Honorable W. Sterling Cole, Chairman, Joint Committee on Atomic Energy, Congress of the United States, *Answers to State Department "List of Possible Questions*," September 14, 1954, Washington D.C., Atomic Energy Commission, 2.

42 Rinehart et al., *Residual Contamination*, iii.

part of the islet. It also found that food plants were extracting radionuclides from the soil; Bikini residents were thus warned not to consume food grown locally.[43]

In 1987, the Bikini Atoll Rehabilitation Committee released the findings of another study of soil contamination by radionuclides. It concluded that in the case of new soils the radioactivity levels are associated with algae concentrations found as a surface crust in undisturbed areas and in coral fragments in eroded places. Buried organic horizons contained more cesium 137 than adjacent soil layers, and roots were more radioactive than the surrounding soil except at the surface. Mixing by animals in old soils and by erosion in young soils contributed to the redistribution of radionuclides near the surface. Cesium 137 and strontium 90 were the principal radionuclides entering a cycle in the soil-plant system.[44] Strontium 90, a by-product of nuclear fission, has a half-life of twenty-eight years. It is found in nuclear fallout and creates long-term health problems because it substitutes for calcium in bones and thereby avoids removal from the body. Because bone marrow is among the more sensitive tissues, strontium 90 can produce a variety of serious bone disorders and diseases, including cancer.

The United Kingdom's nuclear tests also affected the biota of the islands where testing was conducted. Malden Island, for example, was significantly contaminated by radiation, even though the British government had declared that the nuclear weapons tests there had left no radioactive fallout.[45] The quotation from Ken Cox at the beginning of this chapter testifies to the horrifying immediate effects of the May 1957 test on some of the island's biota.

Following the Malden Island detonations, the British moved their nuclear testing to Christmas Island. As noted previously, all of the tests there involved detonations in the atmosphere. The second British bomb test above Christmas Island – Grapple Y (2 Mt) on April 28, 1958 – resulted in significant radioactive contamination at the surface as a result of a change in the wind direction.[46] However, American experts who conducted a study of Christmas Island in 1975 stated that levels they recorded "were lower than those found in most American cities."[47] However, it should be noted that by

43 Martin B. Biles, Letter to Roger Ray, Distad Majuro Marshall Islands, September 2, 1975. RG 326, Collection: L. Joe Deal, Box 13, Folder 4–1 Bikini Radiological Survey-Resettlement, Department of Energy Archives.

44 Bikini Atoll Rehabilitation Committee, *Interim Draft*, Aix.

45 PCRC, *Kirisimasi*.

46 Ibid, 11.

47 Eric Bailey, *The Christmas Island Story* (London, 1977), 61. See also V. Nelson, "Radiological Survey of Plants, Animals, and Soil at Christmas Islands and Seven Atolls in the Marshall Islands," *Progress Reports for 1974–1975*, University of Washington, NVO-269-32 (1977).

1999, when Johnston Atoll was being used to incinerate U.S. chemical weapons removed from West Germany at the end of the Cold War, it was still polluted by radioactive plutonium produced during the U.S. late-1950s and early-1960s nuclear tests that took place on that atoll.[48] The short- and long-term biological contamination of these activities at Johnston Atoll, and perhaps on Christmas Island, have not yet been fully understood, or perhaps not yet disclosed entirely to the public.

A direct but often short-term impact on the biota from aboveground nuclear tests in Remote Oceania was the burning or overheating of vegetation. After the tests on Christmas Island, for example, witnesses reported that the coconut trees on the islands "did not look healthy," and others noted that all the plants on the island, having lost their stems and leaves, appeared as though they had been doused with boiling water.[49] Nevertheless, some authors pointed to the resilience of terrestrial atoll ecosystems to high levels of devastation and to the recolonizing response to nuclear testing impact. For example, the vegetation and accompanying biota on Bikini Atoll, had recovered, at least to the early stages of succession within twenty to thirty years of the tests carried out there. It was reported in the late 1980s that, on the islands of the southwest atoll rim, native *Pisonia grandis* had gradually replaced coconut palms, particularly in the areas most disturbed by the testing, and a mature forest of *P. grandis* had developed.[50] Some studies have found that species composition has changed on atolls where tests had been carried out. If that is in fact the case, however, it is still not clear whether this was the result of differential species tolerance to radiation or if the vegetation was still in an early stage of ecological succession.[51] It has also been reported that individual plants of some species on Mururoa had become extremely large.[52] More research is needed to answer such questions about the short- and long-term impact of nuclear tests on plant life.

Studies on the native seabirds in some test areas have found that radioactivity was concentrated in their bones. The heat generated by the bomb fireballs affected bird species differently: birds with dark-colored feathers were usually burned more severely than those with lighter colored feathers.[53] On

48 PCRC, *Kirisimasi*, 19.

49 Ibid., 48.

50 Ernst Reese, "Terrestrial Environments and Ecology of Enewetak Atoll," in *Natural History of Enewetak Atoll*, 1:200–1.

51 J. R. McNeill, "Of Rats and Men: A Synoptic Environmental History of the Island Pacific," in *The Pacific World: Lands, Peoples and History of the Pacific, 1500–1900* (Aldershot, 2001), 337.

52 F. Raymond Fosberg, "Vegetation of Bikini Atoll, "*Atoll Research Bulletin* 315 (1988): 1–28.

53 Keever, "Fallout."

Christmas Island, huge numbers of seabirds were blinded as the result of the bomb flash and consequently died from starvation. In their testimonies, the Fijian personnel working for the British government at Christmas Island during Operation Grapple frequently mentioned their assignment to the "clean-up detail," which included disposing of the thousands of birds that were mutilated, wounded, blinded, or killed by the nuclear tests.[54] In the late 1970s, it was reported that, although there had been a remarkable recovery among the avian species, some seabird colonies had been exterminated.[55]

Although the impact of nuclear testing on the birds of Enewetak Atoll has not been studied in detail, it is likely that the bird population was decimated.[56] Some mutations, possibly related to nuclear testing, were reported from Enewetak. In July 1971, for example, a young white-tailed tropic bird (*Phaethon lepturus*) on Janet Island was seen with a malformed lower mandible; it perished soon after parental feeding was completed. In addition, several immature sooty terns (*Sterna fuscata*) in a large colony on Janet were observed with left wings so deformed "that the birds could not fly."[57] One scientist who has surveyed the biotic impact on Enewetak has pointed out that the environmental change on this atoll had not been completely harmful to the avian species. "The removal of vegetation from many of the islands as a result of the cleanup program has opened up new nesting areas for ground nesting birds."[58] This, of course, also means that seabird species that nested in or on the vegetation lost much of their needed breeding habitat.

As with birds, rats on the islands affected by nuclear testing were found to have radioactivity concentrated in their bones. After the removal of people from Enewetak Atoll in preparation for the first hydrogen bomb test at Enewetak (Operation Greenhouse, 1952), rats were the only mammals left in the area. All were apparently killed.[59] The rat populations of the various islets of the atoll may have been annihilated by the combined effects of preparatory clearing, construction, and bomb detonations. As part of an experiment at Enewetak, the Atomic Energy Commission reintroduced rats on Ananij Islet after the first nuclear tests: they seem to have flourished. Similar attempts on other islets were apparently not successful, however.

54 Ibid.

55 Bailey, *Christmas Island*, 68.

56 Andrew Berger, "Aviafauna of Enewetak Atoll," in *Natural History of Enewetak Atoll*, 1:216.

57 Ibid.

58 Ibid.; M. Temme, "Bird Populations on Enewetak Atoll," *Mid-Pacific Marine Annual Report* (Honolulu, 1979), 67–80.

59 William Jackson, "Survival of Rats at Eniwetak Atoll," *Pacific Science* 23 (1969): 265–75; McNeill, "Of Rats and Men," 337.

A study of the roof rats (*Rattus rattus*) found that radionuclides the animals ingested from plant material were concentrating in their bodies.[60]

Earlier studies of the rats affected by the nuclear testing did not find any abnormalities that could be associated with elevated radiation levels. The rats were not larger, nor did they have a higher incidence of tumors or reabsorbed embryos. However, studies done in the 1970s and 1980s found a positive correlation between background radiation levels and the frequency of palatal ridge deviations in the rats tested.[61] In the samples of the so-called Polynesian rat (*Rattus exulans*) on Lujor Islet, Enewetak, "the incidence of abnormal palatal ridges was 0.44 . . . the highest test contamination of the islets still harboring this species."[62] Apparently, the minor alterations did not create problems for the rats. Moreover, it was uncertain whether a mutation was involved.

NUCLEAR TESTING IMPACTS ON HUMANS

The huge thermonuclear tests in the Marshall Islands produced fallout that encircled the globe.[63] The large-scale hydrogen bomb testing that began in October 1952 with the Mike test of Operation Ivy literally changed the chemical signature of our bones. Radioactive forms of iodine, cesium, strontium, and other elements were dispersed far and wide, and "as a result all organisms, including humans, carry the watermark of the nuclear era woven into their tissues."[64] Environmental radioactivity derived from some nuclear weapons components like plutonium will persist for up to five hundred thousand years and may be hazardous to humans for at least half that time.[65] Political and military pressure to produce and demonstrate deterrent mass destructive power in the short-term of the Cold War has left us and our descendents with very long-term environmental liabilities.

The vaporization or destruction of living and nonliving things in the vicinity of a nuclear bomb blast is obviously the most intense short-term effect of such tests. Among the other short- and long-term effects that

60 William Jackson, Stephan Vessey, and Robert Bastian, "Biology of the Rodents of Enewetak Atoll," in *Natural History of Enewetak Atoll*, 1:203.

61 Manfred Temme, "Reproductive Parameters of the Polynesian Rat (*Rattus exulans*) in the Northern Marshall Islands," *Zeitschrift für Angewandte Zoologie* 68 (1981): 315–38.

62 Jackson et al., "Biology of the Rodents," 211.

63 Keever, "Fallout."

64 John Harrison, personal communication. See also S. L. Simon, "A Brief History of People and Events Related to Atomic Weapons Testing in the Marshall Islands," *Health Physics* 73 (1997): 5–20.

65 Eileen Welsome, *The Plutonium Files: America's Secret Medical Experiments in the Cold War* (New York, 1999).

have resulted from nuclear testing in Remote Oceania are those associated with exposure to radiation. Exposure can take several forms, including direct exposure to the beta or gamma radiation emitted by nuclear detonations, inhalation of radioactive airborne particles, and consumption of fission products that entered the food chain.

Thermal injuries (skin burns), eye injuries (cornea and retina harm), and radiation injuries (primarily through chromosomal damage) are among the most important radiation effects on humans resulting from nuclear testing. Bone marrow and lymphatic tissue are by far the parts of the body most susceptible to injury by radiation. Children are more sensitive to injuries than adults, and fetuses the most sensitive of all.[66] The most common diseases caused by radiation fallout are leukemia, brain tumors, and thyroid cancer. Since the early 1980s, for example, a considerable increase in the number of cases of these three types of cancer has occurred in French Polynesia and the Marshall Islands, and among Fijian, New Zealand, and British military and civilian personnel who were exposed to radioactive fallout during the British tests in the central Pacific.[67]

The biological effects of radiation exposure can be divided into two types: acute and chronic. Acute effects typically result from rapid exposures and are mainly localized in the skin and thyroid gland. One type of acute effect on the skin is known as beta burn. This seriously affected some Marshall Islanders during the 1954 Bravo test. An example of chronic radiation risk is the exposure of the thyroid gland to the short-lived radioisotope iodine 131 (I-131, half-life of eight days), which has been "assumed to present a special risk due to its tendency to become concentrated in the human thyroid gland."[68] Although it is quite likely that exposure to I-131 does increase the risk of thyroid cancer, there is a history of uncertainty about comparative carcinogenicity of fallout exposure to this specific radioactive isotope versus external radiation from other sources. On October 1, 1997, for example, Dr. Richard D. Klausner, the director of the U.S. National Cancer Institute (NCI), testified in front of the U.S. Senate Committee on Appropriations, Subcommittee on Labor, Health and Human Services, Education and Related Agencies that, up to then, "studies of exposure to I-131 for medical purposes or from fallout in areas downwind from the site of atomic bomb tests during the 1950s have not produced conclusive

66 Sublette, "Effects" A.
67 Danielsson, "Poisoned Pacific"; PCRC, *Interim Draft*; Keever, "Fallout"; Dibblin, *Day of Two Suns*.
68 Sublette, "Effects" A.

evidence that such exposure to I-131 is linked to cancer." Nevertheless, Klausner also noted in his testimony before the committee:

> The NCI appreciates the great interest and concern that you and the public have that high quality and fully disclosed information be provided about nuclear fallout. This is especially true in the context of the legacy of the Cold War in which such information was too often not provided or hidden.[69]

The chronic radiation risk referred to above does exist but results from a prolonged high level of exposure to I-131. The most important effect of long-term exposure to radiation overall is the elevated risk of cancer. This risk is apparently proportional to total radiation exposure, regardless of the quantity of an individual exposure event or rate and duration of such exposure. Genetic damage is another possible long-term biological effect of radiation exposure; and radiation damage to cells of the reproductive organs can cause mutations that are passed on to future generations.

So far as we know, the Bravo test in March 1954 had a greater impact on humans than any other nuclear detonation.[70] This test resulted in a major radiological disaster as a consequence of three factors: (1) U.S. government officials failed to postpone the detonation even after they realized that there had been an unfavorable change in the weather; (2) the bomb detonation had an unexpectedly high yield; (3) there was a lack of precautionary, pretest evacuation drills. Consequently, the Marshallese Islanders on Rongerik, Rongelap, Ailinginae, and Utirik atolls (and quite likely others) were exposed to high levels of radioactive fallout.

In addition, as mentioned earlier, a Japanese fishing vessel was positioned about one hundred miles east of Bikini when the Bravo test occurred. As result of an abnormal airflow in the region, the boat was downwind from Bikini and thus in the path of Bravo's fallout. All twenty-three of the crew members received exposures of three hundred rads of radiation and quickly began to suffer headaches and nausea. When the boat reached Japan two weeks later, the crew members were still suffering from radiation sickness, which included skin blisters and hair loss. One crew member died six months later from liver and blood damage. The fishermen's injuries

69 Richard D. Klausner, M.D., Director, National Cancer Institute, National Institutes of Health, U.S. Department of Health and Human Services. Testimony before the Senate Committee on Appropriations, Subcommittee on Labor, Health and Human Services, Education and Related Agencies, October 1, 1997; Katie Walter, "Assessing Exposure to Radiation," *Science & Technology*, January–February 1997, 15–21.

70 As noted *supra* note 40, we still know very little about the environmental or human health consequences of the Soviet's detonation of the "Tsar Bomba" in the Arctic Sea in 1961. At 50 Mt, its yield was more than three times that of the Bravo test.

caused an international outcry, and two years after the test, the United States handed over $2 million in compensation to the Japanese government.[71]

More or less all of Bikini Atoll was polluted by the radioactivity generated by the Bravo test. Numerous workers involved in Operation Castle were exposed to dangerous levels of radiation from the fallout. "For example, personnel in the firing bunker on Nan Island were trapped for a time when external radiation levels reached 250 rad per hour after the detonation."[72] Following the giant blast, the U.S. government expanded the exclusion zone around the Castle tests to approximately 1.5 million square kilometers, an area approximately equal to 1 percent of Earth's terrestrial area.

The fallout from the Bravo test was political as well as radioactive. The physical harm it did intensified growing international opposition to atmospheric nuclear testing. As a result of several factors, including implications for human health, atmospheric nuclear testing was internationally condemned. Some authors, it should be noted, have argued that Bravo was designed specifically to create a great quantity of deadly fallout. They point out that, even though U.S. officials knew ahead of time that the wind was blowing toward two populated atolls (Rongelap and Utirik), they allowed the test to take place as scheduled.[73] In any case, it has been claimed that this huge thermonuclear explosion produced many special research opportunities and that our "understanding of radio-ecological principles" was significantly advanced:

> It had previously been difficult to separate source terms while studying radioecology at sites of multiple tests. The fallout irradiation of Rongelap Atoll constituted a single-pulse radiological inoculation of an isolated ecosystem which proved extremely informative in subsequent radiobiological studies.[74]

Bravo was detonated in the early morning, and by the middle of the day, the fine powder fallout had reached Rongelap. Unfortunately, young people there who had seen snow only in photographs initially frolicked in what they thought were snowflakes of natural precipitation. The average dose of radiation exposure on Rongelap was estimated to have been 175 rads per person. The maximum total body dose recommended by the International Commission on Radiological Protection is 0.5 rad per year. After the Rongelap islanders and U.S. personnel stationed there had spent some time breathing, eating, and sleeping amid the fallout, the U.S. Navy arrived

71 Dibblin, *Day of Two Suns*.

72 The Nuclear Weapon Archive, http://nuclearweaponarchive.org/Usa/Tests/Castle.html (last visited June 10, 2008).

73 Dibblin, *Day of Two Suns*, 24.

74 Bikini Atoll Rehabilitation Commission, *Interim Draft*, Aiii–Aiv.

to transport them to the military base on Kwajalein Island. Indeed, it was acknowledged early on that, during the acute exposure period immediately following the test and its radioactive fallout, the Rongelap islanders had manifested severe effects, including skin lesions, hair loss, and internal radiation contamination from ingesting fallout material.[75] However, according to the report submitted by a team of U.S. Naval medical researchers that reexamined Rongelap native people who had been exposed to the Bravo test fallout six months after the detonation, they appeared to be "in excellent general health." Nevertheless, the immediate, to say nothing about the long-term, health consequences of the fallout must have been very frightening to the Marshallese who were affected directly by radioactive fallout and many of them continue to suffer the effects of exposure to this radiation.[76]

According to the calculations of Dr. Neal Palafox of the University of Hawaii School of Medicine, the sixty-seven thermonuclear tests conducted in the Marshall Islands had a total yield equivalent to 7,200 times that of the atomic bomb dropped on the city of Hiroshima on August 6, 1945, "an average of more than 1.6 Hiroshima bombs per day for the 12-year nuclear test program."[77] The radiation released by these tests is believed to have been responsible for two very serious health problems among the residents of the atolls such as Rongelap. First, a number of women have given birth to so-called jellyfish babies who do not look like humans and who had apparently been horribly and fatally deformed by the effects of nuclear radiation. Second, people living on all the atolls affected by fallout suffer from high percentages of thyroid cancer, suspected by many to be associated with large doses of radioactivity.

The Marshallese residents of Bikini who had been evacuated before the first atomic test returned to their island in the early 1970s after it was officially declared safe. They were removed once more, however, when that assessment was called into question later in the decade. Their health has become a controversial issue. The only clear truths are the following: (1) they have extraordinarily high rates of malignant thyroid tumors, miscarriages, and stillbirths; (2) they tend to ascribe any and all ailments to radiation poisoning; and (3) they have become adept at the politics of nuclear compensation. By 2002, the U.S. government had made payments

75 Merze Tate and Doris Hull, "Effects of Nuclear Explosions on Pacific Islanders," *Pacific Historical Review*, 33, no. 4 (1964): 383.

76 Steward Firth, *Nuclear Playground* (Honolulu, 1987), 39–48; Johnson, *Nuclear Past, Unclear Future*, 16–24.

77 C. Woodward, "You Can't Go Home Again," *Bulletin of Atomic Scientists*, 54, no. 5 (1998); Keever, "Fallout."

totaling $60 million dollars for health compensation to 1,500 Marshallese cancer patients.[78]

More than fifty years after the Bravo test, Marshall Island residents exposed to the fallout it produced, as noted earlier, continue to suffer health problems. Palafox has pointed out that the U.S. National Cancer Institute reported "530 excess cancers, mostly on northern atolls and from all over the now independent Marshall Islands."[79] In fact, Palafox has noted, Marshallese frequently do not even realize that "they have cancer because of the lack of detection facilities" making it very difficult to "track cancer in the Pacific, because data is not available."[80]

A cleanup action on Enewetak Atoll carried out between 1977 and 1979 removed more than 110,000 cubic yards of debris and soil contaminated by the numerous nuclear tests carried out there. This heavily polluted material was then dumped into the Cactus Crater Containment Site, which utilized the original bomb crater created by the huge Ivy Mike thermonuclear explosion in 1952, and then covered with a half-meter-thick cap of Portland cement, creating a crypt known as the Runit Dome. The dome, more than eight meters high, has been designated a permanent containment site. The native peoples of Enewatak are worried, however, about the possible danger of radioactive leakage from this unusual tomb. Jack Ading, a senator who represents Enewetak and Ujelang atolls in the Republic of the Marshall Islands' National Parliaments, addressed this issue when he spoke before the U.S. House of Representatives Committee on Foreign Affairs Subcommittee on Asia, the Pacific and the Global Environment on July 25, 2007:

> This site needs to be monitored to assure the integrity of the structure and to assure that no health risks from the radioactive waste site are suffered by us. To effect the foregoing, a long-term stewardship program of the Runit Dome and the remainder of Runit Island needs to be implemented by the U.S.[81]

In the case of the Britain's Operation Grapple in 1957–8, nearly 300 Fijians, 528 New Zealand military personnel, and thousands of British military personnel traveled to the central Pacific for these tests. By the late 1990s, many of the veterans had experienced health problems that they attributed to exposure to radiation during the Operation Grapple tests.[82]

78 Keever, "Fallout"; Johnson, *Nuclear Past, Unclear Future*, 29–48.

79 Gemma Casas, *The Honolulu Advertiser*, Oct. 11, 2006.

80 Ibid.

81 Jack Ading. Statement of the Newetak/Ujeland Local Government before the House Committee on Foreign Affairs subcommittee on Asia, the Pacific and the Global Environment, U.S. House of Representatives, July 25, 2007, Submitted by the Honorable Jack Ading, Senator, Nitijela of the Marshall Islands.

82 PCRC, *Kirisimasi*.

Some authors have suggested that the British government ignored the health and environmental impacts of its nuclear bomb tests in Remote Oceania, especially the impact on Pacific Islanders living near the test sites and the personnel, civilian and military, of the bases on Christmas Island.[83] The British government argued for many years that the military personnel were far enough away from the detonation points to avoid harmful exposure to radiation. The Christmas Island nuclear veterans have disputed this claim for many years; some have even argued that they were deliberately used as "guinea pigs."[84] It has been claimed that British military authorities had realized long before Operation Grapple that personnel involved in nuclear tests could be exposed to radiation. In cases before the European Court of Human Rights, Christmas Island veterans have submitted archival evidence indicating that one of the purposes of the tests was to study the effects of nuclear detonations "on personnel and equipment."[85]

The cases of the veterans of Britain's nuclear testing program are among the best documented. There has been a high rate of death from cancer among them, and they and their descendants have suffered serious health problems that they assume were caused by exposure to radiation. These health problems are also apparent among older Pacific Islanders on Christmas Island who were exposed to radiation during the British bomb testing in the 1950s.[86] In another survey, more than seven hundred Fijian site workers testified to their own serious health problems and reported the deaths of coworkers that they assume were caused by exposure to radioactivity.[87]

In French Polynesia, too, health problems caused by exposure to radiation have been reported. Mururoa Atoll's rim of coralline reef was contaminated not only by radioactive fallout from atmospheric bomb tests but also by so-called safety tests in which conventional explosives were used to destroy nuclear weapons to test the weapons' vulnerabilities and to observe the resulting dispersion of radioactive plutonium isotopes. Five such tests were carried out on islets in the northern part of Mururoa between 1966 and 1974.[88] An even greater danger to the health of the residents of islands in the region than the local contamination at Mururoa is the plutonium that spilled over the reef of that atoll during the safety tests. The sites where these tests took place were roughly fixed with a covering layer of bitumen; unfortunately, however, this mixed waste containing plutonium

83 Ibid., 7.

84 Ibid., 15.

85 Ibid.

86 Ibid., 66.

87 Ibid., 69.

88 Centre de Documentation et de Recherche sur la Paix et les Conflicts, *The French Nuclear Tests in Polynesia: Demanding the Truth and Proposals for the Future: Proceedings of the Symposium, 20th February 1999*, organized by Marie-Helene Aubert and Michele Rivasi (Lyon, 1999).

was later dispersed by subsequent typhoons. The waste that was carried away contained enough radioactivity to potentially exterminate the entire population of French Polynesia.[89] It has also been suggested that the nuclear fallout of the forty-four atmospheric tests conducted in French Polynesia between 1966 and 1974 is still with us (mostly absorbed in our bodies), and, furthermore, that the sixty-three underground tests carried out between 1975 and 1983, rather than diminishing the health hazards posed by nuclear testing, added several new sources of radioactive pollution.[90]

During the 1960s, radiation laboratories in New Zealand and Australia registered a steady increase of radioactive strontium and cesium fallout that was associated with the French nuclear testing. Scientists at the labs focused intensively on milk produced in their countries and throughout the Pacific islands. By 1971, the fallout figures had returned to the high recorded in 1963 during the period of "frenzied" British and American testing before the Pacific Test Ban Treaty took effect.[91]

The most powerful nuclear device France ever tested, a 2.5 Mt thermonuclear bomb, was detonated on Fangataufa Atoll in August 1968. Fangataufa was contaminated so heavily that it was declared off-limits to everyone but specially approved government employees for the next six years. Technicians working at the site after the bomb blast could stay for only a very limited amount of time using special protective gear.[92] It was reported that, in the early 1980s, government personnel were still allowed to work on Fangataufa only in rotating shifts because the atoll was still contaminated.[93]

According to the estimates of the International Atomic Energy Agency, the total radioactivity of the residual radioactive waste accumulated underground at Fangataufa was 94 times the maximum fixed by French regulations, and at Mururoa it was 371 times the maximum. Each atoll thereby qualified to be classified as a Basic Nuclear Facility; in other words, the level of radioactive contamination there is equal to what would be expected at a typical nuclear energy plant.[94]

In late March 2009, after decades of denial, the French government announced that it would present a compensation bill to the parliament to address complaints from people claiming health problems caused by French

89 Danielsson, "Under the Cloud of Secrecy" and "Poisoned Pacific."
90 Danielsson, "Poisoned Pacific."
91 Danielsson, "Under the Cloud of Secrecy."
92 Ibid.; The Nuclear Weapon Archive, http://nuclearweaponarchive.org/France/FranceOrigin.html (last visited June 10, 2008); Greenpeace International, http://archive.greenpeace.org/comms/vrml/rw/text/def/fangataufa.html (last visited March 12, 2004).
93 Greenpeace International, ibid.
94 Centre de Documentation et de Recherche sur la Paix et les Conflicts, *French Nuclear Tests*, 108.

nuclear weapons testing in Algeria and French Polynesia.[95] According to French Defense Minister Hervé Morin, the bill would earmark 10 million euros (approximately US$14 million) to compensate confirmed victims suffering any one of eighteen ailments associated with exposure to radiation identified by the UN Scientific Committee on the Effects of Atomic Radiation. As many as 150,000 civilian and military personnel and other people who worked or lived in the areas where the French nuclear testing took place could, in theory, be eligible for compensation. The amount of money this bill would allot is relatively meager, especially in comparison to the hundreds of millions of dollars that the U.S. government had spent by early 2009 on compensation for the effects of its nuclear testing in the Marshall Islands, compensation that some regard as grossly inadequate.[96] Insufficient as it might be, the proposed French legislation nonetheless signals an important break with the long-standing unwillingness of French governments to acknowledge a connection between atomic detonations and radiation-related illnesses. Shortly after the French government reported its compensation plans, the government of the Republic of the Marshall Islands announced that it would be seeking considerably more compensation – perhaps as much as an additional $2 billion – from the U.S. government.[97]

It should be noted here that the most serious chronic risk from fallout for humans lies in the consumption of foodstuffs grown or collected in contaminated areas. Food crops can absorb radioisotopes through their root systems or be contaminated by fallout descending on the leaves. Gross contamination of food plants or fodder from the fallout plume of a groundburst is an obvious hazard; the gradual dispersal of fallout across the globe is also a problem.[98]

95 See, e.g., Delphine Chavet, "Dix millions d'euros pour les victimes d'essais nucléairesm," *Le Figaro*, March 24, 2009, at http://www.lefigaro.fr/actualite-france/2009/03/24/01016–20090324 ARTFIG00004-dix-millions-d-euros-pour-les-victimes-d-essais-nucleaires-.php; Julien Peyron, "Les victimes des essais nucléaires devraient être indemnisées," *French 24 L'actualite Internationale*, March 24, 2009, at http://www.france24.com/fr/20090324-dix-millions-euros-victimes-essais-nucleaires-sahara-polynesie-gouvernement-fran%C3%A7ais-herve-morin (accessed May 25, 2009); Hugh Schofield "France Offers Nuclear Test Money," *BBC News International Version*, March 24, 2009, at http://news.bbc.co.uk/2/hi/europe/7960534.stm (accessed May 30, 2009).

96 By early 2009, the U.S. government had paid out hundreds of millions of dollars for direct compensation as well as "for health services for the people inadvertently affected by the testing program, for environmental monitoring, and for restoration of the affected islands where there is hope of their eventual resettlement." Clyde Bishop, Ambassador to the Republic of the Marshall Islands, quoted in Giff Johnson, "U.S. Nuclear Compensation to RMI Inadequate," *Marianas Variety*, March 27, 2009 (at http://www.mvariety.com). See also Johnson, *Nuclear Past, Unclear Future*, 29–48.

97 Johnson, "U.S. Nuclear Compensation"; "Marshall Islands Renews Appeal for Nuclear Compensation," *Australian Network News*, March 26, 2009, at http://australianetworknews.com/story .htm?id=16539.

98 Sublette, "Effects" A.

In Micronesia, American researchers discovered that both coconuts and coconut crabs, both regularly eaten by the local islanders, are easily contaminated by radiation.[99] On Bikini, even though the amount of residual radiation had substantially decreased in the atoll since the end of the tests, sufficient quantities remain at present to make human consumption of crops grown there still unsafe. The extent of the radiological hazard to humans is the central question at issue in proposals to rehabilitate Bikini Atoll and allow former residents to return. In the course of the cleanup subsequent to the nuclear detonations on this atoll, vegetation was stripped from Bikini and Eneu Islands at Bikini Atoll, and new plantings of coconut palms (*Cocos nucifera*) and pandanus trees (*Pandanus tectorius*) were made; both are traditional sources of food and other products among the Marshallese people. A survey following the cleanup found that cesium 137 was the primary contaminant of island soil. It also found this radioactive isotope in local coconut palms and pandanus trees. The authors of this survey also pointed out that strontium 90 was the "radionuclide of greatest concern with regard to internal dose"; therefore, they recommended soil in the planting area be removed and that calcium be added to the diet of the Bikinians.[100] This survey, despite the authors' warnings, was the basis for the decision to allow the Bikinians to return to their atoll in the early 1970s; however, in 1978, they were also pulled out again by U.S. government. When strontium 90 in their bodies reached dangerous levels, the Bikinians were once again relocated to Kwajalein Atoll. On Enewetak, the situation is not any better, especially on the northern side of the atoll. It is unlikely that Enewetak Atoll will ever again be a self-sufficient island in the sense of providing locally produced food for its human population.[101]

In French Polynesia, local residents have reportedly consumed fish and other marine organisms contaminated by fallout.[102] In April 1970, the Mahina Laboratory in Papeete reported that strontium 90 was found in the food supply in Tahiti.[103] Fijian troops stationed at Malden Island and Christmas Atoll during Britain's Operation Grapple went spearfishing along the shores and "ate the fish [they caught] on the beach."[104] Even though

99 Danielsson, "Under a Cloud of Secrecy."
100 Bikini Atoll Rehabilitation Committee, *Interim Draft*, Ax.
101 Reese, "Terrestrial Environments," 201; Ading, Statement of the Newetak/Ujeland Local Government.
102 Danielsson, "Poisoned Pacific."
103 Ibid.; Danielsson, "Under a Cloud of Secrecy"; Danielsson and Danielsson, *Poisoned Reign*; Barnes, *French Nuclear Tests*; Lewis, *Blowing Up Paradise*; Hecht, *H-France Review*.
104 PCRC, *Kirisimasi*, 55.

the British officials on the islands were supposed to be checking the fish for radiation, there was a "lively trade" in fish, and even a "fish and chips shop" on the island.[105]

Another source of contamination in the atolls was rainwater containing radioactive particles injected into the air by the nuclear explosions. Because atoll dwellers depend on rainwater for basically all of their freshwater, this form of contamination posed a very serious hazard. Rainwater is generally stored in concrete tanks and subject to rapid evaporation, which can increase the concentration of radionuclides.[106] The disastrous French nuclear test that de Gaulle ordered to go forward on September 11, 1966, produced fallout that reached most, if not all, islands to the west of Mururoa. Four days later, researchers from the New Zealand National Radiation Laboratory tested rainwater catchment tanks at Apia, the capital of Western Samoa, 3,200 kilometers downwind from the French test; they found extremely high levels of radiation.[107] It should also be noted that some Fijian personnel who had worked on Christmas Island between 1957 and 1958 also expressed concerns about water contamination. Local residents were distilling seawater for drinking and cooking, but the water was not being checked for contamination by radioactivity.[108]

CONCLUSIONS

The nuclear weapons testing programs in Remote Oceania were inspired by the geopolitical tensions of the Cold War era. The decisions to detonate the nuclear bombs on small, isolated islands in the Pacific Ocean was politically convenient at the time, especially because the islands were under the control of the Western nations carrying out the destructive tests. Remote Oceania was chosen by the governments of the United States, Great Britain, and France as an appropriate region in which to conduct atomic testing because of the lack of politically if not environmentally acceptable opportunities to conduct atmospheric nuclear experiments in any continental areas at home or their colonies in other parts of the world. The vast expanse, moderate climate, and limited human population of the central region of the tropical Pacific Ocean, provided a number of what were deemed convenient, isolated sites for nuclear testing. However, the environmental effects of testing commanded scant interest from authorities, especially during the early years

105 Ibid., 17.
106 Danielsson, "Under a Cloud of Secrecy."
107 Greenpeace, *French Polynesia*; Barnes, *French Nuclear Tests*.
108 PCRC, *Kirisimasi*, 18.

of the testing programs. Government leaders and officials believed that the fate of the free world depended on these experiments.

Nuclear bomb tests and radioactive contamination have had a variety of direct and indirect environmental consequences in Remote Oceania. Some impacts were short term. Although the detonations and fallout may have been extremely devastating for organisms exposed to the bomb blasts, biological dispersal and ecological succession over time have resulted in the apparent return of biological communities, at least at some of the test sites. Other environmental impacts have had long-term effects. One persistent problem is the radioactive poisoning of people that can result from ingestion of toxic food grown on their contaminated atolls. Another ongoing concern is Runit Dome on Elugelap Island at Enewetak atoll. This concrete crypt contains a large quantity of material contaminated by radioactivity and must therefore be closely and permanently monitored. In addition to the nuclear bomb tests themselves, activities connected with the preparation of and cleanup after the tests and associated construction (e.g., of roads and airfields) disturbed the local ecology and had varying impacts on the environment. The long-range consequences of these activities, some of which may well cause unanticipated interaction with radioactive material, still cannot be completely assessed or foreseen. The fates of the people caught within the fallout range of the weapons tests are still not fully known. Finding out what happened to them should be a priority so that they can be given appropriate medical attention and just compensation.

More research is needed to determine the actual and potential short- and long-term effects of nuclear testing in Remote Oceania. More openness on the part of all the governments involved is absolutely necessary so that the health risks to those who were or might have been exposed to the effects of the tests can be fully assessed and addressed. Such research and open disclosure of the environmental impacts on all organisms, including humans, can provide significant benefit for the habitats of Remote Oceania. It can, of course, also be of great service for other parts of the world that have suffered already or might suffer the effects of such testing or, heaven forbid, that might be subject to the combat use of these instruments of mass destruction in the future. George Kennan, the noted diplomat and historian, made the following comment in accepting the Albert Einstein Peace Prize in 1981:

> To my mind, the nuclear bomb is the most useless weapon ever invented. It can be employed to no rational purpose. It is not even an effective defense against itself.

It is only something with which, in a moment of petulance or panic, you commit such fearful acts of destruction as no sane person would ever wish to have upon his conscience.[109]

Despite the truth of Kennan's observations and despite the end of the Cold War, the specter of nuclear weapons and nuclear proliferation continue to threaten humankind and the entire biosphere.

109 George Kennan, "A Modest Proposal," *New York Review of Books*, July 16, 1981. See also Kennan, *The Nuclear Delusion* (New York, 1982).

7

A Curtain of Silence

Asia's Fauna in the Cold War

GREG BANKOFF

The Cold War, the longest war of the twentieth century, not only devastated those environments where combat actually took place but also was highly detrimental in terms of the unprecedented preparation for warfare that both consumed and destroyed so many resources on a truly global scale. Although the Iron Curtain and, to a lesser extent, the Bamboo Curtain were lifted in 1989 following the fall of the Berlin Wall and the economic opening of the People's Republic of China, another curtain still remains very much in place, a curtain of silence that shrouds the fate of Asia's fauna over the past four decades. Without attempting to minimize in any way the extent of human immiseration wrought particularly on the peoples of Korea, Indochina, and Afghanistan, animals and their habitats, too, were very much the victims of superpower rivalries and the conflicts that they generated.

Asia was a major arena of the Cold War.[1] Armed struggles ranged across the spectrum of conflict types from the more conventional confrontation in Korea to widespread guerrilla warfare in the jungles of Indochina and the mountains of Afghanistan to the lower-intensity asymmetrical struggles of the Malayan Emergency. The negative consequence of warfare on the environment has long been recognized, but recent changes in modern military tactics that emphasize widespread interdiction have escalated the intensity of environmental destruction. The use of massive firepower against landscapes in which an enemy is thought to be sheltering or against croplands, water supplies, and transportation routes that support them have become standard conventional practice. About 75 percent of all U.S. munitions expended during the Korean War (1950–3) were used in this way, and

1 On the origins and course of the Cold War, see the new histories by John Lewis Gaddis and Odd Arne Westad: Gaddis, *The Cold War: A New History* (New York, 2005); Westad, *The Cold War: Third World Interventions and the Making of Our Times* (Cambridge, 2007).

the figure rose to as high as 85 percent in Vietnam (1965–73).[2] Moreover, the transformation of warfare from conventional to low-intensity conflicts has proved particularly destructive to environments increasingly degraded by the indiscriminate use of land mines and the laying to waste of local resources.

Countless thousands of domestic animals whose bodies or labor were considered as aiding the enemy were lost during such wars or in their aftermaths. As many of these struggles also took place in border zones or locations far from large towns and cities that were often the last refuge for wildlife already endangered in more settled regions, entire species faced extinction. Animals not only are casualties of warfare, an obvious if sometimes neglected point; different species are affected in different ways under different conditions. As in human societies, there are even animal winners as well as animal losers in such contests. A species might benefit from the change of circumstances, for example, or from the sudden absence of competitors to expand its range. Many of the difficulties that afflict human populations also have their counterpart among animal ones. Thus, many animals fleeing a war zone become refugees in contiguous areas, and some few are actually attracted to places of death and decomposition. This chapter seeks to understand how Asia's fauna fared during the Cold War by considering them from a perspective that takes into account species, habitats, and circumstances among other variables.

ANIMALS AND WARFARE

Animals have fared badly in the historiography of warfare. On the rare occasions when their presence is acknowledged, it is usually to recognize their contribution as useful adjuncts to human activities. They are faithful cocombatants in the form of valiant horses, courageous dogs, or plucky pigeons. Their special skills as mine clearers, guards, or beasts of burden are celebrated. Or their role is recorded as one of the innumerable dogs, ponies, pigs, goats, cats, and rabbits – and even bears, buffalo, and alligators – that serve as regimental or unit mascots.[3] A honey bear known as Isau (Malay for "girl friend") served in this latter capacity with the British King's Own Light Infantry in Malaya during the Emergency, and a duck apparently accompanied the U.S. 187th Regimental Combat Team to Korea in 1950.[4]

2 Charles Southwick, *Global Ecology in Human Perspective* (New York, 1996), 312–27.

3 Juliet Gardiner, *The Animals' War: Animals in Wartime from the First World War to the Present* (London, 2006), 141–63.

4 Gardiner, *Animals' War*, 149–50.

Sometimes an individual is singled out as representative of these unsung heroes, like Rifleman Khan, an Alsatian who received the Dickin Medal for bravery for saving his handler from drowning under heavy gunfire during the assault on the Dutch island of Walcheren in 1944.[5] Anecdotal stories of this nature periodically enliven the histories of the First and Second World Wars but are less prevalent in later conflicts. A partial exception is the more academic consideration given to the use of dogs in combat.[6]

Interest in the environmental effects of modern warfare has increased in recent years, prompted by the poor physical condition of former service personnel exposed to the defoliants used in Vietnam and to the extensive aerial and marine pollution caused by the ignition of oil wells and the emptying of oil tanks into the sea during the Gulf War of 1991. As part of a growing awareness of the environmental costs and consequences of this new type of warfare, one that does not merely inflict collateral damage on a landscape and what grows on it but one that purposefully targets an enemy's ecosystem as part of wider strategic concerns, some consideration has been extended to the fate of animal populations. That interest is, however, tangential to the focus on the environment as a finite and often-contested resource that is to be denied to one's foe or secured for one's own war effort. Animals, however, rarely appear directly in these narratives but are generally regarded as an undifferentiated part of an abstract environment or, at best, as elements of a threatened ecosystem.

Animals, however, are conscious decision makers even if their agency is limited and they cannot be depicted en masse but must be considered in their own right both collectively and by individual species.[7] One of the few theoretical constructs to give serious consideration to the fate of animals in conflict situations is the notion of war zones and game sinks used to explain why there is often an abundance of highly prized megafauna in buffer zones between warring parties but a scarcity of the same game in contiguous regions acknowledged to be the territory of one group or another. Rather

5 Jilly Cooper, *Animals in War: Valiant Horses, Courageous Dogs, and Other Unsung Animal Heroes* (Guilford, Conn., 2002), 196. The Dickin Medal, named after Mrs. Maria Dickin, the founder of the People's Dispensary for Sick Animals, was instituted in 1943 to honor animals displaying conspicuous gallantry and devotion during the Second World War and its aftermath. Until 1949, fifty-four medals were awarded, thirty-two of which were to pigeons! See Gardiner, *Animals' War*, 127.

6 Charles Sloane, "Dogs in War, Police Work and on Patrol," *Journal of Criminal Law, Criminology, and Police Science* 46, no. 3 (1955): 385–95; Michael Lemish, *War Dogs: Canines in Combat* (Washington, D.C., 1997); Mary Murray, "The Contributions of the American Military Working Dog in Vietnam," M.A. thesis, Army Command and General Staff College, Fort Leavenworth, Kansas, 1998.

7 On the question of agency, see Jason Hribal's discussions of animals and class: "Animals Are Part of the Working Class: A Challenge to Labor History," *Labor History* 44, no. 4 (2003): 435–53; "Animals, Agency, and Class: Writing the History of Animals from Below," *Human Ecology Review* 14, no. 1 (2007): 101–12.

than explaining such phenomena simply as the result of environmental conditions such as climate, soil, and foliage, tension between potentially antagonistic peoples creates intertribal buffer zones, empty quarters, neutral zones, no-man's-lands or war zones in which otherwise-hunted animals thrive. Though rich in prey, such areas are risky for human parties to enter, as small groups or individuals run the constant risk of ambush. In effect, these buffer zones are often turned into unofficial sanctuaries for animals hunted elsewhere.[8] Applied first to explain the variation in wild game numbers in the American Midwest during the eighteenth and nineteenth centuries, the concept has since been applied to explain animal populations in a number of more recent settings such as the Jordan River delta between Israel and Jordan, the Evros River between Greece and Turkey, areas of Southern Rhodesia/Zimbabwe during the Unilateral Declaration of Independence or white secessionist period, and sections of Rwanda during the civil war of 1990–4.[9] Such refugia can even be found in urban settings, given the extraordinary exigencies of contemporary conflicts. The standoff in Central Europe, for example, turned the railway lines and terminals of West Berlin under East German ownership into green wildernesses in the heart of that divided city.[10] In much the same vein, Bernard Nietschmann and others have noted how conflict can actually function to conserve animal populations by discouraging human activities such as hunting, logging, mining, and farming in rural areas or less exploited habitats.[11]

Such favorable outcomes, however, are unusual, and war more often leads to a decline in animal numbers. Domesticates and wildlife are vulnerable in a number of disparate ways. They are affected long before actual combat takes place, as the preparation for warfare that has become such a feature of the modern military affects increasingly large areas of land either in the form of bases and ranges or through the disposal of hazardous wastes. After fifty years of use as a practice range for the U.S. Navy, Isla de Vieques off of Puerto Rico has more craters per square kilometer than the moon.

8 Harold Hickerson, "The Virginia Deer and Intertribal Buffer Zones in the Upper Mississippi Valley," in *Man, Culture and Animals: The Role of Animals in Human Ecological Adjustments*, ed. Anthony Leeds and Andrew Vayda (Washington, D.C., 1965), 43–66; Lawrence Keeley, *War before Civilization* (New York, 1996); Paul Martin and Christine Szuter, "War Zones and Game Sinks in Lewis and Clark's West," *Conservation Biology* 13, no. 1 (1999): 36–45.

9 Bertel Bruun, "Birds, Bombs and Borders," *Explorers Journal* 59 (1981): 154–9; Joseph Dudley, Joshua Ginsberg, Andrew Plumptre, John Hart, and Liliana Campos, "Effects of War and Civil Strife on Wildlife and Wildlife Habitats," *Conservation Biology* 16, no. 2 (2002): 319–29.

10 Fay Duffner and Peter Wathern, "Building an Urban Wilderness: Berlin's Green Island," *Environment* 30, no. 2 (1988):13–15, 32–4.

11 Bernard Nietschmann, "Conservation by Conflict in Nicaragua," *Natural History* 99, no. 11 (1990): 42–9.

Apart from its use as a bomb range, the island's forests have been used to test the effects of Agent Orange, its soils contaminated with depleted uranium munitions, and its marine environment polluted by toxic heavy metal emissions. Although no study has been done on how Vieques's wildlife has fared under this onslaught, the incidence of cancer among its human population is 26 percent greater than in the rest of Puerto Rico, and the island's children register high levels of mercury and lead.[12] In fact, the U.S. Department of Defense is disputably the world's largest single polluter, producing more hazardous waste per year than the five largest U.S. chemical companies combined. Washington's Fairchild Air Force Base alone produced more than 13 million pounds of hazardous waste in 1997.[13] The most destructive prewar preparation activity of modern warfare, however, is the production and testing of nuclear weapons; the mining, processing, assembly, and disposal of radioactive materials contaminate extensive areas. Since 1963, the United States and the United Kingdom have exploded more than 670 nuclear devices in the Nevada desert alone, and all life on four coral atolls in the South Pacific (Bikini, Eniwetok, Moruroa, and Fangataufa) has been rendered far too radioactive for human occupation by American and French detonations, despite extensive cleanup programs. The former Soviet Union, China, and other nations have exploded many more such devices with unknown environmental consequences.[14] Most of this weapons testing, moreover, takes place in isolated and relatively undisturbed environments, with the result that soils, plants, and animals are destroyed or contaminated for millennia.

As for combat, Malcolm Browne reminds us that "war feeds on life."[15] One aspect of human warfare that has changed little over the centuries is the need for combatants and displaced persons to live off the land. The European bison or wisent (*Bison bonasus*) was virtually annihilated in its last refuge in eastern Poland to supply the mess kitchens of both German and Soviet troops during successive stages of the Second World War.[16] Similarly, wildlife in the Pacific, especially bird populations, was often adversely affected as a result of the intense fighting during that conflict. Nesting sites were destroyed and eggs smashed; patterns of migration were interrupted;

12 The navy occupied twenty-six thousand of Isla de Vieques's thirty-three thousand acres.

13 Bob Feldman, "War on the Earth," *Dollars and Sense*, March–April, 2003, 24–7.

14 Bernard Nietschmann, "Battlefields of Ashes and Mud," *Natural History* 99, no. 11 (1990): 35–7.

15 Malcolm Browne, Michio Kaku, James Fallows, and Eric Fischer, "War and the Environment," *Audubon*, September–October, 1991, 88–99.

16 Fortunately, sufficient numbers were left to provide breeding stock for a conservation program that has allowed numbers to recover and remove the animal from the danger of extinction. See Browne et al., "War and the Environment," 91.

and many birds killed outright or perished as a result of the introduction of nonindigenous predators such as dogs, cats, and rats. The war is credited with the complete or probable loss of the Laysan rail (*Porzana palmeri*), the Laysan finch (*Telespiza cantans*), and the Wake Island rail (*Rallus wakensis*); the extirpation of the brown booby (*Sula leucogaster*) from Guam, the Marianas mallard (*Anas oustaleti*), and the Marianas or Micronesian megapode (*Megapodius laperouse*).[17] In the low-intensity, asymmetrical conflicts that have characterized recent warfare in the developing world, high-value resources such as diamonds and animal products like ivory have been "harvested" by warring parties to buy weapons and much-needed military supplies. Elephant populations in strife-torn countries such as Sudan, Chad, and the Central African Republic have declined by up to 90 percent. In Angola's civil war (1975–91), both sides shot rhinos and elephants, selling the horns and tusks to buy uniforms and weapons.[18] Moreover, warfare seriously disrupts government conservation efforts as staff go unpaid or are caught up in the conflict themselves, and as the reserves and protected areas are left open to all forms of hunting and poaching.[19]

Animals are still very much at risk in postconflict situations as well. The proliferation in the use of land mines poses a serious threat to animals. Their exact location and extent is often poorly documented, and their deployment especially in contested border areas compromises these regions' use as refugia by endangered large mammal species. Unexploded ordnance and explosive residues such as white phosphorus only compound the dangers.[20] Outbreaks

17 Susan Lanier-Graham, *The Ecology of War: Environmental Impacts of Weapons and Warfare* (New York, 1993), 27–8; Arthur Westing, *Warfare in a Fragile World: Military Impact on the Human Environment* (London, 1980). Jurgen Brauer accuses Lanier-Graham of exaggerating her claims on the extinction of birdlife directly attributable to the Second World War: Brauer, "War and Nature: The Problem of Data and Data Collection. Paper presented at Identifying Wars: Systematic Conflict Research and Its Utility in Conflict Resolution and Prevention," Uppsala, Sweden, June 8–9, 2001, at http://www.aug.edu/∼sbajmb.

18 Robert Parker and Joyce Wolkomir, "Caught in the Crossfire," *International Wildlife* 22, no. 1 (1992): 4–11.

19 Wendy Vanasselt, "Armed Conflicts, Refugees, and the Environment," in *World Resources 2002–2004 Decisions for the Earth: Balance, Voice, and Power* (Washington, D.C., 2003), 2. On the impact of conflicts on biodiversity in various African countries, see the series of studies produced for Washington, D.C.'s Biodiversity Support Program in 2001: Allard Blom and Jean Yamindou, *A Brief History of Armed Conflict and Its Impact on Biodiversity in the Central African Republic (CAR)*; John Hatton, Mia Couto, and Judy Oglethorpe, *Biodiversity and War: A Case Study from Mozambique*; Michael Jacobs and Catherine Schloeder, *Impacts of Conflict on Biodiversity and Protected Areas in Ethiopia*; José Kalpers, *Overview of Armed Conflict and Biodiversity in Sub-Saharan Africa: Impacts, Mechanisms and Responses*; Andrew Plumptre, Michel Masozera, and Amy Vedder, *The Impact of Civil War on the Conservation of Protected Areas in Rwanda*; Chris Squire, *Sierra Leone's Biodiversity and the Civil War*.

20 Dudley et al., "Effects of War and Civil Strife on Wildlife and Wildlife Habitats," 322.

of diseases, too, are frequently attributable to the breakdown of veterinary services and to the displacement of livestock during and following conflicts. Epidemics of anthrax and rabies among wild and domesticated animals over large areas of Zimbabwe in the 1970s and rinderpest among flocks in the border regions at the head of the Persian Gulf in the 1980s and early 1990s had their origins in the protracted nature of the fighting that raged over those regions for years.[21] Nor is disease only epiphenomenal to conflict. Anthrax and glanders were employed by Germany and probably France during the First World War against, respectively, their opponent's cattle and horse populations in an attempt to undermine food supplies, transport, and cavalry. Although the use of bacteriological agents in warfare was forbidden under the 1925 Geneva Protocol, research into their potential in modern warfare has persisted.[22] Refugees represent a third way in which animals are affected in postconflict situations. The large numbers of displaced persons that increasingly seem to characterize modern-day conflicts (20 million in 2001) can place untenable strains on what are often resource-scarce and fragile ecosystems. Local wildlife represents a needed source of protein, water sources are sullied, and habitats are destroyed to furnish building materials or firewood.[23] As many of these situations often endure for years, animal populations have little chance of recovery, and the long-term consequences can be more injurious than actual military engagements.

Yet another aspect of warfare needs further consideration in this respect: the increase in the amount of land given over to food production to support armies at the front. In the United States alone, some 40 million additional acres of land were cleared for cultivation to help feed European allies during the First World War, much of which was only marginal to agriculture. In the process, natural reservoirs and wetlands were destroyed in the Midwest and native grasses ploughed under in the southern plains of Kansas, Oklahoma, and northern Texas. The results were drought, erosion, and the eventual abandonment of many of these new farms. In the South, cotton was overplanted, and large swathes of forest were cut down in the upper Midwest to meet the near-insatiable wartime demand for timber.[24] Much

21 Ibid., 325.

22 Douglas Holdstock, "Biotechnology and Biological Warfare," *Peace Review* 12, no. 4 (2000): 549–53. Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War 1 to Silent Spring* (Cambridge, 2001).

23 Vanasselt, "Armed Conflicts," 2–3.

24 Katherine Glover, *America Begins Again: The Conquest of Waste in Our Natural Resources* (New York, 1939).

the same fate awaited Japan's forests between 1941 and 1945. Some 9 million acres, about 15 percent of the total, were logged, the majority of it clear-cut. Meanwhile, artificial reforestation all but ground to a halt as a result of the loss of able labor and the dwindling supply of seedlings that made replanting impossible.[25] Habitat change on such a large scale seriously affected local fauna, and the failure of populations to regenerate opened the way to inadvertent or even purposeful colonization by exotic species.[26]

THE COLD WAR AND ASIA'S FAUNA

The military competition that ensued within a few years of the conclusion of the Second World War between the United States of America, the Soviet Union, and their respective allies and clients was initiated by a series of so-called security dilemmas in Iran, Turkey, Czechoslovakia, Yugoslavia, and Berlin. Although it is difficult to identify exactly at what point the Cold War began, the superpower rivalry that ensued took on truly global dimensions, raging across all the inhabited continents. The Cold War never went beyond military standoff in Europe but resulted in three protracted armed conflicts in Asia – in Korea (1950–3), Vietnam (1965–73), and Afghanistan (1979–91). Even the dates usually given to delimit these wars are misleading. Military confrontation on the Korean Peninsula persists to the present. The French Indochina War may not have begun as a Cold War confrontation in 1946, but it clearly had become one by its conclusion in 1954. Fighting continued in Afghanistan long after the withdrawal of the last Soviet troops and intensified following the U.S.-led invasion in 2001. There were also many other proxy wars fought by the allies or clients of these principal protagonists, the most notable being the Malayan Emergency and the suppression of the Malayan Communist Party by British and Commonwealth forces between 1948 and 1957.[27] All these conflicts, of course, were not solely or even principally about ideological differences; they were also independence, civil, or interethnic struggles. Such subtleties of definition, however, made little difference to the fauna of these states.

25 William Tsutsui, "Landscapes in the Dark Valley: Towards an Environmental History of Wartime Japan," *Environmental History* 8, no. 2 (2003): 294–311. On the relationship between forest and warfare in historical perspective, see John McNeill, "Woods and Warfare in World History," *Environmental History* 9, no. 3 (2004): 388–410.

26 James Paterson, "The Role of Warfare in Promoting the Introduction and Invasion of Alien Species," http://members.lycos.co.uk/woodyplantecology/docs/war-ww2.rtf; McNeill, "Woods and Warfare."

27 There was a Cold War dimension to the four Arab-Israeli Wars as well: the so-called Independence War of 1948–9, the Sinai War 1956, the Six-Day War of 1967, and the Yom Kippur War of 1973.

ANIMAL LOSERS AMONG ASIA'S FAUNA

Vietnam and environmental destruction have now become so linked in popular imagination – the term *ecocide* was coined by Barry Weisberg and others at the time to describe its effects – that it is often forgotten that much the same weapons were deployed and many of the same strategies practiced in earlier conflicts.[28] The Korean War, often referred to as the forgotten war to denote the manner in which it has faded from at least Western popular memory, is often cast as basically a conventional one fought by large armies with clearly identified (if at times fluid) front lines. In fact, guerrilla warfare played a much greater part in the conflict than is often credited, and interdiction, the denial of transit through or use of terrain to the enemy by the deployment of massive firepower, was very much a feature of military strategy and tactics.[29] The wars in Vietnam and Afghanistan, in contrast, are characterized primarily as small-unit, low-intensity engagements periodically punctuated by large-scale offensives in the former case and with heavy reliance on aerial interdiction.[30] Increasingly throughout these conflicts, however, interdiction came to be synonymous with environmental devastation, and denying terrain to one's foes also meant destroying the native habitat for local fauna.

Animals are often the inadvertent victims of warfare when they are killed or maimed by weapons deployed against opposing forces. Domesticates, in particular, seem to have been more in the way of military targets and wildlife more the prey of displaced or hungry civilians. In the case of Korea,

28 Barry Weisberg, ed., *Ecocide in Indochina: The Ecology of War* (San Francisco, 1970), which defined *ecocide* as "the premeditated assault of a nation and its resources against the individuals, culture and biological fabric of another country and its environs." See also John Lewallen's *Ecology of Devastation: Indochina* (Baltimore, 1971).

29 On the Korean War, see Bruce Cumings's massive two-volume history, *The Origins of the Korean War* (Princeton, N.J., 1981), as well as more recent works: Michael Hickey, *The Korean War: The West Confronts Communism 1950–1953* (London, 1999); William Stueck, *Rethinking the Korean War: A New Diplomatic and Strategic History* (Princeton, N.J., 2002); Adrian Buzo, *The Making of Modern Korea* (London, 2004).

30 The number of studies of the Vietnam War (as opposed to the French Indochina War) is legion. Classic texts include Frances Fitzgerald, *Fire in the Lake: The Vietnamese and the Americans in Vietnam* (New York, 1973); and Marilyn Young, *The Vietnam Wars 1945–1990* (New York, 1991). Among more recent works, see Kevin Ruane, *War and Revolution in Vietnam, 1930–75* (London, 1998); Robert McMahon, *The Limits of Empire: The United States and Southeast Asia since World War II* (New York, 1999); Gerard DeGroot, *A Noble Cause? America and the Vietnam War* (Harlow, Essex, 2000); Robert Mann, *A Grand Delusion: America's Descent into Vietnam* (New York, 2001). On the 1946–54 conflict, see Fredrik Logevall and Mark Lawrence, eds., *The First Indochina War: Colonial Conflict and Cold War Crisis* (Cambridge, Mass., 2005); and Donald Lancaster, *The Emancipation of French Indo-China.* (New York, 1961). On the Soviet war in Afghanistan, see Henry Bradsher, *Afghanistan and the Soviet Union* (Durham, N.C., 1983); Scott McMichael, *Stumbling Bear: Soviet Military Performance in Afghanistan* (London, 1991); and Mark Galeotti, *Afghanistan: The Soviet Union's Last War* (London, 1995). See also the pertinent chapters in Westad, *Cold War.*

however, so little study has been done on the mammals of the peninsula (and all that subsequent to 1953) that it is impossible to assess the extent of the losses suffered during the war.[31] Given the intensity of the fighting, the successive waves of fast-moving offensives and counteroffensives that characterized the initial year of hostilities and the consequent extensive destruction of countryside, virtually the whole peninsula suffered serious losses of both domesticates and wildlife.[32] Losses were compounded by the widespread illegal hunting and trapping of mammals for use as food or to sell in the marketplace. Such activities proliferated markedly in the period of social disorder that immediately followed the fighting, greatly diminishing animal populations and seriously endangering the survival of some fur-bearing species.[33]

More attention has been paid to the plight of fauna in Vietnam and neighboring states during the years of conflict and its aftermath, though the data are still somewhat anecdotal. Sometimes animals were perceived as being in league with one party or another. Thus, the National Front for the Liberation of South Vietnam reportedly killed all dogs in villages that resisted their ideological advances to prevent the dogs' barking from giving warning of their presence.[34] Similarly, Asian elephants (*Elephas maximus*) were routinely attacked by U.S. military aircraft, strafed, and even bombed on the assumption that they were or could be used to transport enemy military supplies.[35] "Enemy" livestock were perceived by the Americans as legitimate targets, and many water buffalo (*Bubalus bubalis*) died in the shelling and as the result of extensive bombing campaigns. An estimated twenty-four thousand head in North Vietnam and maybe as many as nine hundred thousand animals in South Vietnam were killed in this manner, and herds had not recovered to their former size by the early 1980s.[36] Not easily quantifiable are the effects of toxins on animal metabolic systems. As is well known, herbicides were used extensively throughout the war to defoliate the tropical forests. Although not the subject of direct research, 2,4,-D, the principal component in the most commonly used agents proved

31 Changman Won and Kimberly Smith (1999) "History and Current Status of Mammals of the Korean Peninsula," *Mammal Review* 29, no. 1 (1999): 3. The first comprehensive listings of Korean mammals were not published until 1967–8.

32 T. G. Min, K. O. Kong, and H. B. Song, "The Marketing of the Goat in Korea," Proceedings of the 2001 Conference on Boer Goats, Beijing, October 20–25, 322–8, at http://www.iga-goatworld.org/publication/proceeding/abstract38.PDF.

33 Won and Smith, "History and Current Status," 6.

34 Lewallen, *Ecology of Devastation*, 95.

35 Dudley et al., "Effects of War," 322–3.

36 Arthur Westing, "The Environmental Aftermath of Warfare in Viet Nam," *Natural Resources Journal* 23 (1983): 381–2, 385.

toxic to domestic cattle (*Bos taurus*), which became ill or died after ingesting contaminated grasses.[37] The forests of mainland Southeast Asia are the home of several related wild cattle species, such as gaurs (*Bos gaurus*), bantengs (*Bos javanicus*), and koupreys (*Bos sauveli*), as well as muntjacs (*Muntiacus muntjak*) and other species of deer. Gordon Orians and Egbert Pfeiffer, who toured South Vietnam in March 1969 on behalf of the Society for Social Responsibility in Science, were given intelligence of sick and dying animals, including domestic pigs, following defoliation but were unable to verify the reports. Numerous rumors circulated about South Vietnam that herbicides were causing sickness and death among farm animals.[38] Such toxins also proved to be as highly teratogenic in laboratory animals as they are in human fetuses, but, of course, there are no data on abortion or birth irregularities among animal populations.[39]

Although the conflict in Afghanistan is more recent than the one in Vietnam, far less is known about the effects of the fighting on the country's animal populations. Like the American military, Soviet forces pursued a deliberate policy of environmental destruction, laying waste to ancient irrigation systems in an attempt to disable the local economy. Huge numbers of livestock were lost, especially during the years of endemic warfare after 1988. The cattle population fell from about 5 million to fewer than 4 million and perhaps as many as 9.5 million sheep and goats, comprising more than 50 percent of the entire population, perished. Reproduction rates fell to such low levels – an average of thirty-seven months for calving intervals for cattle and 0.6 ewes per year for sheep – that remaining stock often proved insufficient to rebuild herds, suggesting that livestock, too, are traumatized by wartime conditions.[40] Moreover, the disruption to agriculture created shortages of food and placed a heavy strain on wildlife as desperate people sought to supplement their diet in any way possible. Hunting and trapping, an important remunerative activity in the prewar period, has escalated in recent decades, and the skins of even internationally protected or endangered species such as tigers (*Panthera tigris virgata*, supposedly now extinct), leopards (*Panthera pardus* and *Panthera uncia*), red foxes (*Vulpes vulpes*), and

37 The nitrates accumulated in plants are changed to nitrites in animals and absorbed into the blood system, producing methemoglobin, which results in oxygen deficiencies that cause illness or death.

38 Lewallen, *Ecology of Devastation*, 98.

39 Gordon Orians and Egbert Pfeiffer, "Ecological Effects of the War in Vietnam," *Science* 168, no. 3931 (1970): 544–54; Joe Neilands, "Vietnam: Progress of the Chemical War," *Asian Survey* 10, no. 3 (1970): 221.

40 Tareq Formoli, "Impact of the Afghan-Soviet War on Afghanistan's Environment," *Environmental Conservation* 22, no. 1 (1995): 66–9; "Dealing with the Aftermath: The Role of the Vet Following Conflict or Disaster," *Veterinary Record*, May 14, 2005, 625–8.

hyenas (*Hyaena hyaena*) are traded daily in markets all over the country.[41] The presence of more than 10 million land mines effectively makes Afghanistan into one large minefield that continues to take a toll on both human and animal populations.[42]

Fewer animals were killed as a result of military action during the Cold War, however, than through habitat loss. The indiscriminate nature of modern interdiction techniques, moreover, meant that large areas of terrain were subjected either to massive firepower from bombing or, more latterly, to widespread defoliation from the use of herbicides. Most of this ordnance was delivered aerially, though the significance of artillery and ground land-clearance mechanisms should not be underestimated. Korea was the first opportunity for the U.S. Air Force, newly established as an independent service of the armed forces, to prove that airpower could achieve decisive outcomes both tactically on the battlefront and as a strategic weapon in the overall military campaign.[43] A notable feature of the last year of open conflict were the attacks launched on the irrigation reservoir dams that furnished about 75 percent of the controlled water supply to North Korean agriculture. The series of bombing raids carried out in 1953 destroyed a number of these earthen and stone structures, causing massive floods that swept away roads, rail links, bridges, buildings, and military emplacements as well as countless hectares of rice fields and their supporting irrigation canals. The flash flood as a result of the Toksan raid "scooped clean" twenty-seven miles – nearly forty-five kilometers – of river valley alone. The human, let alone animal, casualties of these raids are unrecorded.[44] More insidious are the allegations that Americans used biological weapons. The Chinese and North Korean governments claim that large quantities of germ-carrying insects and other artificially infected agents such as voles were found in China's western Heilongjiang Province following attacks by U.S. aircraft. Whatever the validity of such assertions, a massive government hygiene campaign ensued, with the goal of nothing less than the annihilation of all the country's flies, mosquitoes, rats, voles, and fleas. Barns, latrines, ponds, wells, storerooms, and grain mills were systematically scoured and

41 It is estimated that the fur trade in 1977 employed four thousand professional hunters and twenty-five thousand full- or part-time smugglers, yielding a total income of US$4.5 million: Formoli "Impact of the Afghan-Soviet War," 67; Aneel Salman, "The Afghanistan Conflict and Its Effects on the Environment" (2002), http://www.takingitglobal.org/express/panorama/article.html?ContentID=786.

42 Daud Saba, "Afghanistan: Environmental Degradation in a Fragile Ecological Setting," *International Journal of Sustainable Development and World Ecology* 8 (2001): 279–89.

43 Conrad Crane, "Raiding the Beggar's Pantry: The Search for Airpower Strategy in the Korean War," *Journal of Military History* 63, no. 4 (1999): 885.

44 "The Attack on the Irrigation Dams in North Korea," *Air University Review* 6, no. 4 (1953–4): 40–61; Crane, "Raiding the Beggar's Pantry," 918.

chemically disinfected, bedding and house-floor surfaces burned, and thousands of cats and dogs culled and their bodies incinerated.[45] A fact-finding international scientific mission dispatched at China's request in 1952 concluded, "The peoples of Korea and China have indeed been the objectives of bacteriological weapons." Nothing, of course, was said about the possible effects on domesticates or wildlife. Although little credence has ever been given to these findings in the West, the issue of whether this event occurred still remains unresolved.[46]

Environmental destruction was such a feature of the conflict in Vietnam that a photograph of a U.S. Air Force C-123 transport aircraft dispensing defoliants over the emerald green tropical forest below has become almost iconic of how the war is remembered. It may come as a surprise to learn, then, that the practice was first tested, albeit in a small way, by the British in Malaya in the early 1950s, using helicopters to deliver a mixture of trioxene and diesolene to limit Malayan Communist Party attempts to grow food in jungle clearings.[47] In Vietnam, however, the use of herbicides escalated from a localized to a national arena and from a tactical to a strategic consideration. In conjunction with extensive bombing campaigns, large areas of Vietnam in both the south and north were systematically and often repeatedly devastated. A variety of herbicides were applied, mainly combinations of butyl ester 2,4,-D or 2,4-T, that were identified by their color-coded barrels: Agents Orange, Blue, and White, and the less well-known Agents Green, Pink, and Purple.[48] Estimates on the quantities of these substances actually applied amount to approximately 72.4 million liters. These figures, however, have been progressively revised upward by 7 to 9.5 million liters as new data on previously unrecorded flight missions have come to light, especially for the pre-1965 period. Agent Orange is believed to have constituted more than 60 percent of all the substances sprayed.[49]

45 Ruth Rogaski, "Nature, Annihilation, and Modernity: China's Korean War Germ-Warfare Experience Reconsidered," *Journal of Asian Studies* 61, no. 2 (2002): 381–415.

46 Stephen Endicott, "Germ Warfare and 'Plausible Denial': The Korean War, 1952–1953," *Modern China* 5, no. 1 (1979): 79–104; Stephen Endicott and Edward Hagerman, *The United States and Biological Warfare: Secrets from the Early Cold War and Korea* (Bloomington, Ind., 1989); Milton Leitenberg, "Resolution of the Korean War Biological Warfare Allegations," *Critical Reviews in Microbiology* 23, no. 3 (1998): 169–94: Kathryn Weathersby, "Deceiving the Deceivers: Moscow, Beijing, Pyongyang and the Allegations of Bacteriological Weapons Use in Korea," *Bulletin of the Cold War International History Project* 11 (1998): 176–85.

47 G. Henderson, "Whirling Wings over the Jungle," *Air Clues* 9, no. 8 (1955): 241.

48 The various agents were also used at different times: Agents Pink and Green, 1961–5; Agent Purple, 1962–5; Agent Orange, 1965–70; Agent White, 1966–71; and Agent Blue, 1962–71.

49 Arthur Westing, *Ecological Consequences of the Second Indochina War* (Stockholm, 1976), 26; Jeanne Stellman, Steven Stellman, Richard Christian, Tracy Weber, and Carrle Tomasallo, "The Extent and Pattern of Usage of Agent Orange and Other Herbicides in Vietnam," *Nature* 422 (April 2003): 682.

Agents had different properties, though most were deployed against forest cover, and only Agent Blue was specifically designed to destroy agricultural crops. In all, an estimated 2.6 million hectares were sprayed, some areas repeatedly, especially in the provinces surrounding Saigon, which received more than half the total amount.[50] Areas along the Ho Chi Minh trail in Laos, the major supply and transport supply route for communist forces in the south, were also heavily defoliated.[51]

The use of herbicides, of course, was only one element of a concerted strategic assault on the Vietnamese environment. Increasingly, as the war progressed, landscapes were stripped of their vegetation through the pioneering use of heavy twenty-ton tractors, the so-called Rome plows. Equipped with a special eleven-foot, two-and-half ton blade designed to sever and push aside trees of any size, the machines worked in concert to completely clear an area. The resulting debris was either burned, pushed into gullies, or left to rot. Small-scale clearing activities began in 1966 to create barren strips of earth up to nearly one thousand feet wide along highways to forestall ambushes. After 1968, however, massed tractors organized into companies were used to strip bare large contiguous tracts of land; perhaps as much as 2 percent of the total land area of South Vietnam was cleared in this manner, including entire forests.[52] Nor were ecosystems simply poisoned or denuded: they were also just blasted apart. Between 1965 and 1973, the United States expended a total of 14.3 million tons of munitions in Vietnam, nearly half from the air.[53] Even more than the herbicides or land clearance, the bombing left the greatest impact on the landscape.[54] Each of the one hundred five-hundred-pound bombs dropped daily for more than eight years by B-52 Stratofortresses produced a crater about twenty to fifty feet wide and from five to twenty feet deep. The United States dropped thousands of five-hundred-pound bombs in patterns of four or five that were designed to saturate indiscriminately a rectangular area of about sixty five hectares.[55] Bigger bombs served more specialized purposes. The BLU-82/B "big bomb" was used to trigger landslides, especially along the Ho Chi Minh trail. The even bigger fifteen-thousand-pound "daisy cutter," containing a gelled aqueous slurry of ammonium nitrate and

50 Westing, "Environmental Aftermath," 371.

51 Stellman et al., "Extent and Pattern," 685.

52 The 7,100-hectare Hô Bô woods in central Bien Hoa Province, the 3,600 hectare woods of the same name in west-central Binh Duong Province, and the 2,700 hectare Boi Loi woods in southeastern Tay Ninh Province, all in Military Region III, were removed in this fashion. See Richard Wagner, *Environment and Man* (New York, 1974), 369; and Westing, *Ecological Consequences*, 46–7.

53 On the history of the air war over Indochina, see Ronald Frankum, *Like Rolling Thunder: The Air War in Vietnam, 1964–1975* (Lanham, Md., 2005).

54 Wagner, *Environment and Man*, 365.

55 Westing, *Ecological Consequences*, 12–13.

aluminum powder, was designed to explode aboveground, leaving no crater but devastating everything within a three-acre zone; it was often employed to create instant helicopter-landing sites.[56] All told, there are an estimated 20 million craters in Indochina, disproportionately strewn over Military Regions I (the five provinces immediately south of the Demarcation Line with North Vietnam) and III (the provinces surrounding Saigon) and along transport and supply routes through southern Laos.[57]

The impact of this "lunarization program," as John Lewallen described it, on animal habitats is hard to fully imagine.[58] Arthur Westing divides the upland forests affected in South Vietnam between those that were completely obliterated and those that were severely or partially damaged, estimating the former at 4 percent of total acreage (417,000 hectares) and the latter at slightly more than 50 percent (5.6 million hectares).[59] The replacement vegetation in these latter areas consists almost entirely of herbaceous grasses and shrubby bamboo or, as a result of the largely unsuccessful new economic zone program, of crops. These new environments cannot support the rich and varied wildlife that had previously thrived within or below the forest canopy. The animal community that recolonized these areas comprises fewer (and often, in human terms, undesirable) species.[60] The biota worst devastated as a result of the war was the estuarine one, whose home lay in the mangrove swamps found mainly in the south. This part-aqueous and part-terrestrial environment is home to a productive but relatively restricted community of birds and mammals and constitutes the breeding and nursery grounds for numerous saltwater and freshwater fish and crustaceans. Unfortunately, this ecosystem also proved particularly susceptible to the chemicals used in defoliants, and some 124,000 hectares, more than 40 percent, of South Vietnam's mangroves were utterly destroyed between 1965 and 1970, leaving vast areas virtually lifeless.[61] During their tour of defoliated areas in 1969, Orians and Pfeiffer failed to sight a single species of insectivorous or frugivorous birds with the exception of migratory barn swallows

56 Wagner, *Environment and Man*, 369.

57 Ibid., 565; Westing, *Ecological Consequences*, 14.

58 Lewallen, *Ecology of Devastation*, 103.

59 Included among the lands permanently devastated are upland forests that were sprayed more than four times (0.5 percent), land completely cleared through mechanized means (approximately 3 percent), and areas rendered useless through aerial craterization (1 percent). As some of these areas might be included twice, he then reduces the figure by 10 percent. See Westing, "Environmental Aftermath," 374–6. Richard Wagner puts the area permanently destroyed at 5 percent: *Environment and Man*, 367.

60 Westing, *Ecological Consequences*, 72.

61 Westing, "Environmental Aftermath," 377. Westing initially estimated that only 20 percent of mangroves had been completely laid bare: Westing, "Ecological Effects of Military Defoliation on the Forests of South Vietnam," *BioScience* 21, no. 17 (1971): 897.

(*Hirundo rustica*). Even the number of fish-eating birds was reduced, suggesting that the aquatic life, too, had been adversely affected. Clams disappeared completely from affected areas, and inshore ocean fishing reported declining catches.[62] As the animals that live in such areas are specialists adapted to a particular environment, they are effectively "inhabitants of islands" surrounded by unsuitable habitats and have nowhere to retreat to.[63] Ten years after Orians and Pfeiffer visited, most mangroves had not regenerated, and the areas sprayed had been occupied mainly by low-growing plants or, less frequently, had been converted to rice and other food-crop production.[64] In most cases, the resultant animal communities depended either directly or indirectly on the nature of vegetative succession.

The natural vegetation of the central Asian arid zone that includes Afghanistan has been experiencing rapid regression for millennia, partly from human activities such as clearing, overgrazing, collecting firewood, and charcoal making, and partly as a result of adverse climatic changes. Afghanistan, however, was considered to have had one of the region's better land-use practices before the Soviet invasion.[65] Since 1979, however, ecosystems have degraded at unprecedented rates. Much of this degradation can be attributed to the war, especially the 50–70 percent decrease in agricultural production as a result of forced evacuations, the purposeful destruction of farmlands, land mines, and the general social displacement of the population. Hungry people seeking food and security have few alternatives but to live off the land, often in regions whose wildlife had previously largely escaped concerted human attention. In particular, the limited forest cover, estimated at only a little more than 3 percent of Afghanistan's surface area in the mid-1980s, has been further dramatically reduced. These areas in the mountainous south and southeast have been the target of illegal loggers, who smuggle their wares across the border to Pakistan virtually unhindered by the writ of central government that has either waned or vanished altogether.[66] Similarly, Afghanistan's wetlands – its lakes, lagoons, and marshes that are nesting places to thousands of migratory ducks, pelicans, flamingos, and other waterfowl, some already in danger of extinction, like the Siberian crane (*Grus leucogeranus*) – have lost what limited protection they had previously enjoyed under conservation management prior to the

62 Orians and Pfeiffer, "Ecological Effects," 548; Westing, "Ecological Effects," 897; Wagner, *Environment and Man*, 368; Westing, "Environmental Aftermath," 378.

63 Orians and Pfeiffer, "Ecological Effects," 548.

64 Westing, "Environmental Aftermath," 378.

65 Terje Skogland, "Ecology and the War in Afghanistan," in *The Tragedy of Afghanistan: The Social, Cultural and Political Impact of the Soviet Invasion*, eds. Bo Huldt and Erland Jansson (London, 1988), 175–96.

66 Formoli, "Impact of the Afghan-Soviet War," 66; Saba, "Afghanistan."

invasion. Subsequent egg retrieval, habitat disturbance, livestock grazing, and indiscriminate hunting have only further compromised the situation.[67] Wildlife often unique to these microenvironments have suffered accordingly, and perhaps only those animals inhabiting extremely remote and isolated areas such as the famous Marco Polo sheep (*Ovis ammon polii*) in the Pamir may have been spared – though even here there are undocumented reports of the activities of hunters and smugglers.[68] Moreover, it is known that Soviet forces also employed chemical weapons and pursued many of the same kind of tactics such as land clearance along highways that were practiced in Vietnam but with unknown longer-term consequences to the environment.[69]

The Cold War affected Asia's fauna both directly as a casualty of war and even more severely through loss of habitat. Species, however, responded to this assault in different ways. Some sought "asylum" in neighboring countries; most were able to recover even if their numbers or range were not as great or extensive as they had been formerly. Others, the less fortunate, simply disappeared. A hallmark of both Vietnam and Afghanistan are the reports of "refugee" animals, that is, animals that vacate one region where combat or human pressures are intensified for others where conditions might be more favorable. Reports from eastern Cambodia prior to the overthrow of Norodom Sihanouk in 1970 suggest that populations of deer, wild cattle, elephants, rhinoceros, pigs, and monkeys had all increased as animals fled the escalation of hostilities in southern Vietnam during 1968–9 for the tenuous peace that prevailed on the other side of the frontier.[70] In the case of Afghanistan, animals were driven out of their traditional habitats above all by the influx of human refugees into remote and mountainous regions.[71] As Westing points out, though, relocation is not always successful, as forests and landscapes are already usually fully occupied, and interlopers may incite problems, ranging from overcrowding to competition for resources and aggression.[72]

Other animals, however, had no such option either because they were too specialized to adapt to surrounding habitats or because they belonged to species that were simply unable to translocate. For them, the future was altogether grimmer: decimated by war, with declining populations and further erosion of their habitats, some faced extinction. As a result of the Korean War following hard on the conclusion of the Second World War, the

67 Formoli, "Impact of the Afghan-Soviet War," 167.
68 Ibid.
69 Saba, "Afghanistan."
70 Neilands, "Vietnam," 223; Westing, *Ecological Consequences*, 71.
71 Salman, "Afghan Conflict."
72 Westing, *Ecological Consequences*, 71.

numbers of many mammals on the peninsula declined precipitously, and some fur-bearing species have become endangered or face extinction, such as the tiger (*Panthera tigris*). Of the ninety-five species of Korean mammals, forty-two are listed as rare, vulnerable, or endangered, although, given the state of current research, it is not clear what can be directly attributable to the war or its aftermath.[73] As might be expected, much more information exists for the Vietnam War. Claims have been made about the fate of many species: that the war provided the coup de grâce to animals already at risk, with at least five species reported to be in danger of disappearing from southern Vietnam and a further fifty-six endangered.[74] On the list of possible extinctions are the Asian black bear (*Ursus thibetanus*), the Javan rhinoceros (*Rhinoceros sondaicus*), Owston's civet (*Chrotogale owstoni*), the kouprey (*Bos sauveli*), the Malayan tapir (*Tapirus indicus*), the pileated gibbon (*Hylobates pileatus*), the Indochinese (white-cheeked or black) gibbon (*Hylobates concolor*), the douc langur (*Pygathrix nemaeus*), and the imperial and Edward's pheasants (*Lophura imperialis* and *Lophura edwardsi*). Nor have Vietnam's waterways fared much better, with the loss of the Indo-Pacific tarpon (*Megalops cyprinoides*) and a species of clam (*Polymesoda coaxans*) at least from the Mekong Delta.[75] Such weighty claims, however, have not gone uncontested, and Brauer argues strongly that existing data are insufficient to establish their actual risk status without further investigation or research.[76] More research is needed, too, on the fate of Afghanistan's mammals. The populations of many were already in sharp decline before the Soviet invasion, and there is some evidence that the war may have accelerated the decline in some cases.[77] The Asiatic wild ass (*Equus hemionus*) that was once commonly sighted in Badghis Province has now all but disappeared.[78] Less certainty surrounds the status of wildlife inhabiting the more remote mountainous and forested areas of the country, such as the wild goat (*Capra*

73 Won and Smith, "History and Current Status," 6–7.

74 Arthur Westing and Carol Westing, "Endangered Species and Habitats of Viet Nam," *Environmental Conservation* 8, no. 1 (1981): 59.

75 Neilands, "Vietnam," 223; Westing, *Ecological Consequences*, 72; Westing and Westing, "Endangered Species," 59–60; Parker and Wolkomir, "Caught in the Crossfire"; Lanier-Graham, *Ecology of War*, 37. Seldom are numbers provided for surviving animals, but Westing and Westing, "Endangered Species," 60, reported that a population of less than a thousand koupreys in the early 1940s had been reduced to ten individuals by the late 1960s sheltering in the Truong Son Mountains of Thua Thien Province.

76 Brauer, "War and Nature," 3.

77 Populations either extinct or endangered include the Turanian tiger (*Panthera tigris virgata*), the snow leopard (*Panthera uncia*), the leopard (*Panthera pardus*), the wolf (*Canis lupus*), the red fox (*Vulpes vulpes*), the brown bear (*Ursus arctos*), the cheetah (*Acinonyx jubatus*), the hyena (*Hyaena hyaena*), the lynx (*Lynx lynx*), and the ermine (*Mustela erminea*).

78 Saba, "Afghanistan."

aegagrus), ibex (*Capra sibirica*), markhor (*Capra falconeri*), urial (*Ovis orientalis*), Bactrian deer (*Cervus elaphus bactrianus*) and the feral yak (*Bos grunniens*).

ANIMAL WINNERS AMONG ASIA'S FAUNA

Just as there are people who are able to take advantage of wartime situations, profiteers, or others whose occupations are fueled by the fires of death and destruction, so, too, there are animals for which the general devastation and mayhem create circumstances that are conducive to their species. This state can be immediate in that more food or an alternative food source is suddenly made available or the number of competitors is reduced or eliminated. Such scenarios particularly favor predators and scavengers. Alternatively, conditions may be of a longer-term nature and involve restoration of previous habitats or changes to existing ones that promote animal welfare in general or certain species in particular. Often, however, the animals that profit from such occasions are considered undesirable or even a menace in human terms.

One of the most persistent observations of the Vietnam conflict in this respect concerns reports of tigers. It appears that, far from being endangered by the hostilities, tigers increased in number in South Vietnam, especially during the later years of the war, much as the wolf population did in Poland during the Second World War. It was even reported that animals learned to associate the sound of gunfire with food and to move rapidly toward places where dead and dying soldiers lay.[79] Apparently, the availability of human carrion more than compensated for the almost-insatiable demand among GIs for tiger skins, which could be purchased in Saigon, and the reports that attracted the attention of American shikaris (big-game hunters).[80] Presumably, this new source of provender provided relief for species that normally constituted the diet of such predators. Rodent populations, too, were observed to proliferate in the transformed habitats that herbicides produced. Although the wholesale spraying of tropical rainforest proved devastating to most of the native mammalian fauna, rats (*Rattus rattus*) came to comprise the most prominent recolonizing species.[81] They were equally able to profit from the rapid growth in urban and periurban areas as displaced people sought a measure of personal security in the city.

79 Orians and Pfeiffer, "Ecological Effects," 553; Lewallen, *Ecology of Devastation*, 101; Westing, *Ecological Consequences*, 72–3; Lanier-Graham, *Ecology of War*, 38. The source for this observation seems to be Orians and Pfeiffer, who went on to qualify their assessment by noting that there were no accurate prewar statistics with which to compare tiger populations in the present.

80 Browne et al., "War and the Environment," 90–1.

81 Westing, *Ecological Consequences*, 72.

The urban population of South Vietnam rose from 3,085,000 (22 percent) in 1960 to 6,060,000 (35 percent) by 1970.[82] Such environments proved ideal habitats for rats, which also began to develop partial resistance to the pesticides used to try to control their numbers.[83]

Other species profited from the radically reengineered rural landscapes that emerged during the war. The extensive areas of forest with their dead or damaged trees proved a bonanza to termites and the predators that feed on wood-eating insects.[84] Animals that were able to take advantage of the invasive vegetation of herbaceous grasses (particularly *Imperata cylindrica*) and bamboos that colonized the newly denuded areas benefited as well.[85] Many of the 20 million bomb craters penetrated the water table (whose level was rising anyway from the loss of tree cover) and were converted into fish ponds used to farm crayfish and other delicacies.[86] Annual yields of between two to three tons per hectares from intensive freshwater pisciculture were common a decade or so later.[87] The remaining bomb craters, however, filled with water during the wet season and proved ideal breeding grounds for the malaria-vector mosquito anopheles.[88] Shrimp farming seems to have been the only industry to have thrived in the otherwise-herbicide-devastated mangrove swamps.[89]

The Cold War had unexpected benefits as well. Although the Vietnam War was nothing less than an ecological disaster, some important biological research was initiated during the Cold War, such as the Migratory Animal Pathological Survey on the flight patterns of East Asian birds. Initially a war-related study, the data it yielded have subsequently proved very useful for conservation management.[90] Perhaps the greatest irony of all, however, is that sometimes war or even just the threat of hostilities serves to maintain or create habitats where animals prosper. The Korean Demilitarized Zone (DMZ), a United Nations–designated no-access, no-man's-land, is an enduring legacy of that war and the largest tract of land to be set aside

82 Allan Goodman and Lawrence Franks, "The Dynamics of Migration to Saigon, 1964–1972," *Pacific Affairs* 48, no. 2 (1975): 199–214. Saigon grew from 2,296,000 to 3,320,000 inhabitants, but the population of other urban areas expanded even faster, most notably Da Nang, from 110,000 in 1961 to 400,000 in 1971, and perhaps reached 500,000 by 1975.

83 Lewallen, *Ecology of Devastation*, 101.

84 Westing, "Ecological Effects," 896; Wagner, *Environment and Man*.

85 Westing, "Ecological Effects," 896.

86 Orians and Pfeiffer, "Ecological Effects," 552; Browne et al., "War and the Environment," 90.

87 Westing, "Environmental Aftermath," 380.

88 Westing, *Ecological Consequences*, 72.

89 Westing, "Environmental Aftermath," 380.

90 Jeffrey McNeely, "War and Biodiversity: An Assessment of Impacts," in *The Environmental Consequences of War*, ed. Jay Austin and Carl Bruch (Cambridge, 2000), 366.

for political reasons. It runs continuously from east to west across the center of the peninsula for 248 kilometers and is 4 kilometers wide. Parallel on the southern side stretches the Civilian Controlled Area (CCA) of between 5 and 20 kilometers, to which human access is restricted.[91] Altogether, an area of 2,276 square kilometers in the heart of one of the most densely populated countries on earth is almost entirely devoid of human life.[92] Moreover, the zone encompasses a cross-section of habitats that includes the rocky east coast, the country's mountainous spine, the marshy interior basin of the Imjin River, and the intertidal mudflats of the Han River as it merges into the Yellow Sea.[93] This military standoff has persisted since the 1953 Armistice Agreement that marked the de facto end to the Korean War.

Despite the presence of armies poised to annihilate one another, the razor-sharp fences, and the minefields – or rather because of them – the DMZ represents one of the world's largest unintentional wildlife reserves, a breeding ground for migratory birds and a sanctuary for many endangered species.[94] As a result of the severe proscriptions on human intrusion, much of the zone, especially in the mountains to the east, remains a mystery even to Korean natural scientists.[95] The northern brown and Asiatic black bear, the Siberian leopard and lynx, and the Chinese wolf and wild boar inhabit its trackless fastnesses. At least one hundred Amur gorals (*Nemorhaedus goral*), a species of wild cattle that has been hunted to near extinction for their hides and medicinal properties elsewhere south of the border, find safety here. There have even been several unconfirmed sightings of the Siberian tiger (*Panthera tigris altaica*), not previously seen in the peninsula since 1923. Moving westward, the central basin around Chowlon provides the winter nesting ground for one of the world's most endangered birds, the red-crowned

91 Under the Boundary Support Act of 2000, South Korea declared part of the CCA and the area immediately south of it a designated conservation zone, adding an additional 7,678 square kilometers of land in which certain human activities are proscribed.

92 Kwi-Gon Kim and Dong-Gil Cho, "Status and Ecological Resource Value of the Republic of Korea's De-militarized Zone," *Landscape and Ecological Engineering* 1 (2005): 4.

93 Colin Poole, "The Gift of a No-Man's-Land," *BBC Wildlife* 9, no. 9 (1991): 636–9.

94 The DMZ's only rival is the 2,826-square-kilometer Exclusion Zone straddling the Ukrainian and Belarusian frontier that surrounds the site of the world's worst nuclear accident at Chernobyl in 1986. The human population was evacuated and relocated elsewhere, whereas the zone's wildlife has proven unexpectedly resilient to the extreme radioactivity and has flourished, effectively creating a "nuclear sanctuary." See Mary Mycio, *Wormwood Forest: A Natural History of Chernobyl* (Washington, D.C., 2005).

95 The DMZ is so inviolate to human presence that most assessments of wildlife in the DMZ are based on surveys conducted over the past thirty years in the CCA, which is fully under the control of the Republic of Korea. See Ke-Chung Kim, "Preserving Biodiversity in Korea's Demilitarized Zone," *Science* 278, no. 5336 (1997): 242–3.

crane (*Grus japonensis*). About 150 individuals of this majestic bird, which occupies such a prominent position in Korean folklore, winter in the DMZ's wetlands. Furthest west still, another endangered crane, the white-necked crane (*Grus vipio*), descends every autumn to the area surrounding the truce village of Panmunjom, one of the few permitted human presence in the zone, whose abandoned paddy fields provide much-sought-after habitats.[96]

The Han River, as it reaches the Yellow Sea on the west coast, gives rise to one of the world's largest intertidal mudflats and serves as a feeding ground for migratory birds in transit between the Northern and Southern Hemispheres. Among the hundreds of thousands of birds that rest here each year are many endangered species, including Nordmann's greenshank (*Tringa guttifer*), whose entire global population of fewer than a thousand individuals is thought to pass through here twice a year.[97] Even the offshore islands hold their surprises: in 1987, a small islet in the Yellow Sea was found to be the breeding ground for 430 pairs of the Chinese egret (*Egretta eulophotes*), 50 percent of the world's entire population.[98] In all, the DMZ is thought to be populated by six mammalian species designated as natural monuments, such as the goral as well as another five internationally protected ones; twenty-eight legally protected species of birds; and a large number of amphibians, reptiles, fish, and insects.[99] The preservation of this unique biosphere and the treasures it harbors is a dividend of war, and its principal threat is peace.[100] Its survival has so far depended on the continuation of the Cold War in the Korean Peninsula long after it has thawed nearly everywhere else. Although discussions are under way to formally recognize and protect at least sections of the zone as protected wildlife reserves,[101] further détente between the two warring nations, beginning with the agreement to restore rail links in June 2000, may threaten its continuing viability. In all events, the DMZ stands as a monument to the vitality of animal life to adapt itself to any circumstances and to profit from warfare and its legacies.

96 George Archibald, "Cranes over Panmunjom: How Korea's Demilitarized Zone Became a Lush Wildlife Sanctuary," *International Wildlife* 94, no. 4 (1975): 19–21.

97 Bruun, "Birds, Bombs and Borders," 158–9; Poole, "Gift," 636–7; Kim, "Preserving Biodiversity."

98 Poole, "Gift," 638.

99 Kwi-Gon Kim, "A Study on the Feasibility as well as an Operational Strategy to Develop DMZ Transboundary Biosphere Reserve between DPR Korea and Republic of Korea," research report submitted to UNESCO, Jakarta Office, Indonesia (2001).

100 Lisa Brady, "Life in the DMZ: Turning a Diplomatic Failure into an Environmental Success," *Diplomatic History* 32, no. 4 (2008): 585–611.

101 Arthur Westing, "A Transfrontier Reserve for Peace and Nature on the Korean Peninsula," paper presented at the Parks for Peace International Conference on Transboundary Areas as Vehicles for International Co-operation, Somerset West, Cape Town, South Africa, September 16–18, 1997.

A CURTAIN OF SILENCE

As John Lewallen points out, "little attention has been devoted to the wartime fate of animals." It is important, therefore, to realize that there were both animal winners and losers in the Cold War, as in other conflicts, though not necessarily in equal measure.[102] Some species fare better from the change in circumstances that war necessarily brings about than others – just as some humans do. The curtain of silence that obscures the fate of animals owes its origins to more than mere human preoccupation with our own species and its subgroups or simple indifference to the fortune of other life forms. It also has partly to do with the perspective and temporal span with which historians tend to view wars as events, not processes. As with disasters caused by natural hazards, it is also important to see wars as more than purely destructive events in the short term and to consider them transformative agents in the longer term.[103] In fact, wars may be significant catalysts of change in their own right, causing political, economic, and social adjustments; triggering needed adaptations in human behavior and the built environment; and perhaps contributing to the overthrow of dynasties, economic systems, and even civilizations. From the animal perspective, war affects the food supply, alters the biotic relationships within ecosystems, and can even create new environments that benefit some species more than others. The species that subsequently inhabit an area, at least on a localized basis, may not be the same as those that did so previously.

The Cold War was the twentieth century's longest war, fought extensively on a global scale across a range of environments. More than other continents, Asia bore the brunt of the destruction. More significantly, the nature of warfare changed over its course. It became more wasteful to the environment, whose destruction was considered a strategic military objective and not simply as a tactical backdrop. The increasingly asymmetrical nature of combat and the weaponry developed to counter it wrecked ecosystems in a way not experienced previously, certainly not on such an extensive scale over so long a period.[104] As a consequence of these developments, wildlife in general, and not just those domesticates employed in military service, suffered as never before, victims not only as individuals but also

102 Lewallen, *Ecology of Devastation*, 96.

103 Greg Bankoff, "Time Is of the Essence: Disasters, Vulnerability and History," *International Journal of Mass Emergencies and Disasters* 22, no. 3 (2004): 23–42.

104 On the relationship of technological supremacy and American foreign involvement, see Michael Adas, *Dominance by Design: Technological Imperatives and America's Civilizing Mission* (Cambridge, Mass., 2005). See also Byung-Min Ahn, "Restoration of the Seoul-Shinuiju Line: Review and Outlook," *East Asian Review* 14, no. 1 (2002): 107–19.

collectively as entire species were brought to the brink of extinction or beyond. The word *ecocide* was not coined arbitrarily to describe how the living environment fared under these new practices of war. The Cold War was immensely destructive to certain species of Asian animals, but the conclusion of hostilities posed further hazards. Paradoxically, sustained periods of peace, if long enough and combined with rising populations and/or economic growth, may prove even more costly. The deadliest war is not necessarily the one between humans but the war humanity is mindlessly waging against other living things for the sake of what the Nazis called *Lebensraum* (living space).[105] The pursuits of peace in the name of progress and for the sake of development can be equally or even more harmful to other species. As James Fallows concludes: "The Asian experience indicates that war can be less damaging than peace."[106]

105 Browne et al., "War and the Environment," 91.
106 Ibid., 94.

8

Against Protocol

Ecocide, Détente, and the Question of Chemical Warfare in Vietnam, 1969–1975

DAVID ZIERLER

> The chemical weed killers are a bright new toy. They work in a spectacular way; they give a giddy sense of power over nature to those who wield them, and as for the long range and less obvious effects – these are easily brushed aside as the baseless imaginings of pessimists.
>
> – Rachel Carson, *Silent Spring*, 1962

In his first foreign policy report to Congress in 1970, President Richard Nixon declared that "the postwar period in international relations has ended." He then proceeded to lay out his plan for American leadership in a period of global flux. The United States was to reexamine the assumptions that had guided U.S. Cold War policy since the Korean War. Rising tensions between the Soviet Union and China, along with the grinding war in Vietnam and Washington's waning influence within the Atlantic alliance, convinced Nixon and National Security Adviser Henry Kissinger that the global struggle between the two blocs could not continue.[1] The new administration believed that these geopolitical changes required a new era of cooperation and political dialogue with Cold War allies and enemies alike.

In the strategy Nixon called "a structure of peace," a budding détente with the communist world could offer a way out of Vietnam by enhancing U.S. diplomatic and military flexibility and thereby diminishing the war against communism in Vietnam as the dominant symbol of American resolve in the Cold War.[2] Central to this strategy was disarmament, which

1 President of the United States, "U.S. Foreign Policy for the 1970s: A New Strategy for Peace," Report to the Congress, February 18 (Washington, 1970), 2.

2 The most authoritative accounts of the Nixon-Kissinger détente strategy with regard to Vietnam are Raymond L. Garthoff, *Détente and Confrontation: American-Soviet Relations from Nixon to Reagan*

The views, opinions, and interpretations expressed herein are those of the author alone and are not necessarily those of the U.S. Department of State or the U.S. government. This essay is based on fully declassified and open-source material.

the administration defined on two levels: (1) international reduction in strategic stocks of nuclear, chemical, and biological weapons, and (2) massive withdrawal of American troops from Indochina to be replaced by the American-supported Army of the Republic of Vietnam and a new round of negotiations with the North to end the war.

In recognition of the Soviet Union's achievement of strategic parity, or at the least the capability to inflict unacceptable damage to the United States and its allies, the president initiated an ambitious plan to slow the nuclear arms race with the Soviets by shrinking existing stocks and pledging limits on the development of new weapons systems. Nixon was equally intent to put a curb on America's chemical and biological weapons arsenal, which had expanded since the 1950s, when Pentagon strategists had looked to bolster the deterrent value of nuclear weapons.[3] At this relatively late juncture in the superpower competition, the Nixon disarmament initiative recognized that America's capacity to contain communism was limited. This approach accepted as fact that it was safer to accommodate rather than to challenge Moscow's strategic and political power on the world stage. Although disarmament would not end the Cold War, it would reduce the chance that a crisis might erupt into all-out war.

On November 25, 1969, the president issued a sweeping statement on U.S. policy on chemical and biological warfare based on a major interagency review (the first undertaken in fifteen years) by the National Security Council, the Departments of State and Defense, and the Arms Control and Disarmament Agency (ACDA). Nixon reaffirmed the long-standing policy that the United States would not be the first nation to introduce chemical weapons in war but vowed to keep a chemical arsenal solely for retaliatory (and hence, deterrent) purposes. Citing the "massive, unpredictable and potentially uncontrollable consequences" of biological weapons, the president renounced all forms of biological warfare and directed the Department of Defense to dismantle its offensive bacteriological program.[4] Finally, the president pledged to submit the Geneva Protocol of 1925 to the Senate for its advice and consent to ratification. The White House saw ratification

(Washington, 1984), 248–56; and John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of Postwar American National Security Policy* (New York, 1982), 274–308. In his memoirs, Nixon describes the entire détente framework as hinging on ending the Vietnam War. It was "the key to everything," he recalled. Richard Nixon, *RN: The Memoirs of Richard Nixon* (New York: Grosset and Dunlap, 1978), 16.

3 For a comprehensive overview of Nixon's disarmament initiatives, see "Ninth Annual Report of ACDA Transmitted to the Congress," reprinted in U.S. Department of State, *Bulletin* 62 (May 4, 1970): 585–92.

4 President of the United States, "Statement on Chemical and Biological Defense Policies and Programs, November 25, 1969." The full text is available at *The American Presidency Project*, University of California, Santa Barbara, http://www.presidency.ucsb.edu/ws/?pid=2343.

of the Geneva Protocol, the most important international treaty dealing with biological and chemical weapons, as the capstone of its disarmament initiative. But although it was eager to secure ratification of the protocol to bolster American claims of international leadership in the pursuit of détente and disarmament, the Nixon administration also sought to base ratification on a narrow interpretation of the protocol that would not call into question its use of chemical agents in Vietnam.[5]

Contrary to his intentions, Nixon's resubmission of the Geneva Protocol to the Senate for ratification opened the way for a congressional debate on U.S. policies on chemical and biological warfare, including the use of herbicides in Vietnam. Unwittingly, Nixon had set the stage for the intersection of two major political formations of the day. By the late 1960s, America's massive and ecologically destructive use of herbicides in Vietnam had spurred a campaign to halt herbicidal warfare for all time led by academic scientists who were opposed to the war in general and particularly disturbed by the deleterious effects of herbicides on the people and nature of Vietnam. During hearings before the Senate Foreign Relations Committee, these scientists argued that the destruction of Vietnam's forests and croplands was shortsighted and politically counterproductive, serving only to harm and alienate the very people whose "hearts and minds" the United States was trying to win.

This episode represents a fusion of the environmental and antiwar movements at a time when the salience of militant anticommunism was coming under fire at home and around the world. As the historian Adam Rome has rightly pointed out, 1960s historiography has largely overlooked the fact that "the rise of the environmental movement owed much to the events of the 1960s," yet Rome himself glosses over the direct connection between environmental warfare in Vietnam and the environmental movement at home. This essay bridges that gap by demonstrating how ecological activists appropriated a key aspect of Nixon's détente strategy as an affirmation of both antiwar values and global environmental protection.

In an attempt to deflect political attention from the question of chemical warfare in Vietnam following Nixon's announcement, the administration contended that the Geneva Protocol did not extend to herbicides or chemical riot-control agents, which had also come under fire as another class of chemical weapons used in Vietnam. The White House sought to sidestep debate in the United Nations and at home on America's adherence to

5 Nixon's speeches almost always displayed a flair for the dramatic. As William Bundy observes of Nixon's style, "The model of Charles de Gaulle was always with him: saying little until the timing was right and then speaking with the greatest possible force." Bundy, *A Tangled Web: The Making of Foreign Policy in the Nixon Presidency* (New York, 1998), 517.

international law, and officials in the Pentagon sought to retain the capacity to kill plants and subdue combatants with chemicals they deemed tactically useful and relatively harmless.[6]

The White House strategy rested on a strange logic that almost immediately produced the exact opposite effect from the one intended: Nixon sought to push the United States to the fore of global disarmament by ratifying an international treaty with the understanding that the United States had not violated it.[7] The ensuing debate on ratification was thus cast in terms of a stark choice on the nation's place in the world: Would the United States take the lead in promoting peace and disarmament? Or would it continue to commit "ecocide," as critics charged, against Vietnam and thereby stand apart as the only nation since World War I to engage in chemical warfare?

In the Geneva Protocol, Nixon saw a political opportunity to shape a post-Vietnam future for global détente. On this count, the president failed, largely because of the work of a small number of civilian American scientists who had witnessed and studied the devastating effects of herbicidal warfare in Vietnam and protested vigorously against it. These scientists recognized the legal opportunity offered by the Geneva Protocol to halt the decimation of Vietnamese nature and to prevent the same from happening elsewhere. In step with an increasingly antiwar Congress and international opinion, these scientists successfully championed a reading of the Geneva Protocol that would oblige the United States to consider the environment in its worldwide pursuit of national security.

THE GENEVA PROTOCOL

Nixon's resubmission of the Geneva Protocol and the question of chemical warfare in Vietnam reignited an American debate that had lain dormant since the 1920s. Following World War I, the United States had taken the lead in seeking a ban on the first use of chemical and biological weapons. In the Versailles Treaty of 1919, the victorious Allies reaffirmed the prohibition against poison gases adopted at the Hague Peace Conferences of 1899 and 1907, and forbade Germany from manufacturing and importing chemicals

6 "United States Criticizes Vote in UN on Meaning of Chemical Warfare Ban," *New York Times*, December 12, 1969.

7 As a nonparty to the Geneva Protocol, the United States was technically invulnerable to charges that it had violated international law. Official statements had indicated that the United States had considered itself an adherent to the Geneva Protocol since its creation in 1925 (and throughout the Vietnam War) as a matter of customary (meaning normative) international law. For the standard definition, see "customary international law" in *Black's Law Dictionary*, 8th ed. (St. Paul, Minn., 2004), 835.

or other materials necessary to produce such weapons. At the Washington Naval Disarmament Conference of 1922, the United States proposed a ban on the use of poisonous gases, and the proposal was adopted in the resulting Washington Naval Treaty. The U.S. Senate voted unanimously in favor of the treaty, but France's objection to provisions relating to submarine warfare prevented the agreement from entering into force.[8]

Still, the Washington conference succeeded in encouraging the great powers to take the lead in chemical weapons disarmament and provided the diplomatic foundation for the 1925 Geneva Conference for the Supervision of the International Traffic in Arms. Again, the United States proposed a ban on gas warfare, and with a proposal offered by Poland banning bacteriological warfare, the conference endorsed the Geneva Protocol, which was signed on June 17, 1925. Over the next five years, all of the European powers ratified the protocol. Despite support for the protocol in the Senate Foreign Relations Committee, it was never put up to a vote in the Senate as the result of a strong lobbying campaign coordinated by the Army Chemical Warfare Service and the chemical industry.[9] In 1947, almost two decades after the protocol was signed, President Harry Truman officially withdrew the protocol from the Senate.

Although the United States remained the sole major power that was not a party to the Geneva Protocol, U.S. officials regularly proclaimed that the United States was firmly holding to its prohibitions. President Franklin Roosevelt offered a strong affirmation to this effect when he declared on June 8, 1943:

> The use of such weapons has been outlawed by the general opinion of civilized mankind.
>
> This country has not used them, and I hope that we never will be compelled to use them. I state categorically that we shall under no circumstances resort to the use of such weapons unless they are first used by our enemies.[10]

A major international challenge to the American stance came in 1966, when Hungary accused the United States in the United Nations of violating the Geneva Protocol by using herbicides and riot-control agents in Vietnam. The American delegation denied the charges, contending that the protocol prohibited only antipersonnel weapons, and effectively co-opted the debate

8 The full text and negotiating history of the Washington Conference can be found in Frank Barnaby et al., *The Problem of Chemical and Biological Warfare* (Stockholm, Almqvist & Wiksell, 1971), 4:46–9.

9 The successful lobbying campaign in the Senate is recounted in Daniel P. Jones, "American Chemists and the Geneva Protocol," *Isis* 17 (September 1980): 426–40.

10 Franklin Roosevelt, quoted in U.S. Department of State, Current Treaties and Agreements, "Narrative on the Geneva Protocol," available at http://www.state.gov/t/ac/trt/4784.htm.

by introducing General Assembly Resolution 2162 B (XXI), which called for "strict observance by all States of the principles and objectives" of the Geneva Protocol and condemned "all actions contrary" to them. The U.S.-sponsored resolution made no mention, however, of specific weapons. The resolution passed on a vote of 90 to 1 with one abstention. Although the U.S. succeeded in passing Resolution 2162 B (XXI), it was forced for the first time to defend its military policies in Vietnam before the United Nations.[11]

The UN General Assembly continued debate on American use of herbicides in Vietnam and, in the following two years, passed a string of resolutions emphasizing that all states should adhere to a broad interpretation of the Geneva Protocol. Finally, Resolution 2603 (XXIV) of December 16, 1969, brought to a vote by the Swedish ambassador to the United Nations, leveled a direct protest against U.S. policy in Vietnam on two levels. First, the resolution defined strict observance of the Geneva Protocol "regardless of any technical developments," thereby casting the protocol as an evolving agreement that applied to a range of weapons that did not exist in 1925. Second, the resolution undermined the American interpretation of the protocol as applying only to lethal antipersonnel weapons by defining chemical agents of warfare as a "chemical substance – whether gaseous, liquid, or solid – which might be employed because of the direct toxic effects on man, animals, or plants."[12] The resolution passed eighty to three; thirty-six nations abstained, most on the grounds that the General Assembly was an inappropriate forum for interpreting treaty law. The United States was joined by two nations that had good reason to protest the resolution: Australia, whose forces had taken part in herbicidal missions in Vietnam, and Portugal, which was using chemical herbicides against revolutionary insurgents in Angola. Endorsed by an overwhelming vote, the resolution offered a clear sign that the international community regarded the distinction between chemicals toxic to humankind and the environment an artificial one.

OPERATION RANCH HAND: "ONLY YOU CAN PREVENT FORESTS"

At the outset of the herbicidal warfare program – with a code name that evoked the work of American cattlemen and an unofficial slogan that played

11 UN Resolution 2162 (XXI), *Official Records of the General Assembly, Twenty-fourth Session*, 10–11.

12 UN Resolution 2603 (XXIV) in ibid., *Twenty-first Session*, 16–17. The majority opinion of this resolution was reaffirmed by Secretary General U Thant in UN Report E. 69 I. 24, published as *Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use* (New York, 1970), xxvi.

off the Smokey the Bear campaign[13] – Pentagon officials expressed concern that the large-scale use of chemicals to defoliate forests and destroy croplands in Vietnam would make the United States vulnerable to international condemnation. In 1961, when the Kennedy administration was exploring a number of counterinsurgency options to confront the guerilla-style tactics of National Liberation Front (NLF, known by most Americans as the Viet Cong or VC) forces in South Vietnam,[14] the Joint Chiefs of Staff warned the National Security Council that "care must be taken to assure that the U.S. does not become the target for charges of employing chemical or biological warfare. International repercussions could be most serious."[15] A year later, after several experimental defoliating missions in South Vietnam's highland rainforests, Secretary of Defense Robert McNamara wrote Kennedy, "Politically, it would appear that the earlier herbicide tests in South Vietnam induced the maximum amount of adverse Sino-Soviet propaganda, although we received none of the benefits of a successful herbicide operation."[16] Still, McNamara believed that the worst of international criticism had already passed, and he remained convinced that the benefits of herbicides would become more readily apparent when applied over larger areas. McNamara counseled Kennedy to expand the herbicide program to an operational level, beginning with the defoliation of coastal mangrove forests. The president consented after further consultations with his key advisers on Vietnam, Walt W. Rostow and McGeorge Bundy.[17]

13 The altered image of the famous Smokey the Bear poster can be found in "Gallery: James G. Lewis on Smokey Bear in Vietnam," *Environmental History* 11 (July 2006): 599. Richard Slotkin discusses John Kennedy's penchant for describing his Cold War policies with clichés associated with the settling of the American West in *Gunfighter Nation: The Myth of Frontier in Twentieth-Century America* (Norman, Okla., 1998), 1–4.

14 The Kennedy administration's consideration of available counterinsurgency options is detailed in Larry E. Cable, *Conflict of Myths: The Development of American Counterinsurgency Doctrine and the Vietnam War* (New York, 1986), 185–201.

15 Quoted in E. W. Pfeiffer "Operation Ranch Hand: The U.S. Herbicide Program," *Bulletin of the Atomic Scientists* 38 (May 1982): 21.

16 "Memorandum from Secretary of Defense McNamara to the President," memorandum no. 254, August 1, 1962, in *Foreign Relations of the United States, 1961–1963*, ed. Department of State, vol. 2, *Vietnam 1962*, available at http://www.state.gov/www/about_state/history/vol_ii_1961–63/w.html.

17 National Security Action Memorandum 178, "Destruction of Mangrove Swamps in South Vietnam," August 9, 1962. Available from the searchable database of the Digital National Security Archive, at http://www.nsarchive.org (hereafter DNSA). Of the key officials of the Kennedy administration, Assistant Secretary of State Roger Hilsman was most concerned with the political and moral ramifications of herbicidal warfare and lobbied unsuccessfully for the termination of the program. "Defoliation," he later wrote, "was just too reminiscent of gas warfare. It would cost us international political support, and the Viet Cong would use it to good propaganda advantage as an example of the Americans making war on the peasants." Hilsman, *To Move a Nation: The Politics of Foreign Policy in the Administration of John F. Kennedy* (Garden City, N.Y., 1967), 443.

South Vietnamese President Ngo Dinh Diem was an ardent advocate of herbicidal warfare as a key component of counterinsurgency strategy. His support encouraged U.S. officials initially to consider disguising American involvement with aircraft bearing South Vietnamese insignias, but they soon thought better of the idea.[18] Following an experimental phase that had garnered strong support from Ranch Hand officers, Secretary of State Dean Rusk issued a directive in May 1963 that delegated primary authority for herbicidal missions to the Military Assistance Command, Vietnam (MACV), after which point Operation Ranch Hand quickly expanded as U.S. military officials saw ever more of Vietnam as a battlefield.[19] The initially limited attempt to create vegetation-free buffers around military bases and along transport routes was soon transformed into a battlefield tactic aimed against guerrilla fighters throughout the South Vietnamese countryside. The amount of herbicide deployed in Operation Ranch Hand shot up from approximately 1 million liters in 1964 to 10 million liters in 1966.[20]

By 1965, Air Force crewmen were routinely flying defoliating missions in lumbering, low-flying C-123 aircraft, targeting forests and cropland thought to give cover and nourishment to NLF fighters. As the spray volume figures indicate, the scope and intensity of the Ranch Hand missions grew in step with the rapid escalation of the war under President Lyndon Johnson: in 1966, the acreage of forest and farmland targeted by Ranch Hand more than tripled, jumping from 230,000 acres in 1965 to 840,000, and then doubled again, to 1.7 million acres, in 1967. After spraying 1.3 million acres in 1968, Ranch Hand began to taper off, and large-scale defoliating missions ceased in December 1970.[21]

Ranch Hand relied primarily on three liquid chemical herbicides: Agents White, Orange, and Blue, whose names derived from the identifying color bands on the fifty-five-gallon drum containers in which they were stored. Agents Orange and White were used to destroy broadleaf plants in South Vietnam's triple canopy rainforest. Agent Orange is a 1:1 mixture of two chemicals, 2,4-dichlorophenoxyacetic acid (2,4-D) and 2, 4,5-trichlorophenoxyacetic acid (2,4,5-T). Agent White is a 3.8:1 mixture of 2,4-D and 4-amino-3,5,6-trichloropicolinic acid (picloram). These agents killed plants by mimicking their growth hormones; single applications cause

18 Walter Boyne, "Ranch Hand," *Air Force Magazine*, August 2000, 86.

19 The memo is reprinted in William A. Buckingham Jr., *Operation Ranch Hand: The Air Force and Herbicides in Southeast Asia, 1961–1971* (Washington, D.C., 1982), 59.

20 Jeanne Mager Stellman et al., "The Extent and Patterns of Usage of Agent Orange and Other Herbicides in Vietnam," *Nature* 422 (April 17, 2003), 684.

21 Frank Barnaby et al., *Ecological Consequences of the Second Indochina War: A Report by the Stockholm Peace Research Institute* (Stockholm, Almqvist & Wiksell, 1976), 28–9.

rapid deformities and death in a variety of broadleaf plant species. Agent Blue, a 2.6:1 mixture of sodium dimethyl arsenate and dimethyl arsenic acid, was the preferred compound for Ranch Hand's crop-destroying missions. The compound's arsenical makeup acted as a desiccating agent that proved especially effective at destroying rice paddies.[22] In all, Operation Ranch Hand sprayed 19 million gallons of herbicides over 4.5 million acres of South Vietnam, 12 percent of the country's total surface area – an area of chemical devastation larger than the state of Massachusetts.

In a war without well-defined fronts to advance or defend, U.S. military and political officials came to rely on statistics on destruction to measure success in the battlefield. The best-known example of this practice was developed by U.S. Army General William C. Westmoreland, who offered optimistic reports to his civilian commanders in terms of "body count" i.e., the number of Vietnamese killed in a given period of time, often with little attempt to distinguish between civilians and enemy combatants. Similarly, political and military assessments of the strategy of environmental warfare tended to isolate and magnify the immediate tactical value of destruction and to minimize the unintended harmful consequences. A report commissioned by U.S. Ambassador to South Vietnam Ellsworth Bunker in January 1968 offered one of many clear endorsements for the military utility of herbicides against NLF guerillas. South Vietnam, the report stated,

> is covered with dense forests, jungle and mangrove. Utilization of this natural concealment has afforded the enemy great tactical and logistical advantages *vis-à-vis* Allied forces. A paramount military problem from the outset, therefore, has been the difficulty of locating the enemy. . . . Without information about enemy dispositions our forces cannot exploit their advantage of superior firepower. Defoliation by chemical herbicides is the principal way by which Allied forces obtain visible observation of enemy forces, facilities ambush sites, [and] infiltration routes.[23]

As an article in *Air Force Times* described it, the mission of herbicidal warfare was to "uncover Charlie" from his jungle hideouts.[24] The idea was that the use of defoliant chemicals would help reduce the vulnerability of American ground forces to ambush, booby traps, and sniper fire and

22 A comprehensive description of these chemicals and their uses can be found in U.S. Department of the Army, Training Circular FM 3–3, "Tactical Employment of Herbicides" (Washington, D.C., 1971), 2–1–2–3.

23 U.S. Agency for International Development, Embassy of South Vietnam, and MACV, "Review: Herbicide Policy Committee," May 1968, qtd. in Buckingham, *Operation Ranch Hand*, 146.

24 Curtis Jordan, "Uncovering Charlie: Spray Destroys Hiding Places of Viet Cong" *Air Force Times*, May 11, 1966, 14. See also Lt. Col. Stanley D. Fair, "No Place to Hide: How Defoliants Expose the Viet Cong," *Army* 14 (September 1963): 54–5.

also force the NLF into open battle,[25] which, in turn, would allow U.S. forces to fight the pitched, head-on battle of annihilation that the army had traditionally preferred in what Russell Weigley famously described as "the American way of war."[26] Reports and public statements issued by MACV consistently defended the strategic logic of environmental warfare as indispensable to protecting soldiers and maintaining military dominance over the countryside.[27]

ECOLOGICAL ACTIVISM AND THE END OF RANCH HAND

A key strategy employed by scientists appalled by America's war on nature in Vietnam was to argue that ecocide should be treated as a war crime, and they looked to the Nuremberg trials as a model for holding those responsible for war crimes accountable for their actions. If the term *genocide* had come to command a moral weight, then a term extending its meaning to the environment might be able to do the same for nonhuman casualties of war.[28] As the legal scholar Richard Falk put it, somewhat breathlessly, "Surely it is no exaggeration to consider the forests and plantations treated by Agent Orange as an Auschwitz for environmental values."[29] By the late 1960s, several scientists with firsthand knowledge of the effects of Ranch Hand were able to

25 The idea that chemical defoliation saved the lives of soldiers became a key argument for supporters of Operation Ranch Hand. See, e.g., Richard L. Kenyon, "Chemical Agents for Guerilla Warfare," *Chemical and Engineering News* 43 (August 16, 1965); and George R. Chamlin, of the Continental Chemiste Corporation, who wrote, "When it comes right down to it, given a choice between the life of a tree and the life of a soldier, we must choose in favor of the life of an American soldier"; Letters to the Editor, *Science* 170 (December 11, 1970): 1156.

26 Russell Weigley, *The American Way of War: A History of United States Military Strategy and Policy* (Bloomington, Ind., 1973).

27 Military assessment reports consistently advanced this view, even after Operation Ranch Hand had ended. See, e.g., Joseph M. Dougherty, USAF, "The Use of Herbicides in Southeast Asia and Its Criticism," Report No. 4562, Research Report Submitted to the Faculty, Maxwell Air Force Base, Ala. 1972.

28 Genocide became a crime of international law under UN Resolution 96 (I) of December 11, 1946. The term was fully defined by international agreement at the Convention of Human Rights Convention on the Prevention and Punishment of the Crime of Genocide (known as the Genocide Convention) of December 1948. The full text of the Convention is available at http://www.yale.edu/lawweb/avalon/un/genocide.htm.

29 Richard A. Falk, "Environmental Warfare and Ecocide: Facts, Appraisal, and Proposals," *Bulletin of Peace Proposals* 4 (January 1, 1973): 84. In response to Operation Ranch Hand, Falk proposed the Convention on the Crime of Ecocide in 1973, which combined the norms established at the Genocide Convention with the Declaration of the 1972 Conference on the Human Environment of the UN General Assembly. This proposal helped shape the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques of 1977, signed at Geneva and entered into force under UN mandate in October 1978 – with full American participation. Both texts are reprinted in Arthur Westing, *Environmental Warfare: A Technical, Legal, and Policy Appraisal* (London, 1984), 45–9 and 93–8.

advance this view in congressional testimony.[30] For these scientists, the question of whether herbicides were prohibited by the Geneva Protocol was not simply a legal issue. With no end of the war in Vietnam in sight, they sought to put an end to at least one cruel and environmentally destructive tactic.

In January 1970, several senators and representatives convened the Congressional Conference on War and National Responsibility. A two-day deliberation on the question of American war crimes in Vietnam, it was modeled, apparently, after the International War Crimes Tribunal organized by Bertrand Russell in 1967.[31] The participants included prominent scholars of widely varying ideological dispositions (e.g., Hannah Arendt, Hans Morgenthau, Gabriel Kolko) as well as lawyers and scientists. During a panel titled "Technology and American Air Power," Arthur Galston, a professor of plant biology at Yale University, introduced the word *ecocide* to the lexicon:

> It seems to me that the willful and permanent destruction of environment in which a people can live in a manner of their own choosing ought similarly to be considered as a crime against humanity, to be designated by the term *ecocide*. I believe that most highly developed nations have already committed autoecocide over large parts of their own countries. At the present time, the United States stands alone as possibly having committed ecocide against another country, Vietnam, through its massive use of chemical defoliants and herbicides.[32]

The discussion then turned to the questions of how an international war crimes tribunal might handle ecocide and whether the prosecution of IG Farben at Nuremberg might provide a precedent for bringing charges against Dow Chemical, the primary producer of Agent Orange.

The notion of ecocide as a criminal military tactic became a common theme in congressional debate. Senator Stephen Young of Ohio was one of many legislators who explicitly made this connection in Congress by linking environmental warfare and the indiscriminate killing of innocents:

> Often lost amid the statistics of our war dead and wounded and those of the Vietcong and North Vietnamese is the fact that more than half a million women, children, and old men have been killed or maimed for life by our artillery, our napalm bombing, and our use of chemical defoliants.[33]

30 See Robert David Johnson, *Congress and the Cold War* (Cambridge, 2006), 69–104, on the key role played by the liberal new internationalists in the formulation of American Cold War policy in the Vietnam era.

31 John Duffett, ed., *Against the Crimes of Silence: Proceedings of the Russell International War Crimes Tribunal* (New York, 1968).

32 The proceedings are reprinted in Erwin Knoll and Judith Nies McFadden, eds., *War Crimes and the American Conscience* (New York, 1970). Galston's statement appears on p. 71.

33 *Congressional Record*, June 17, 1970, 20,079. The term *ecocide* was quickly adopted by nonscientist critics of the herbicidal warfare program. See especially L. Craig Johnstone, "Ecocide and the

In his farewell address as president of the Botanical Society of America, Galston made the case that scientists and student antiwar activists had to join forces to stop the environmental destruction of Vietnam. He registered his concern about the widespread alienation of students from the sciences. Citing the growing cooperation between the Pentagon and academia as the source of this gulf, Galston observed that most students had come to believe that "science no longer promises the better life, but rather a harsher, depersonalized over-technologized existence, devoid of higher social values." The widespread use of herbicides in Vietnam exemplified the dark turn of applied science: "It is the deliberate application of botanical knowledge for destructive, rather than constructive ends."[34] Although Galston did not "name names," his critique of the profession amounted to a repudiation of the legacy of the botanist E. J. Kraus, who, as a consultant to the War Department during World War II, was the first scientist to realize and champion the military use of herbicides in the Pacific theater.[35] The time had come, Galston argued, for the profession to elevate the productive over the destructive capacity of science (in part by harnessing and redirecting the rage and alienation of America's college students) and for scientists to assume a political mantle by compelling the U.S. government to adhere to international law. In the case of herbicidal warfare, botanists had a special opportunity: by advocating a broad interpretation of the Geneva Protocol, they could be at the cutting edge of global environmental policy and halt at least one of the more controversial tactics of the Vietnam War.

Galston was a central figure in the group of scientists who, in dozens of articles in both popular and scientific publications, challenged America's strategy of environmental warfare.[36] Civilian scientists were generally no

Geneva Protocol" *Foreign Affairs* 49 (July 1971): 711–20; and Paul R. Ehrlich and John P. Holdren, "Starvation as a Policy: Spraying of Herbicides in Vietnam, Ostensibly as a Military Matter, Kills Civilians Wholesale," *Saturday Review* 54 (December 4, 1971).

34 Arthur W. Galston, "Plants, People, and Politics," *Bioscience* 20 (April 1, 1970): 405–10.

35 On the development of herbicides, see Gale Peterson, "The Discovery and Development of 2,4,-D," *Agricultural History* 41 (1967): 243–53; and Nicolas Rasmussen, "Plant Hormones in War and Peace: Science, Industry, and Government in the Development of Herbicides in 1940s America," *Isis* 92 (June 2001): 291–316.

36 These articles uniformly denounced Operation Ranch Hand as an ecological and humanitarian disaster guided by a strategy that traded immediate tactical benefits in battle zones for long-term liabilities – both to America's standing as a moral force in world affairs and to the overall environmental health of the planet. See, e.g., John Constable and Matthew Meselson, "The Ecological Impact of Large Scale Defoliation in Vietnam," *Sierra Club Bulletin* 56 (August 1971): 4–9; Robert E. Cook, William Haseltine and Arthur W. Galston, "Deliberate Destruction of the Environment: What Have We Done to Vietnam?" *New Republic* 163 (October 1, 1970): 18–21; Stanford Study Biology Group Pamphlet, "The Destruction of Indochina" (1970); Gordon H. Orians and E. W. Pfeiffer, "Ecological Effects of the War in Vietnam," *Science* 168 (March 1, 1970): 544–54; and

better informed on military operations in Vietnam than the general public and had to rely on press reports for information.[37] Although herbicides had been in wide use on American farms since the late 1940s, botanists were still struggling in the early 1960s to understand how and why herbicides killed domestic plants.[38] Thus, a growing number of scientists questioned the use of Vietnam as a laboratory to study the effects of the large-scale use of undiluted herbicides. Scientific information based on studies of the agricultural use of herbicides in the United States, they reasoned, was irrelevant given the quantities and concentration of chemicals used in Ranch Hand.[39] The first formal scientific protest against herbicidal warfare came in January 1966. A group of scientists led by John Edsall, a professor of biochemistry at Harvard, sent a petition to President Johnson decrying the practice of chemical crop destruction in Vietnam. Assistant Secretary of State Dixon Donnelley responded that the chemicals posed no threat to humans or animals, had a proven track record in its use at home, and were, furthermore, crucial to counterinsurgency operations.[40]

In December 1966, E. W. Pfeiffer, a professor of zoology at the University of Montana, urged the American Association for the Advancement of Science (AAAS) to launch an independent field study in Vietnam on the ecological effects of herbicidal warfare.[41] The board of directors of the

Arthur H. Westing, "Ecological Effects of Military Defoliation on the Forests of South Vietnam," *Bioscience* 21 (September 1, 1971): 893–8.

37 In its first two years, Operation Ranch Hand received cursory coverage in major publications including *Newsweek*, *Time*, the *New York Times*, and the *Washington Post*. The earliest negative response in the American press located by this author is "One Man's Meat," *New Republic* 148 (March 23, 1963): 4–5. This editorial refers to "Communist charges" that the United States had used poisons on Vietnamese forests and rice crops. The international communist press latched on to the herbicidal warfare story almost immediately. See, e.g., "South Viet-Nam: War Against the Trees," *New Times* (Moscow) 25 (April 1962): 24–6.

38 See especially A. S. Crafts, *The Chemistry and Mode of Action of Herbicides* (New York, 1961). This study demonstrates a strong distinction between botanists' knowledge of the effects of certain herbicidal chemicals on particular plants and the basic mysteries regarding the mode of action, or the biochemical processes, that creates the death of plant cells.

39 See, e.g., Howard Odum, "Status of Knowledge on Herbicide and Ecology," *Ecology* 49 (Autumn 1968): 1215; and James A. Duke and John T. McGinnis, "Vietnam Refoliation," *Science* 170 (November 20, 1970): 807. The most comprehensive documentation of domestic herbicide and pesticide use can be found in *Down to Earth*, the in-house trade journal published by Dow Chemical Company beginning in 1945.

40 "Scientists Protest Viet Crop Destruction" *Science* 151 (January 21, 1966): 309. See also "Scientists Decry 'Chemical Warfare,'" *Chemical & Engineering News*, January 24, 1966: 26. Donnelley's response is reprinted in *Bioscience* 17 (January 1967): 10. The response offered by the White House did not quell scientific concerns; in February 1967, Lyndon Johnson received another petition signed by five thousand scientists to the same effect. "5000 Scientists Ask Ban on Gas in Vietnam," *Washington Post*, February 15, 1967.

41 Pfeiffer recounted his efforts to galvanize scientific opinion against herbicidal warfare in "Chemical Warfare in Vietnam and the American Scientific Community," *Scientific World* 12 (December 1968): 16–19.

AAAS demurred, suggesting instead that the National Academy of Sciences (NAS), a quasi-governmental body, was better equipped to handle the task. Pfeiffer and others objected that the NAS was incapable of an objective review because of its history of close collaboration with the Pentagon on matters of chemical and biological warfare – not least its central role in the development of the herbicidal weapons research program at Fort Detrick, Maryland.[42]

The AAAS eventually appealed to the Pentagon to launch a review on the basis that it had insufficient resources for such a study. Military officials, eager to contain the brewing scientific protests, responded to the AAAS request by contracting the Midwest Research Institute (MRI) of Kansas City to conduct a review of herbicides, which was to be reviewed by the NAS before submission to the AAAS. The MRI hurriedly completed its work by December 1967, but the report failed to assuage concerns about the effects of herbicidal warfare.

The MRI researchers did not leave their offices in Kansas City; under the terms of their contract with the Pentagon, their job was to conduct a review of all extant literature on herbicides. The Pentagon thus entirely ignored the protesting scientists' call for original field research in Vietnam. The report offered a comprehensive review of all domestic and international use of herbicides, which gave the impression that Ranch Hand was merely a military extension of established and accepted domestic practices of weed control. It also offered an extremely uncritical (and brief) assessment of the ecological consequences of herbicidal warfare in Vietnam. The authors devoted sixteen of three hundred pages to the issue, and they introduced the section on Vietnam by quoting a U.S. forestry official, who observed "the forests of South Vietnam have been devastated for many centuries. First nomadic or semi-savage people occupied the land and destroyed the forests without discrimination for centuries."[43] The Department of Agriculture and military assessments of the effects of herbicidal warfare that the report cited maintained that sprayed forest areas would experience a pause in plant succession "similar in some respects to that found in abandoned forest clearings."[44]

42 For an excellent overview of the NAS-Pentagon alliance on chemical and biological weapons research, see Philip Boffey, *Brain Bank of America: An Inquiry into the Politics of Science* (New York, 1975).

43 L. Williams, "Forests of Southeast Asia, Puerto Rico and Texas, USDA, ARS Report No. CR-12–67 (1967), qtd. in W. B. House et al., "Assessment of Ecological Effects of Extensive or Repeated Use of Herbicides," Midwest Research Institute Project No. 3103-B, sponsored by the Advanced Research Projects Agency, Department of Defense (Kansas City, Mo., 1967), 130.

44 Ibid., 145.

Because the NAS had agreed to review the MRI report on the basis of the commission MRI had received – rather than in terms of what Pfeiffer and other scientists thought necessary – its approval amounted to little more than an endorsement of MRI's capacity to conduct library work and summarize the extant literature. Unsurprisingly, the report served only to inflame scientific opinion and confirm suspicions that the military would rather mute the controversy than respond to it with a legitimate scientific investigation.[45] Individual members of the AAAS complained that the MRI report offered no new substantive information. They again called for an independent investigation, now convinced that any government study would subordinate scientific inquiry to political expedience. The AAAS board of directors issued a statement in its journal *Science* on July 19, 1968:

> Because large-scale employment of herbicides has taken place in Vietnam, and because questions of the long-term welfare of all the peoples of Vietnam are of great importance to the United States and other countries, we urge that steps be promptly undertaken to initiate long-term, on-the-spot studies of the regions of Vietnam affected by the use of herbicides.[46]

The statement proceeded to call on the military to open its records on Operation Ranch Hand to independent researchers, and it urged the United Nations to lead a scientific mission to Vietnam. The AAAS's call went unheeded; the Pentagon had no intention of declassifying its records in the midst of the war, and the United Nations was unprepared to take an active role beyond its numerous resolutions on the Geneva Protocol.

Having exhausted all other options, the AAAS decided to take up its own Vietnam herbicide study. In December 1969, the board appointed Dr. Matthew S. Meselson, a biologist from Harvard University and an expert on chemical and biological weapons, to head the Herbicide Assessment Commission of the AAAS.[47] The commission members made a six-week trip to Vietnam in August 1970, but returned doubtful about the trip's usefulness. Accompanied by military escorts to conflict zones, the scientists collected samples of soil, flora, and fauna as well as of human hair and

45 See, e.g., Franklin P. Huddle, Report, U.S. Congress, House, Committee on Science and Astronautics, *A Technology Assessment of the Vietnam Defoliant Matter: A Case History*, 91st Cong., 1st Sess., 1969, 44–6; and Sheldon Novick, "The Vietnam Herbicide Experiment," *Scientist and Citizen* 10 (January–February 1968): 20–1. Fred Tschirley, a scientist with the U.S. Department of Agriculture, writing from an official point of view, offers a more sympathetic review in *Ecology* 49 (November 1968): 1211–12.

46 "On the Use of Herbicides in Vietnam," *Science* 161 (July 19, 1968): 253–4.

47 The team consisted of Meselson; Arthur S. Westing, a professor of botany at Windham College; John Constable, a professor of surgery at Harvard University Medical School; and Robert E. Cook, a graduate student studying with Arthur Galston at Yale.

breast milk. The Pentagon, however, refused to provide any data on Ranch Hand spraying in the areas where the samples were collected. "Without the data," Meselson complained upon his return to the United States, "it relegates the study to being a collection of disconnected pieces without a clear guide to the relative importance of each piece."[48] Unfortunately, Meselson's lamentation was to be echoed in nearly every subsequent attempt to gain more solid epidemiological data. Even today, decades after the war, the question of the long-term effects of exposure to Agent Orange on human health remains mired in scientific controversy.[49]

The AAAS team nonetheless believed that it had gained sufficient data from the trip to release a study that harshly condemned herbicidal warfare as an unmitigated ecological disaster and possible long-term threat to the health of exposed populations. The report, which was widely circulated in Congress and the press, had two key findings. First, herbicidal spraying had "utterly destroyed" fully half of Vietnam's mangrove forests and had done irreparable harm to its tropical hardwood forests, which, as a result of the spraying, were being replaced by invasive bamboo and grasses; in addition, widespread tree kills created soil erosion and "nutrient dumping."[50] Second, the crop destruction program of Operation Ranch Hand was a failure because military planners were unable to distinguish conclusively between areas under civilian control and areas under guerilla control. Although the AAAS study was silent on the tactical value of forest defoliation, it was unequivocal in its denunciation of the crop destruction program, declaring that it had failed in its stated mission of denying the enemy food but was quite successful at starving civilian Vietnamese.[51] Despite numerous constraints,

48 Meselson, qtd. in Philip Boffey, "Herbicides in Vietnam: AAAS Study Runs into a Military Roadblock," *Science* 170 (October 2, 1970): 43.

49 Although there is near-universal agreement that dioxin, a contaminant that is produced as an unwanted by-product in the production of Agent Orange, is extremely toxic to humans, there is far less accord regarding the effects of dioxin exposure as a result of Operation Ranch Hand activities during the Vietnam War. One major problem is that there are few diseases with symptoms that manifest only as a result of dioxin exposure. By way of comparison, mesothelioma is a rare form of lung cancer found in patients almost always known to be exposed to airborne asbestos particles.

50 An editorial review of the 1970 AAAS annual meeting in Chicago defines nutrient dumping as occurring when "the soil of the region contains few nutrients and its plant cover depends on the minerals released throughout the year by the decay of a steady fall of leaves and other plant debris. When the debris falls nearly all at once, as a result of spraying with defoliants, the nutrients are leached away by rainfall before they can be utilized by the plant life. The result is the starvation of the plants, and the destruction of the plant life makes the environment unfavorable for the animal life it formerly supported." Editorial, "Defoliation in Chicago," *Scientific American* 224 (February 2, 1971): 44.

51 The AAAS report was condensed by Philip Boffey, "Herbicides in Vietnam: AAAS Study Finds Widespread Devastation," *Science* 171 (January 8, 1971): 43–7. On the crop destruction program, the RAND Corporation issued a study in 1967 that mirrored the highly critical AAAS report. See Russell Betts and Frank Denton, "An Evaluation of Chemical Crop Destruction in Vietnam,"

Dr. John Constable, the team's medical expert, set out to examine the human health effects of herbicide exposure. Constable observed a spike in the number of birth defects and stillbirths in areas known to have been subject to heavy spraying missions. He also criticized the methodology of an army study that had found no correlation between birth defects and herbicidal exposure.[52]

The herbicide report issued by AAAS did not trigger the fight to end Operation Ranch Hand that its authors had expected and wanted. Because the phaseout of the herbicide program had already begun by the time the scientists undertook their fieldwork, their findings did not make a political impact until Congress opened debate on the future of herbicidal warfare in 1971. Despite its insistence that herbicides and tear gas were not prohibited by the Geneva Protocol, the Nixon administration proved willing to curtail the use of certain herbicides as a matter of public health. In October 1969 – more than a year before the publication of the AAAS study – the National Cancer Institute had released preliminary findings that demonstrated a link between sustained exposure to dioxin, a highly toxic by-product of the manufacturing process of 2,4,5-T (which constituted half of the Agent Orange compound), and the incidence of cancer and birth defects in laboratory mice.[53] Dr. Lee A. DuBridge, Nixon's science adviser, announced on October 29 the government's intentions to restrict use of 2,4,5-T in both domestic and international applications. DuBridge's order went out to the Department of Agriculture to halt use of 2,4,5-T on crops and to the Department of the Interior to avoid spraying 2,4,5-T "in populated areas or where residues from use could otherwise reach man." The Department of Defense was likewise told to curb its use of Agent Orange in Vietnam.[54]

Memorandum No. RM-5446–1-ISA/ARPA (Santa Monica, Calif., 1967). On the military value of the defoliation, the group offered no opinion on its tactical value on the grounds that such an assessment was not the purpose of the study. A more likely explanation, however, is that the scientists did recognize its utility. E. W. Pfeiffer, on returning from his own assessment of the ecological effects of herbicides in Vietnam in March 1969, acknowledged the military usefulness of Operation Ranch Hand. Walter Sullivan, "Zoologist, Back from Vietnam, Notes Defoliants' Value and Toll," *New York Times*, April 4, 1969.

52 In reaction to concerns in the United States about birth defects and Agent Orange, the Military Assistance Command, Vietnam, in partnership with the Ministry of Health, Republic of Vietnam examined obstetrical records from twenty-two hospitals for the period 1960–9. Robert T. Cutting et al., "Congenital Malformations, Hydatidform Moles, and Stillbirths in the Republic of Vietnam, 1960–1969," Office of the Command Surgeon, MACV (Washington, D.C., 1970).

53 Bryce Nelson, "Studies Find Danger in Defoliation Herbicides: White House Removes One from Use after Tests on Mice Indicate Cancer," *Los Angeles Times*, October 30, 1969. For an overview of the toxic characteristics of dioxin, see Barry Commoner, "Toxicologic Time Bomb," *Hospital Practice* 13 (June 1978): 56–7; and "Dioxin Factsheet" offered by the National Institute of Environmental Health Sciences, available at http://www.niehs.nih.gov/oc/factsheets/dioxin.htm.

54 Statement by Lee DuBridge, qtd. in Thomas Whiteside, *Defoliation* (New York, 1970), 94–5.

DuBridge acknowledged the tactical importance of the chemical on the battlefield and stated that the studies were only preliminary and offered no evidence as to the toxicity of 2,4,5-T to humans.[55] Meanwhile, use of 2,4-D (which constituted the other half of Agent Orange) in Vietnam and the United States remained unaffected.[56] At its annual meeting in December 1969, amid raucous antiwar protests by students, AAAS argued that the directives curtailing domestic use of herbicides had no bearing on the large-scale use of undiluted herbicides in Vietnam.[57]

In April 1970, the AAAS saw some of its goals achieved. A study conducted by the National Institutes of Health demonstrated that pure, dioxin-free 2,4,5-T was capable of producing birth defects in mice.[58] Almost immediately after the report became public, the Departments of Agriculture and the Interior issued an almost total ban on 2,4,5-T, restricting it to only limited use far removed from crops and population centers.[59] The Pentagon followed suit with an order to "temporarily suspend the use of 2,4,5-T in all military operations pending a more thorough evaluation of the situation."[60] Reflecting the government's prioritization of human health, the directive placed no curbs on Agents White and Blue, which remained in use in Ranch Hand missions. Subsequently, however, General Creighton Abrams, who succeeded Westmoreland as Commander of MACV, canceled forest defoliation missions as of July 17, 1970. Crop destruction missions were rapidly dwindling as well.

Meselson's team, in other words, arrived in Vietnam to study the effects of an operation that, for the most part, had already ended. At this late juncture, the AAAS was operating as both a scientific and a political entity. Because the war in Vietnam was rapidly deescalating, the data the research team collected would be most useful in the AAAS's efforts to prevent ecocide from happening elsewhere. Still, the White House wanted to limit the political

55 Dow Chemical immediately protested these findings and, to this day, maintains that studies on Agent Orange and other herbicides have failed to prove a definitive causation of birth defects and cancers in humans. See "Safety in the Development of Herbicides," a report by Dr. Julius E. Johnson, Vice President and Director of Research for Dow Chemical, *Down to Earth* 27 (Summer 1971): 1–7. See Dow's current statement on Agent Orange at http://www.dow.com/commitments/debates/agentorange/index.htm (Dec. 15, 2009).

56 Bryce Nelson, "Herbicides: Order on 2,4,5-T Issued at Unusually High Level," *Science* (November 11, 1969): 978.

57 Buckingham, *Operation Ranch Hand*, 164. See also James K. Glassman, "AAAS Boston Meeting: Dissenters Find a Forum," *Science* 167 (January 2, 1970): 36–8.

58 Nancy Gruchow, "Curbs on 2,4,5-T Imposed," *Science* 168 (April 24, 1970): 453.

59 "2,4,5-T Is Going the Way of DDT: Nixed in Home and Aquatic Areas; Is Taken Out of Action in Vietnam," *Oil, Paint and Drug Reporter: The Chemical Marketing Newspaper*, April 11, 1970, 1, 48.

60 Qtd. in Buckingham, *Operation Ranch Hand*, 166.

impact of the report. On December 26, 1970, the AAAS released a "Resolution on Chemical Defoliants" that called on the government "rapidly to phase out the use of all herbicides in Vietnam."[61] That same day, the Nixon administration announced its plans "for an orderly, yet rapid phase out of the herbicide operations."[62] Ranch Hand had effectively come to an end by that point, but the White House wanted to appear to be taking the initiative on curbing herbicidal warfare in anticipation of the upcoming Senate deliberations on the Geneva Protocol.

The AAAS had initially set out to understand the ecological and human health effects of an unprecedented chemical attack on plant life in Indochina. U.S. military strategy conceived of Vietnamese nature solely as a tactical liability to be dominated and did not want to relinquish its immediate plans to counter the guerillas' attritional strategy or risk its long-term flexibility to plan for future Communist insurgency wars around the globe.[63] This is why the Pentagon was unwilling and unable to consider the protection of Vietnam's environment as a valuable goal with merits independent of its strategy to win the war. More importantly, it explains why military officials were unwilling to allow civilian outsiders to have a say in strategic policies.[64] By default, then, the AAAS found itself leading the herbicide investigation, which quickly confirmed the fears of the scientists who had first called for the study. The key achievement of the AAAS research team was its ability to publicize and denounce the immense chemical destruction of nature in Vietnam as a war crime unjustifiable under any circumstances.

61 The resolution is reprinted in William Bevan, "AAAS Council Meeting 1970," *Science* 171 (February 19, 1971): 711.

62 U.S. Department of State, *Bulletin*, January 18, 1971, 77. The similarity in wording was probably not accidental. On December 15, Matthew Meselson met with Henry Kissinger at the White House to brief him on the pending AAAS announcement. Memorandum, Michael Guhin to Dr. Kissinger, National Security Council, "Memcom of Meeting with Matt Meselson and Information as Requested," available from DNSA.

63 A leaked report prepared by the U.S. Army Corps of Engineers in 1971 indicated that the Pentagon considered herbicidal warfare an integral component to strategic planning in a variety of potential theaters of war. With the code name Spectrum, these war-games scenarios deemed herbicides essential to counterinsurgency operations in Cuba, Ethiopia, and Venezuela and in conventional operations on the Korean Peninsula and against Warsaw Pact forces in France and the Benelux countries. Spectrum suggests that the political goal of détente had not penetrated the military ethos in the wake of Vietnam; despite Nixon's rhetoric to foster a structure of peace, the Pentagon was clearly planning to fight future wars not unlike that in Vietnam. The details of the report appeared in "Defoliation: Secret Army Study Urges Use in Future Wars," *Science and Government Reporter* 2 (August 18, 1972): 1–4.

64 In this context, "civilians" include representatives from the major chemical manufacturers of herbicides, including Dow and Monsanto. Although Operation Ranch Hand required close cooperation between industry and the military, there is no evidence that corporate lobbying influenced Pentagon policy.

In an alliance with a congress increasingly alive to the environmental movement and critical of the war in Vietnam, the scientists ensured that the Nixon administration could not ratify the Geneva Protocol on its terms.[65]

SPLITTING THE PROTOCOL: THE DIPLOMACY OF DISARMAMENT

The move to undertake a major review on chemical and biological weapons (CBW) was initiated by Secretary of Defense Melvin Laird in April 1969. Laird, an influential congressman from Wisconsin, was tapped by Nixon to head the Pentagon because of his reputation as a highly skilled politician and bureaucrat. Accordingly, Laird called for the review with an eye to Capitol Hill; he predicted that a comprehensive review headed by the National Security Council would help stave off mounting antiwar sentiment and clarify U.S. policy on chemical and biological weapons.[66]

The NSC study, led by Kissinger, was the basis for Nixon's directive of November 25. In large part, the NSC was able to resolve the previously neglected issue of CBW policy because Nixon's initiative was both politically and strategically expedient. The time was right for the United States to clarify its position on chemical warfare, and the unilateral renunciation of a biological weapons capacity was a bold step on the path to Cold War disarmament. Further, the renunciation of the use of toxins (poisonous chemical substances produced by living organisms) and biological warfare aligned U.S. policy with the Geneva Committee on Disarmament, which began negotiations in July 1969. In April 1972, the committee, consisting of representatives of the United States, the United Kingdom, and the Soviet Union, signed a treaty prohibiting the "development, production, and stockpiling" of biological weapons and toxins.[67] Much like the Geneva Protocol, the Biological Weapons Convention, as the treaty was commonly known, recognized and sought to curb the threat posed by horrifying new biological weapons capable of self-regeneration that could wreck havoc across vast areas. The president's affirmation of no first use of chemical weapons rounded out his disarmament initiatives, which quickly received

65 A detailed analysis on the congressional stance toward environmental issues generally and the herbicides specifically is U.S. Congress, Senate, Hearings, Committee Commerce, *Effects of 2,4,5-T and Related Herbicides on Man and the Environment*, 1970, 90th Cong., 2nd Sess.

66 Memorandum from Melvin Laird to Henry Kissinger, "U.S. National Policy on Chemical and Biological Warfare Activities," April 30, 1969, available from DNSA.

67 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Signed at London, Moscow, and Washington, April 10, 1972, full text available at http://www.opbw.org/convention/conv.html.

solid bipartisan support. The reaction of Congressman Robert Kastenmeier, a Democrat from Wisconsin, was typical:

> The President's announcement [of] November 25 on our future chemical and biological warfare policy has uniformly been well received throughout the Nation and the world. I think this is an important step on the road to disarmament, and its timing at the commencement of the SALT talks is particularly appropriate. Our total renunciation of the use of biological warfare is a practical demonstration of a reversal in the trend toward harnessing our technological skills for more efficient means of destroying ourselves.[68]

Assessing Nixon's initiative by what it promised rather than by what it left out, there was little with which critics could take issue. But as several legislators complained, the White House strategy effectively banned all the chemical and biological weapons that the country had kept in reserve without placing any restrictions on those actually used by the military.[69]

The political points Nixon had gained as a result of the CBW initiative, then, were almost immediately subsumed in the debate over the Geneva Protocol. In late 1969, a year before Operation Ranch Hand was drawing to a close, the administration's efforts to halt hypothetical doomsday scenarios involving anthrax proved unable to deflect widening concern for what was actually happening in Vietnam. In essence, the president set himself the impossible task of crafting future policy without accounting for the determination of citizens and policy makers to prevent a repeat of anything resembling Vietnam. By standing firm on the issue of herbicides, the administration was sending a clear message that it was prepared to use them again.

Despite the Nixon administration's nearly yearlong delay in sending the Geneva Protocol to the Senate as it debated strategy for confronting the political controversy surrounding the use of chemical warfare in Vietnam, there is no evidence that the option to accept the broad interpretation including herbicides and tear gas was ever under serious consideration.[70]

68 Kastenmeier, testimony, U.S. Congress, House, Committee on Foreign Affairs, *Chemical and Biological Warfare: U.S. Policies and International Effects*, 1969, 91st Cong., 1st Sess., 136.

69 See, e.g., "Senate Resolution 154 – Submission of a Resolution Relating to a Comprehensive Interpretation for the Geneva Protocol" proposed by Sen. Hubert Humphrey, *Congressional Record*, July 23, 1971, 26,931.

70 In a December 1969 memorandum, the White House science adviser Lee DuBridge warned Henry Kissinger that the November 25 announcement "touched off another round of sharp criticism" on the use of chemicals in Vietnam. DuBridge counseled that the administration should demonstrate flexibility by indicating its willingness to conduct a review of the chemical agents "after termination of hostilities in Vietnam." Lee A. Dubridge to Dr. Henry A. Kissinger, Memorandum, December 22, 1969, available from DNSA.

Discussions within the administration did not center on the question of whether the chemicals used in Vietnam violated the Geneva Protocol but rather on how this sensitive issue could be avoided. The fact that the United States was not a party to the Geneva Protocol and therefore technically not bound to observe its dictates was of little use to a president who sought to portray the United States as a guarantor of international law and leading proponent of disarmament. Moreover, White House recognition that the military use of chemicals in Vietnam was illegal would have demolished the long-standing government assertion that the United States had always adhered to the Geneva Protocol.[71] At the very least, such an acknowledgment would have amounted to an act of contrition that the country was unprepared to make in the midst of an ongoing war; worse, it would have exposed the Nixon administration to the excruciating question of why it was employing tactics it considered illegal.

Getting around this political conundrum required a multifaceted strategy. A joint memorandum by the Departments of State and Defense and the Arms Control and Disarmament Agency laid out three options:

1. Provide an explicit written statement to the Senate and countries party to the Geneva Protocol that the United States did not consider chemical herbicides and tear gas to be prohibited by the protocol.
2. Provide verbal communication to the Senate and parties to the protocol on the White House interpretation but leave out any language to the effect of option 1.
3. Same as option 2 except only the Senate would receive verbal communication while parties to the protocol would be offered no explanation of the unique American interpretation.[72]

The choice, in other words, was between forms of damage control. The memo acknowledged that protest against the restrictive view of the protocol was already overwhelming, so the goal was to present the resubmission of the Geneva Protocol in such a way as to avoid outright rejection of the White House's stance. Rejection was, however, likely. The Senate could simply tack on to the protocol resolution the opposite position taken by the White House. And if the Senate declined to put up a fight, the nations already party to the protocol could refuse to recognize the American ratification and/or

71 The first official denial that U.S. military policy was in violation of the Geneva Protocol was offered by Secretary of State Dean Rusk during a news conference in 1965, where he affirmed, "We are not embarking on gas warfare in Vietnam." Excerpts of the conference were reprinted in *New York Times*, March 25, 1965.

72 Condensed and paraphrased by the author. Department of State, Memorandum for the President, February 2, 1970, "Submission of 1925 Geneva Protocol to the Senate," available from DNSA.

refer the American interpretation of the protocol to the International Court of Justice.[73]

Essentially, the Nixon administration wanted all the prestige associated with the Geneva Protocol but none of the restrictions it would impose on American actions in Vietnam. Recognizing the conundrum posed by irreconcilable objectives, the administration opted for a strategy wholly concerned with style over substance. Because the phaseout of Operation Ranch Hand was already well under way, the administration's decision-making process on formal versus informal reservations and of verbal versus written communications had become oddly detached from the actual use of herbicides in Vietnam.

The president decided that a formal communication of the administration's narrow interpretation of the Geneva Protocol only to the Senate offered the best chance for minimizing political liabilities and retaining the option of first use of herbicides in future wars.[74] This two-pronged strategy, settled upon a week before the submission of the Geneva Protocol to the Senate, intended to demonstrate that, in the future, the decision to use herbicides would rest with the president rather than with military officials and that no chemicals harmful to human beings (such as Agent Orange) would be employed in war.

On August 19, 1970, Nixon sent the Geneva Protocol to the Senate with a message that restated the goals of his November policy initiative, namely the renunciation of all biological weapons and the restriction of a chemical weapons arsenal solely for its deterrent effect against a chemical, biological, or nuclear attack on the United States. In an attached report, Secretary of State William Rogers detailed this stance in a formal reservation, already asserted by France, Britain, and the Soviet Union, that would release the country from its treaty obligations and permit chemical retaliation in the event of an attack on American soil using chemical weapons. Rogers reaffirmed the president's declaration that "the United States always has observed the principles and objectives of the protocol." He also underscored the need for the United States finally to become a party to the "basic international agreement" that prohibited chemical and biological warfare. On the issue of the administration's narrow interpretation, Rogers explained

73 General Assembly Resolution 2603 of December 16, 1969, had demonstrated that a great majority of nations viewed the Geneva Protocol inclusively to include all wartime use of chemicals. But unlike the International Court of Justice, the General Assembly offers only a forum to debate internationally significant issues; it has no legislative authority to issue rulings on treaty law.

74 National Security Council, "National Security Decision Memorandum 78: Authorization for Use of Riot Control Agents and Herbicides in War," August 11, 1970, available from DNSA.

that "it is the United States' understanding of the Protocol that it does not prohibit the use in war of riot-control agents and chemical herbicides. Smoke, flame, and napalm are also not covered by the Protocol."[75]

The Senate Foreign Relations Committee began hearings on the Geneva Protocol the following March. The committee assembled a list of witnesses that included legal scholars, scientists, and politicians known to be critical of the White House interpretation.[76] Operation Ranch Hand and the controversy surrounding 2,4,5-T had already received a considerable amount of negative attention in the mainstream media. The previous month, Senator Gaylord Nelson of Wisconsin, who founded Earth Day in 1970 and had become the major voice for environmental issues in Congress, proposed that Senate ratification document of the Geneva Protocol conclude with the statement: "It is the understanding of the Senate, which understanding inheres in its advice and consent to the ratification of the protocol, that the terms of the protocol prohibit the use in war of chemical herbicides."[77]

In their testimony, administration officials repeatedly touted the global significance of Nixon's disarmament strategy, but the discussion invariably shifted to the war in Vietnam. Senator William Fulbright of Arkansas, the chair of the Foreign Relations Committee, tried to corner Assistant Secretary of Defense G. Warren Nutter:

> The Chairman: Do you know if any other nations view our use of these weapons as an international criminal act?
> Mr. Nutter: View these weapons as criminal?
> The Chairman: Yes; do any of them make that assertion?

75 Nixon's message to the Senate and Rogers's accompanying report are reprinted in U.S. Department of State, *Bulletin* 63 (September 7, 1970). The inclusion of napalm and smoke seems to have been a last-minute decision to include all controversial weapons used by U.S. forces in Vietnam.

76 Among the witnesses was McGeorge Bundy, who had left government service to become president of the Ford Foundation. Bundy opposed the White House view "in the interest of the future safety of mankind," and, incredibly, was not pressed to explain why his change of heart had not occurred earlier in his career. For a scathing critique of the tendency of Kennedy- and Johnson-era national security officials to distance themselves from Vietnam during the Nixon years, see Robert Kagan's review of *A Tangled Web*, by William Bundy (brother of McGeorge and a major player in his own right on Vietnam for the Kennedy and Johnson administrations). Kagan, "Disestablishment," *New Republic*, August 17, 1998, available from the Carnegie Foundation at http://www.ceip.org/people/kagpubs.htm.

77 U.S. Congress, Senate, Hearings, Committee on Foreign Relations, *The Geneva Protocol of 1925*, 1971, 91st Cong., 2nd Sess., 435. Nelson, like many legislators, declared his great respect for the work of scientists such as Arthur Westing and E. W. Pfeiffer to raise consciousness on herbicidal warfare. At the kickoff speech for Earth Day, the national coordinator Denis Hayes referred to the "ecological catastrophe" of the Vietnam War. He went on to declare, "We cannot pretend to be concerned with the environment of this or any other country as long as we continue the war in Vietnam," thus underscoring both common ground with antiwar protestors and the transnational character of the event. Hayes, "The Beginning," in *Earth Day: The Beginning*, ed. National Staff of Environmental Action (New York, 1970), xiii–xv.

Mr. Nutter: No, sir. I am not familiar with any list of nations that would view the use of riot control agents and herbicides as criminal acts.

The Chairman: I thought I read several articles that there had been great revulsion about the effect, particularly of herbicides, with our growing concern about the pollution of our planet. The stories about these tended to view that the destruction of forests and crops was thought to be a very serious matter, including many Americans. That is true; isn't it?

Mr. Nutter: Yes; and we share that concern.[78]

The committee displayed little patience for either the administration's legal views or military officials' avowals of the tactical necessity of herbicides and tear gas.

The rest of the witnesses received a far more sympathetic hearing. That was particularly true for the testifying scientists, Arthur Galston and two members of the AAAS herbicide mission, Matthew Meselson and Arthur Westing. All urged ratification of the Geneva Protocol without any restrictions or qualifications. Westing, emphasizing his work as a herbicide specialist with the U.S. Forest Service, argued against the Nixon administration's interpretation of the Geneva Protocol. In Westing's view, herbicides had proved to be "at least as pernicious in their effects upon human beings and other living things" as upon targeted vegetation and should, for that reason, be regarded as an antipersonnel weapon explicitly prohibited by the Geneva Protocol.[79] Galston again declared that the ecocide in Indochina must be confronted in a manner similar to the way the Nuremburg trials confronted genocide. He then permitted himself an ecological soliloquy echoing Rachel Carson's plea for technological humility and invoking Paul Ehrlich's doomsday scenario:

> Let me tell you why, as a botanist, I am so convinced of the necessity of banning herbicides and defoliants as weapons of war. These days it is convenient for man to consider himself as master of all he surveys. His ability to reach the bottom of the sea or the surface of the moon, to fly at supersonic speeds, to split the atom, and to construct sophisticated computers makes him feel that there is no problem requiring scientific or technological expertise that he cannot overcome. . . . But the attitude that I describe I consider a dangerous fallacy which could lead man to overlook his own Achilles' heel.
>
> For man lives in this world only by the grace of vegetation. He is totally dependent on and cannot substitute for that thin mantle of green matter living precariously on the partially decomposed rock that we call soil. . . . In view of the present population of about 3.5 billion people on earth and the estimated doubling of the population

78 Ibid., 297.

79 Ibid., 234–5.

> in about 30 years, it ill behooves us to destroy with profligacy the ability of any part of the earth to yield food for man's nutrition, fiber for his clothes, wood to build and heat his houses, and other useful products, too numerous to mention.[80]

Fulbright told Galston that his testimony "ought to be brought to the attention of everybody in the country." The two thereupon engaged in a lengthy philosophical dialogue covering Louis XIV, humankind's vanity, and the foreign policy of Sweden, among other topics.

In addition to enlivening the hearings – otherwise largely devoted to a debate on the arcana of treaty law – the inclusion of an ecological perspective provided the Senate committee with a logic militating against a restrictive interpretation for which the Nixon administration could not rebut. Galston and his colleagues had effectively reimagined the meaning of herbicidal warfare in a way that effectively separated the issue of herbicidal warfare from the question of its utility in counterinsurgency. The scientific objection to herbicides in war framed the issue as one of unmitigated human and natural devastation, and in so doing, upstaged the rhetoric of utilitarian tactical expedience advanced by the defenders of Operation Ranch Hand. The ratification debate on the Geneva Protocol thus touched on an issue that was to become ever more prominent in the years that followed: is it possible to find a balance between technological innovation, economic growth, and environmental protection? There were, of course, no easy answers to this question, but the Geneva Protocol clarified the existence of these tensions.

On behalf of the Foreign Relations Committee, Fulbright wrote to the president on April 15, 1971, urging the White House to reconsider its restrictive interpretation of the Geneva Protocol. Although Fulbright expressed his admiration for the great strides Nixon had taken in the field of disarmament – and for resubmitting the protocol in the first place – he made clear that the White House was isolated: its position on herbicides and riot-control agents ran against the grain of world opinion and was counterproductive to the basic goal of nonproliferation. Crucially, Fulbright admitted that it was not clear legally who had the authority to define the scope of the Geneva Protocol. What was totally clear, he emphasized, was that herbicides were utterly frightening from an environmental perspective and should be banned absolutely for all time. Fulbright closed the letter with an appeal to Nixon's ego and political instincts:

> If the administration were to take the longer and broader view of our own interests, I cannot imagine any serious opposition to that decision, either here at home or

80 Ibid., 325–6.

abroad. On the contrary, I personally believe that were you to take this initiative your action would be regarded as truly courageous and possessed of real moral force.[81]

The White House offered no immediate response to Fulbright or to the Senate resolutions and calls from members of Congress urging the administration to abandon its interpretation of the protocol in the interest of rapid ratification.[82] Instead, the administration chose to retrench until it could counter with the results of new fact-finding missions already underway. In January 1971, the president had ordered a major review of all chemicals used in the Vietnam War with regard to military utility, environmental effects, and international and domestic political liabilities.[83] Although Congress had ordered the National Academy of Sciences to conduct its own survey of herbicidal warfare in October 1970, the White House wanted an internal report before the completion of the NAS study, which was not scheduled for release until 1974.[84] The National Security Council summarized the preliminary findings in September. That report again underscored the military utility of herbicides and tear gas while acknowledging the political liabilities associated with the use of any chemicals in war. It was also the first memorandum to explore seriously the pros and cons of acceding to Fulbright's advice, although the administration gave no indication either in public or in its private consultations with the Foreign Relations Committee that it might back away from its position.[85]

Transcripts of Senate hearings are customarily printed and available to the public shortly after the hearings conclude. But Fulbright delayed publication of the testimony on the Geneva Protocol for a year and a half, until

81 William Fulbright, Letter to President Nixon, April 15, 1971, J. William Fulbright Papers, Series 71, Box 32, Folder 21, University of Arkansas Libraries, Fayetteville. (Thanks to Vera Ekechukwu, Fulbright Papers Archivist, for locating this letter.)

82 Senate Resolutions 154 and 158 reprinted in Committee on Foreign Relations, *The Geneva Protocol of 1925*, 436–9.

83 National Security Council, National Security Study Memorandum 112, "U.S. Post-Vietnam Policy on Use of Riot-Control Agents and Herbicides in War," available from DNSA.

84 By 1970, the directors of the NAS had found that the herbicide issue had become too controversial and well known to ignore, and they promptly consented to lead an exhaustive research project in Vietnam. The four-year study produced a massive, two-part report. National Academy of Sciences, *The Effects of Herbicides in South Vietnam; Part A: Summary and Conclusions and Part B: Working Papers: Beliefs, Attitudes, and Behavior of Lowland Vietnamese* (Washington, D.C., 1974). The study arrived at a late juncture during the legislative impasse; therefore, its highly critical conclusions of the ecological havoc wreaked by Operation Ranch Hand served mainly to vindicate both the AAAS report and the individual scientists who had called for a major study eight years earlier. A good summary of the report is provided by John W. Finney, "Vietnam Defoliation Study Sees Effect of 100 Years," *New York Times*, February 22, 1974.

85 National Security Council, Memorandum, "Interdisciplinary Political-Military Group's Final Report of the Geneva Protocol of 1925," September 8, 1971, available from DNSA.

August 1972, when it seemed clear that the administration was unlikely to budge from its position. The release of the hearing transcripts in itself thus became a political act; Fulbright hoped to reignite the debate, especially because the Bacteriological Convention on Disarmament had recently concluded and the White House had submitted the resolution to the Senate for ratification.[86] Although the destruction of U.S. bacteriological stocks announced in Nixon's policy initiative of November 1969 aligned U.S. policy with the convention, the Senate Foreign Relations Committee made ratification dependent on finding a solution to the impasse on the Geneva Protocol. By late 1972, then, the Nixon administration's entire strategy on chemical and biological weapons was stalled and would remain so until the president's resignation in August 1974. Rather than serve as a beacon of Nixon's détente policies, the Geneva Protocol had become an early sign of a presidency in crisis.

In late 1974, President Gerald Ford renewed efforts to find common ground on the Geneva Protocol with the Foreign Relations Committee as part of a larger initiative to move beyond what the new president had famously called "our long national nightmare." Significantly, the White House did not send Kissinger to represent the administration before the committee; as the main symbol of Nixonian continuity, Kissinger was too polarizing a figure, and in any event, defending policy to Congress had never been his strong suit. Instead, Ford dispatched Fred Ikle, the director of the Arms Control and Disarmament Agency, to strike a compromise. Ikle presented an option that had actually been developed by the National Security Council in April 1974 while Nixon was still in office.[87] On December 10, Ikle informed the Foreign Relations Committee that the White House was prepared "to renounce as a matter of national policy" first use of chemical herbicides and riot-control agents in war, with the reservations that herbicides could still be used around the perimeter of U.S. bases for defensive purposes and that riot-control agents might be employed in humanitarian missions, such as hostage rescue operations, and as an alternative to shooting rioting prisoners of war.[88] These reservations were a clear sign that the Pentagon still firmly believed that the tactical utility of these weapons outweighed the political costs their use entailed. The phrase "matter of

86 William Fulbright, introductory note, Committee on Foreign Relations, *The Geneva Protocol of 1925*, iii–iv.

87 U.S. Department of State, Memorandum for Major General Brent Scowcroft, "Ad Hoc Group Report on U.S. Policy toward the 1925 Geneva Protocol," April 25, 1974, available from DNSA.

88 The full list of reservations can be found in President of the United States, "Executive Order 11850 – Renunciation of Certain Uses in War of Chemical Herbicides and Riot Control Agents, 5 April 1975." The full text is available at *The American Presidency Project*, University of California, Santa Barbara, http://www.presidency.ucsb.edu/ws/?pid=59189.

national policy" avoided an explicit legal acknowledgment that the Geneva Protocol prohibits the first use of herbicides and riot-control agents. The Ford administration was not prepared to break completely with its predecessor's interpretation of the Geneva Protocol – and thereby effectively admit that the United States had violated it. Although the phrasing deliberately avoided legally binding language, Ikle was able to convince skeptical Foreign Relations Committee members that the White House position

> will be inextricably linked with the history of the Senate consent to ratification of the protocol with its consent dependent upon its observance. If a future administration should change this policy without Senate consent whether in practice or by a formal policy change, it would be inconsistent with the history of the ratification, and could have extremely grave political repercussions and as a result is extremely unlikely to happen.[89]

The committee agreed with this political forecast and voted unanimously to bring the resolutions on Geneva Protocol and the Biological Weapons Convention before the Senate. On December 16, the Senate unanimously approved both. On January 22, 1975, Ford signed the instruments of ratification of the Geneva Protocol, nearly fifty years after the United States first proposed it. Two years later, the remaining stocks of Agent Orange were incinerated near Johnston Atoll in the Pacific Ocean. Since then, herbicides have not played a major role in any war.

CONCLUSION

Like many international treaties, the Geneva Protocol relies on vague language to encourage countries to adopt it and abide by its provisions. Consequently, the price over time of the increasing number of ratifying nations has been the degradation of the protocol's capacity to establish clear guidelines of what is and is not acceptable international behavior. The Nixon administration's narrow reading of the Geneva Protocol was not unique: a majority of nations party to the treaty have issued reservations that in some way depart from the protocol's absolute ban on "asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices."[90]

89 Statement reprinted in U.S. Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: Texts and History of Negotiations*, 1977 ed. (Washington, D.C., 1978).

90 Of the 133 nations that have ratified the Geneva Protocol, 92 have issued formal reservations against a ban on the retaliatory use of chemical and biological weapons. It is noteworthy that Vietnam ratified the protocol in December 1980 with a reservation nearly identical to that submitted by the United States in 1975. For a complete list of all member states and explanatory notes, see Stockholm Peace Research Institute, http://www.sipri.org/contents/cbwarfare/cbw_research_doc/cbw_historical/cbw-hist-geneva-parties.html.

From a purely legal perspective, the question on the prohibitory scope of riot control agents and herbicides in war was essentially a gray zone. John Norton Moore, author of the definitive legal analysis of the Geneva Protocol (written in the middle of the impasse between the White House and Foreign Relations Committee) concluded:

> It is important for the Executive and the Senate to reach agreement on a policy for riot-control agents and chemical herbicides as soon as possible. As a starting point both might candidly admit that there is no authoritative interpretation on whether riot-control agents and chemical herbicides are included in the protocol. . . . Both the Administration and the Senate might also agree that in view of the importance of promoting widespread international agreement on the interpretation of the protocol, the United States will support international consideration of the issues, preferably through an international conference but if that proves impractical, through submission through the International Court of Justice.[91]

The point is that legal positions on binding international agreements like that proffered by the Nixon administration tend to focus narrowly (but not illegitimately) on a given treaty's stated prohibitory parameters to the exclusion of the political context in which that treaty came into being. The negotiating parties that convened in Geneva in 1925 recognized the need for an international mechanism to place limits on the production of chemical and biological weapons and deter states from unleashing them in war. Similarly, the scientists who first called on the AAAS to investigate Operation Ranch Hand saw the need for a mechanism to ban herbicidal weapons. The opportunity to make the Geneva Protocol that mechanism came when the Nixon administration, badly miscalculating, submitted the protocol to the Senate for ratification. The scientists and their allies in Congress ultimately prevailed against the administration's efforts to curtail the scope of the protocol. For them, "No more Vietnams!" was a rallying cry both for peace and environmental protection.

91 John Norton Moore, "Ratification on the Geneva Protocol on Gas and Bacteriological Warfare: A Legal and Political Analysis" *Virginia Law Review* 58 (March 1972): 419–509.

9

Environmental Crisis and Soft Politics

Détente and the Global Environment, 1968–1975

KAI HÜNEMÖRDER

In the late 1960s, as international discourse on global and transborder environmental problems was rapidly developing, the Cold War still divided many of the world's industrialized nations. Slogans and metaphors like "Only One Earth" and "Spaceship Earth" spread around the world. The dynamism of global environmental discourse in the early 1970s has been explained in a variety of ways. Some observers stress the eye-opening effect of books like Rachel Carson's *Silent Spring* and the Club of Rome's *The Limits to Growth*. Others point to the spread of new values.[1] The connection at that time between concern for the future of the global environment and the rhetoric of East-West political cooperation has not yet received scholarly attention. When governments in the densely populated countries along the Iron Curtain became more willing to address international problems, they focused on combating marine pollution in the Baltic Sea and the North Sea and on air and river pollution in border regions.

The two German states were deeply involved in these issues. By using West German archival records, this essay tries to assess the influence of détente as a factor in the emergence of environmental issues as factors in Bonn's foreign policy. It seeks to show how attempts were made to develop the environmental question into an integral component of the policy of détente. The new buzzwords *environmental protection* and *environmental crisis* offered governments on both sides of the Iron Curtain a unique opportunity to bridge the ideological divide and to demonstrate their willingness to cooperate.

1 Ronald Inglehart, "The Silent Revolution in Europe. Intergenerational Change in Post-Industrial Societies," *American Political Review* 65 (1971): 991–1017.

I would like to thank Corinna Unger and David Lazar for correcting my English.

The story of détente has usually been cast as the search of a way to change the Cold War status quo.[2] It sought to achieve a relaxation of tensions above all for political reasons. I argue that the policy of détente gave also birth to a particular rhetoric about international environmental politics. By stressing common problems like the pollution of the world's oceans in public, politicians on both sides of the East-West divide tried to use environmental threats as a vehicle for normalizing international relations. Whereas bilateral talks on limiting strategic nuclear weapons had to be conducted outside of public view, the rhetoric of shared global challenges allowed Western governments to publicize their willingness to negotiate with the Eastern bloc states. Because high officials trained in environmental sciences were involved on both sides in multilateral diplomatic initiatives, environmental issues took on an importance of their own alongside international political questions. This resulted in a new form of environmental diplomacy that was centered on huge conferences with intensive media coverage. The rhetoric employed at such gatherings and the predictions about the future routinely offered at them served, in turn, to spur public concern about the environment and to bolster environmental activism.

This chapter traces the Federal Republic of Germany's preparations for multilateral conferences to shed light on the relationship between soft politics and the policy of détente. It focuses on the period from the time of the Swedish suggestion to hold a United Nations environmental conference in 1968 up to the signing of the final accord of the Conference on Security and Co-operation in Europe (CSCE). In the first section, I sketch the evolution of a new rhetoric in dealing with common environmental threats in the West and the East during the preparation of the United Nations Conference on the Human Environment (UNCHE). I then analyze the incorporation of environmental objectives under the umbrella of international relations goals in West Germany's preparations for the CSCE negotiations. The Helsinki Agreement of 1975 represents both a significant landmark in the history of détente and an impressive example of how soft politics and foreign policy goals merged.

Looking at the relevance of the Iron Curtain itself for the cleanup of the environment, it becomes clear that the international conferences and the CSCE process forced foreign policy officials above all in the Federal Republic and the German Democratic Republic (GDR) to address cross-border

2 Robert S. Litwak, *Détente and the Nixon Doctrine: American Foreign Policy and the Pursuit of Stability, 1969–1976* (Cambridge, 1984); Wilfried Loth, *Overcoming the Cold War: A History of Détente, 1950–1991* (Chippenham, 2002); Anne de Tinguy, *US-Soviet Relations during the Détente* (New York, 1999).

environmental problems in tandem with high-priority foreign policy issues. As we will see, the linkage did not work entirely on account of the incompatible priorities of the West German Foreign Office and the Ministry of the Interior.

ENVIRONMENTAL ISSUES AND INTERNATIONAL RELATIONS

The history of the Cold War has been described as "a fluctuating evolution of tension and détente within an overall balance of terror, with occasional crises and local wars by proxy, and with mutual stop-go arms control policies."[3] In the 1960s, the Cold War confrontation between the superpowers made clear important limits to the politics of threat and deterrence. Assisted by a handful of think tanks, the governments of the Soviet Union and the United States searched for ways to overcome the arms race and achieve a level of peaceful coexistence and international stability. Interrupted by the crushing of the Prague Spring in August 1968, a period of change in international relations began as the superpowers worked toward arms control and limited cooperation.

Environmental policy emerged as a field of international cooperation in the late 1960s. Neutral Sweden, for one, was highly concerned about new scientific findings about the impact of transborder pollution on its rivers and lakes. In 1968, it proposed an international conference on environmental issues under UN auspices. The United States quickly backed the proposal.[4] The Soviet Union first mentioned the necessity of international environmental cooperation in the Budapest Appeal of March 1969. In this document, the Political Advisory Committee of the Warsaw Pact states envisioned joint East-West projects in the fields of energy, transportation, water management, air quality, and public health. They stressed, however, that the prerequisite for such projects was the establishment of a

3 Øyvind Østerud, "Intersystemic Rivalry and International Order: Understanding the End of the Cold War," in *The End of the Cold War: Evaluating Theories of International Relations*, ed. Pierre Allan and Kjell Goldmann (Dordrecht, 1995), 12.

4 Since the 1970s, some authors have seen a connection between the constructive governmental environmental offensive of the United States and the environmental war in Vietnam. Between 1962 and 1970, nearly one-seventh of the area of South Vietnam was sprayed with huge amounts of herbicides, especially Agent Orange. This caused massive health and ecological problems lasting until today. On the military usage of herbicides and its results, see the report of the U.S. Senate, Committee on Foreign Relations, "Impact of the Vietnam War, Washington 1971," in *Quellentexte zur Geschichte der Umwelt von der Antike bis heute*, ed. Günter Bayerl; Ulrich Troitzsch, Göttingen (Zurich 1998), 425–6. See also Michael Kilian, "Umweltschutz," in *Handbuch Vereinte Nationen*, ed. Rüdiger Wolfrum, 2nd ed. (1991), 869; Knut Krusewitz, *Umweltkrieg. Militär, Ökologie, Gesellschaft* (Königstein im Taunus, 1985). For the connection between Cold War security policy and environmental warfare in Vietnam, see David Zierler's essay in this volume.

permanent European security system.[5] Both proposals were pushed forward through diplomatic channels of diplomacy quite intensively in the years that followed.

There had been limited technical cooperation across the Iron Curtain before 1968–9.[6] But it was difficult to extend the dialogue on strengthening environmental protection measures on account of the lack of political support in both the East and the West for doing so. That would, however, begin to change in the late 1960s as both the Western and the Eastern camps developed a rhetoric for talking about the environment in public.

THE PREPARATIONS FOR THE UNCHE

The story of the preparations for the United Nations Conference on the Human Environment has been told in detail elsewhere.[7] In 1968, the General Assembly of the United Nations adopted the proposal of the Economic and Social Council (ECOSOC) to hold a conference on global-scale environmental problems.[8] In the following three years or so, some member states began to deal with their national environmental problems systematically for the first time.[9] U Thant, UN secretary-general, called attention to the issue of environmental degradation and asked the delegates to address the increasing poisoning of the environment and the threat it posed to humanity.[10] Drawing on the national reports that had been submitted to the United Nations, the conference's secretary-general, Maurice Strong, presented a "mosaic of environmental dangers" to the press.[11]

5 Bundesarchiv [hereafter BA] Koblenz B 106/34921, "Wirtschaftliche Aspekte einer KSE-Dokumentation,"August 1971.

6 Among the institutions dealing with technical environmental problems since the 1950s and 1960s were the World Health Organization, the Food and Agriculture Organization, the International Union for the Conservation of Nature and Natural Resources, the UN Educational, Scientific and Cultural Organization, the World Meteorological Organization, and the European Council. For precursors such as on the international nature protection in the League of Nations, see Anna-Katharina Wöbse, "Der Schutz der Natur im Völkerbund – Anfänge einer Weltumweltpolitik," *Archiv für Sozialgeschichte* 43 (2003): 177–91.

7 See Kai F. Hünemörder, *Die Frühgeschichte der globalen Umweltkrise und die Formierung der deutschen Umweltpolitik (1950–1973)* (Stuttgart, 2004), 242–76.

8 BA Koblenz, B 106/29410, A/RES/2398 (XXIII), Dec. 6, 1968. See also Harald H. Bungarten and Josef Füllenbach, "Ansätze einer internationalen Umweltpolitik," in *Die Internationale Politik 1970–1972*, ed. Marion Gräfin Doenhoff, Karl Kaiser, Paul Noack, and Wolfgang Wagner (Munich, 1978), 35.

9 Harald H. Bungarten, *Umweltpolitik in Westeuropa. EG, internationale Organisationen und nationale Umweltpolitiken* (Bonn, 1978), 92.

10 Peter Menke-Glückert, Stockholm-Deklaration, in Otto Kimminich, Heinrich Freiherr von Lersner, and Peter-Christoph Storm, eds. *Handwörterbuch des Umweltrechts*, 2nd ed. (Berlin, 1994), vol. 2, 397; Kilian, "Umweltschutz," 869; "Das Gift frißt alles: Erde, Wald und Tiere," *Bild-Zeitung*, June 26, 1969.

11 "Das Trinkwasser von Lagos voller Fäkalien," *Stuttgarter Zeitung*, July 17, 1971.

The two German states were, of course, minor players in world politics, but the relations between them were seen as a potential area to break ground for détente. Bonn's Hallstein Doctrine – its claim to be the exclusive representative of Germany and its refusal to engage in diplomatic relations with any state that recognized the GDR – had negative consequences for humanitarian initiatives and environmental protection alike. In 1968, Western diplomats blocked the admission of the GDR to the World Health Organization at Bonn's urging.[12] An overture the following year by the Scandinavian countries on protecting the marine environment of the Baltic was postponed because of the question of the status of the GDR.[13]

After the change of government that brought the social democratic–liberal coalition led by Willy Brandt to power in the fall of 1969, Bonn tried to pursue a policy of "change through rapprochement" (*Wandel durch Annäherung*) in its dealings with the GDR and the other Eastern bloc states. This new *Ostpolitik* also affected the treatment of environmental questions. Speaking before the newly established NATO Committee on the Challenges of Modern Society some months later, Foreign Office State Secretary Ralf Dahrendorf declared, "We are examining the possibility of bringing environmental problems into the East-West dialogue."[14] Bonn supplemented this announcement by putting forward a number of suggestions to international organizations engaged in East-West cooperation and environmental information exchange such as the European Council and the UN Economic Commission for Europe (ECE). But it took years, not months, for Bonn to make the change from fighting recognition of the other German state to championing multilateral cooperation.[15] Until the two German states took a large step toward more normal relations by signing the breakthrough Basic Treaty in 1972, Bonn's Foreign Office continued to be preoccupied with the question of the GDR's legal status.

In contrast to the transborder cooperation in the Western hemisphere that had intensified since the 1950s, cooperation across the Iron Curtain remained weak. In the 1960s, the ECE became a forum for raising questions

12 *Akten zur Auswaertigen Politik der Bundesrepublik Deutschland* [hereafter *AAPD* 1968], vol. 1, doc. 164, 614–22.

13 BA Koblenz, B 106/55991. Despite the preoccupations of the West German Foreign Office, the GDR tried to raise an arrangement on mutual help against tanker accidents to a governmental agreement. The official in charge in the Ministry of the Interior commented on the harsh reaction of the Foreign Office, which did not sign the final record: "That's apparently the 'new German policy.' Then the subject has to be written off." In the following negotiations, the Soviet Union and Poland insisted on a formal agreement that included the GDR.

14 BA Koblenz, B 136/5308, report to Minister, Dec. 10, 1969; Dahrendorf, Apr. 13, 1970, Ausschuss zur Verbesserung der Umweltbedingungen A 431, in *Handbuch der NATO* (Frankfurt, 1969), 108.

15 Bulletin of the Press and Information Office, 1968, 1241; *AAPD* 1968, vol. 1.

about river and air pollution crossing the Iron Curtain. But when the ECE stated in 1969 that the improvement of environmental conditions was one of its four priorities, little real progress had yet been achieved.[16]

States on both sides of the Iron Curtain undertook careful preparations for the UN Conference on the Human Environment. In the Federal Republic of Germany, the jurisdiction of the Federal Ministry of the Interior was expanded to include environmental protection. Under the government's first environmental program, the ministry was made responsible for preparing for international environmental conferences as well as for seeking both national and international measures to address environmental problems.[17]

The main conference documents were prepared by a committee composed of delegates from all regions of the world. After – and, indeed, even before – the conference convened in the summer of 1972, the committee's preparatory work was called "the most important phase and most valuable result of the conference."[18] Eastern and Western countries condensed huge amounts of environmental information in an action plan and a draft declaration on the human environment. One working group dealt with "the planning and management of human settlement" and asked the conference secretariat to make concrete suggestions on "health, population distribution, excessive population growth in some countries and regions, water supply, sewage, waste disposal, the siting and management of industries, construction processes, housing and transport."[19] A second working group discussed the controversial subject of "development and environment." A third discussed the "identification and control of pollutants and nuisances of broad international significance," including the transformation and transport of pollutants in the atmosphere and man's impact on global climates. The draft documents the working groups prepared dealt with cooperative

16 From its founding in 1947, the ECE had acted as UN-instrument for regional multilateral cooperation in the field of economics and science. BA Koblenz, B 106/34923, CSCE/II/C.2/7, Executive Secretary of ECE: "Die Tätigkeit der Wirtschaftskommission für Europa 1947–1973," Nov. 2, 1973. It was not until the 1960s that the Western states changed their opposition to the treatment of water protection problems of international scale in the frame of the ECE. BA Koblenz, B 142/4958, letter from Bundesministerium für Atomenergie und Wasserwirtschaft [Federal Ministry for Atomic Energy and Water Management, hereafter BMAt] to Auswärtiges Amt [Foreign Office, hereafter AA], 17.7.1959. In 1970, the AA considered the ECE an appropriate institution for exchanging information between Western and Eastern industrialized countries and searching for common standards. BA Koblenz, B 106/25831, letter from AA to BMI, Nov. 9, 1970.

17 Frédéric P. Walthard, Internationale Koordination der Umweltschutzbestrebungen, in *Umweltschutz und Wirtschaftswachstum*, ed. Martin P. v. Walterskirchen (Frauenfeld, 1972), 289; "Umweltprogramm der Bundesregierung," in Bundesministerium des Inneren [Federal Ministry of the Interior, hereafter BMI], *Betrifft* 9 (Bonn, n.d.).

18 Bungarten and Fuellenbach, *Ansätze*, 35; See also Bungarten, *Umweltpolitik*, 140–1; United States Information Service, *Nur diese eine Erde* (Bonn, 1972), 9; published in English as *Only One Earth*.

19 Hauptstaatsarchiv [hereafter HStA] Düsseldorf, NW 455–718, A/CONF.48/PC.13, 15.

protection measures and coordinated national environmental initiatives, and they offered extensive data to foster a better understanding of the world's environment. The committee did not recommend that any responsibility for environmental protection should be transferred from member states to the United Nations, proposing instead that exchange of international environmental information should be given priority as a strategic goal.

As the working groups prepared for the conference, some national governments mounted public relation campaigns for the conference. The U.S. government, for example, distributed a booklet, *Only One Earth*, in several languages that shed light on the increasing use of limited raw materials. The pressure that consumption of natural resources was putting on the environment was, the booklet argued, a "threatening fact" that could jeopardize the well-being of future generations. Increasing energy consumption on an "astronomical scale" would not only deplete petroleum and coal reserves but also disturb the thermal levels of rivers and the atmosphere. "Hundreds of million tons of exhaust fumes and dust from five continents poison the atmosphere, the land and the sea," the booklet warned.[20]

Having spent decades trying to check communist influence and increase American power around the world, Washington called special attention to the fact that environmental problems transcended national borders. "For pollution and ecological degradation national borders do not count," *Only One Earth* observed. "The pollutants spread by wind and water and reach the whole world through rivers, lakes, and seas. In addition, local environmental problems run up to a level of dirty air and polluted water and reach a point through climatic change, loss of raw materials and resources, and degradation of the cities where new insights and new actions on regional and worldwide basis are necessary to protect the resources and environmental quality of our earth."[21]

Each of the superpowers, aware of the importance of the mass media in the East-West ideological competition, realized in the early 1970s that it had to transcend Cold War propaganda and find a new rhetorical style to demonstrate its responsible stance in international relations before a global public.[22] Even contemporary commentators took notice of this new style of speech. For example, the *Frankfurter Allgemeine Zeitung*, a prominent West German newspaper, published a comment on the connection

20 *Nur diese eine Erde*, 14–17.

21 Ibid., 5.

22 The Zentrum für Zeithistorische Forschung Potsdam has recently pointed out the central role of the mass media in the political strategies of the Cold War adversaries. See "European Cold War Cultures? Societies, Media and Cold War Experiences in East and West (1947–1990)," http://hsozkult.geschichte.hu-berlin.de/termine/id=5569.

between environmental protection and foreign policy in early March 1971. Global environmental problems, it argued, increased the need for treaties on cooperation between the Eastern and Western blocs. Increased cooperation could, in turn, help ease tensions between the rival blocs.[23]

Neither the necessity of adjusting their public comments nor the realization of the seriousness of international environmental problems prevented the rival superpowers from trying to instrumentalize environmental policy and the UN conference to achieve more fundamental political objectives, however. The Eastern bloc thus used environmental issues to put pressure on the West on the question of international recognition of the GDR. Stressing the humanitarian issues involved, the Soviet Union argued for broad participation and for allowing non-UN member states to participate throughout the preparations for the conference.[24] In September 1970, GDR Council of Ministers Vice Chairman Werner Titel requested that the GDR be invited to participate in the conference.[25] The GDR did not, however, receive an invitation to participate on equal footing with UN member states. Nevertheless, it prepared a national environmental report. "The neglect of environmental protection in Imperial Germany caused considerable delays in water treatment, air cleaning, the removal of garbage, and the restoration of soils devastated by capitalistic industry," the report maintained. "In addition, overcoming the consequences of the imperialistic Second World War, particularly the devastating destruction it caused, gave the GDR complicated economic tasks, which strained all capacity for reconstruction."[26]

The report gave the impression that East Germany had almost achieved its proclaimed goal of uniting environmental protection and socialism. Heavily polluting factories were to be shut down in the future. Environmental factors would be taken into account in the state's economic and social planning.[27] Speaking as a state in its own right in the report, the GDR voiced its interest

23 Nikolas Benckiser, "Umweltschutz und Außenpolitik," *Frankfurter Allgemeine Zeitung*, March 10, 1971.

24 BA Koblenz B 106/29410, report of Schnippenkoetter to AA about a UN committee meeting, Nov. 13, 1969; Vereinte Nationen 1 (1969), 22–3.

25 BA Koblenz, B 106/29410, copy of a letter of the German Embassy in Stockholm to AA, Oct. 10, 1970.

26 HStA Düsseldorf, NW 455–717, national report of the GDR for the UNCHE, Stockholm 1972. Although the Federal Republic of Germany suspected that the GDR would ride attacks in its report against the environmental problems in Western Germany, they abstained from this. HStA Düsseldorf, NW 455–716, forwarded letter by the BMI, Sept. 16, 1971. Given the effects of the world economic crisis of the middle of the 1970s, it turned out that the leaders of the GDR felt forced to keep important environmental data a secret, because they had failed to reduce the degradation of the environment.

27 Ibid.

in cooperating with other states as equals on environmental protection at the international level: "The German Democratic Republic acts from the insight that cleaning up water and air pollution and protecting the landscape have developed into worldwide problems that can only be solved through the participation of all states with equal rights on complex, interlocking measures."[28]

In the autumn of 1971, the maneuvering on conference participation gave way to open conflict after the UN General Assembly decided to issue invitations on the basis of the so-called Vienna formula.[29] West Germany received an invitation, but East Germany did not, which dealt a blow to détente. Subsequently, a planned governmental ECE conference on the environment was reduced to a "symposium of experts" on account of the GDR's status.[30] The experts and officials working on the preparations for the conference began to fear that the conference, too, might be downgraded.

After the UN Assembly's final decision on conference participation, the Soviet Union withdrew its delegates from all preparation committees.[31] It accused the Western powers of "fetching their attitude towards the participation of the GDR out of the archives of the Cold War."[32] The United States, Great Britain, and France countered that an official invitation would have changed the international status of the GDR and disrupted the ongoing bilateral German negotiations.[33] The three thus supported Australia's proposal that East Berlin send "experts" with observer status to the conference. This suggestion was rejected by the Eastern bloc states, and the Soviet Union and its Eastern European allies signaled that they would boycott the conference unless the GDR was invited.[34]

This turn of events placed considerable pressure on the Federal Republic.[35] Bonn used all of diplomatic channels to limit the impact of

28 Ibid.

29 HStA Düsseldorf, NW 455–720, A/RES.2850 (XXVI). For the Vienna Agreement of Apr. 18, 1961, see *Bundesgesetzblatt* 1964, part 2, 991–2. The Federal Republic's diplomats were in favor of this decision. HStA Düsseldorf, NW 455–716, forwarded letter by the BMI, Sept. 16, 1971.

30 BA Koblenz, B 106/25831, wire decree, Apr. 26, 1971; BA Koblenz, B 106/29306; "BRD-Störversuche in Genf gescheitert," *Neues Deutschland*, Apr. 30, 1971. For the proceedings, see BA Koblenz, B 106/29306, "ECE Symposium on Problems Relating to Environment," October 1971; see also Werner Gruhn, "Umweltschutz in der DDR," *Deutschland Archiv* 5 (1972): 1050.

31 "Smog over Stockholm," *Economist*, October 25, 1971.

32 "Heftiger Streit um die DDR," *Frankfurter Allgemeine Zeitung*, Dec. 4, 1971 .

33 "Abfuhr fuer die DDR in den Vereinten Nationen," *Neue Zürcher Zeitung*, Dec. 23, 1971; "DDR nicht zur Umweltkonferenz," *Frankfurter Allgemeine Zeitung*, Dec. 22, 1971.

34 *Neue Zürcher Zeitung*, Dec. 23, 1971.

35 "Bonner Sorgen um Umweltkonferenz,"*Süddeutsche Zeitung*, Jan. 4, 1972; "Dänemark als treibende Kraft fuer die DDR-Anerkennung," *Frankfurter Allgemeine Zeitung*, Apr. 22, 1972; "Westmächte: DDR nicht stimmberechtigt," *Frankfurter Allgemeine Zeitung*, March 13, 1972.

the Eastern boycott.[36] Sweden, the host of the conference, reacted with dismay to Bonn's stance.[37] Nordic environmental problems such as the pollution of the Baltic Sea were not likely to be solved if the Eastern European countries opted not to attend the conference.[38]

Despite further diplomatic efforts, nearly all of the Eastern European countries did in the end boycott the conference, calling the West's efforts to exclude the GDR an act of "direct sabotage of the future international co-operation on the field of the environment."[39] In this instance, the new environmental rhetoric ran up against the competing foreign policy goals of the Eastern and Western blocs. The nonparticipating Eastern states, in turn, did not officially recognize Principle 21 of the Stockholm Declaration, which affirmed, "States have . . . the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[40] One of the core goals of conference host Sweden thus went unfulfilled.

THE PREPARATIONS FOR THE CONFERENCE ON SECURITY AND COOPERATION IN EUROPE

The Soviet Union did not cease to stress the need for international environmental protection but proposed that the subject should be addressed at a common European Conference on Security and Cooperation. When the Federal Republic and the GDR set out the general terms of their dealings with one another in the December 1972 Basic Treaty, the conflict over the international status of the GDR was removed and the way was open for an international agreement on environmental cooperation.[41]

36 HStA Düsseldorf, NW 455–721, Telex of Schnippenkoetter to AA, May 3, 1972. The foreign minister of the GDR Winzer met with Maurice Strong to influence him directly.

37 "Boykottiert der Ostblock die Umweltkonferenz?" *Frankfurter Allgemeine Zeitung*, Jan. 7, 1972.

38 Günther Graffenberger, "Die Spanne zwischen Hälle und Paradies," *Die Presse* (Vienna), Feb. 19–20, 1972; "Vorbereitung einer UNO-Erklärung ueber Umweltprobleme," *Neue Zürcher Zeitung*, Jan. 15, 1972; "Auf der letzten Etappe ein Fahrrad für Genscher," *Frankfurter Rundschau*, Feb. 11, 1972; cf. *Britische Nachrichten* 4 (1972), ed. British Embassy (Bonn, 1972), 1.

39 *Sowjetunion heute*, April 1972: quoted in *Mensch in der Natur*, Apr. 26, 1972, 4. See also "Moskau droht mit Boykott der Umweltschutz-Konferenz," *Die Welt*, Apr. 1–2, 1972; "Der angedrohte sowjetische Boykott der Umweltkonferenz," *Neue Zürcher Zeitung*, Apr. 6, 1972. Douglas Weiner is mistaken in claiming that "the USSR was well represented at Stockholm in 1972": Douglas R. Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachev* (Berkeley, Calif., 1999), 402.

40 Declaration of the UN Conference on the Human Environment (1972), http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=97&ArticleID=1503.

41 Since May 1970, the NATO Council of Ministers had communicated progress in this field and about the Berlin status as cornerstone for beginning multilateral negotiations on security and cooperation. See *AAPD* 1975, vol. 1, doc. 109, 488–91.

The CSCE preparations covered a wide range of issues policies. The plans to broaden economic, scientific, technical, and environmental exchange rested on the premise that economic cooperation would contribute to the peace and security of Europe and the world as a whole.[42] In the scholarly literature on the CSCE, attention to the crucial role of the CSCE in making an issue of human rights has overshadowed the importance of the environmental question as a point on which the rival blocs had the possibility to bridge their ideological trench warfare. The remainder of this essay thus examines the treatment of transborder and global environmental issues in the CSCE negotiations, focusing on the actions of the Western camp.

The Soviet call for a European security conference in the 1969 Budapest Appeal gave renewed currency to an idea first put forward in the 1950s. The Warsaw Pact states emphasized in the late 1960s that cooperation among European states should take place "independently of their social order" and "on the basis of equality, of respect for the interdependence and sovereignty of the states."[43] Soviet leader Leonid Brezhnev affirmed his willingness to work with the West in a speech at the twenty-fourth conference of the Communist Party of the Soviet Union: "Our country is ready to cooperate together with other interested states in order to solve such problems like environmental protection, and to develop sources of energy and other natural resources."[44]

In the following years, the Central Committee and the Council of Ministers adopted a set of environmental protection measures, thereby acknowledging for the first time that the Soviet Union faced environmental problems.[45] The problems ranged from soil erosion in the countryside to air pollution in the industrialized areas. The threats to Lake Baikal became a symbol of international importance. Cleanup efforts were accompanied by propaganda campaigns. Leading Soviet scientists presented environmental protection as an area in which central planning would demonstrate its efficiency. Comparing the situation in the East and the West, they maintained, "The societal circumstances under Socialism and the socialistic state ownership of the land . . . are a solid basis for the best usage of the natural riches

42 Peter Schlotter, *Die KSZE im Ost-West-Konflikt: Wirkung einer internationalen Institution* (Frankfurt am Main, 1999), 263.

43 Loth, *Overcoming*, 2. Thanks to Cornelia Fabian for collecting additional literature on the CSCE.

44 *Mensch in der Natur*, Apr. 8, 1971, 1. On the history of the plans for a European security conference following Soviet foreign minister Vyacheslav Molotov's first suggested the idea in January 1954, see Wilfried Loth, *Helsinki, 1. August 1975. Entspannung und Abrüstung* (Munich, 1998), 9–10.

45 "Über die Verstärkung und die Verbesserung der Nutzung der natürlichen Ressourcen in der UdSSR," *Sowjetwissenschaft. Gesellschaftswissenschaftliche Beitraege* 3 (1973): 225 (translation of an article from *Pravda*, Jan. 10, 1973).

and effective environmental protection. . . . In contrast, private ownership of natural wealth . . . leads to overexploitation of nature."[46]

This argument reflected both the growing awareness of environmental issues in the early 1970s and the persistence of Cold War ideologies. During the preparatory negotiations for the CSCE, ideological rivalry generally prevailed over commitment to protecting the environment.[47] The idea of peaceful coexistence excluded a direct war between the superpowers but not an ongoing competition on a whole range of issues. The Soviet scientists who played an important role in this battle envisioned a strategy of long-term planning that would include worldwide standards for environmental protection, provisions for supervision to assure adherence to those standards, and centrally planned international distribution of raw materials. They also advocated regulated population growth throughout the world and the creation of international guidelines to secure social and economic stability. Individual nations would have to adapt their policies to those guidelines.[48]

The idea that economic planning could curb the negative effects of growth also gained adherents in Western Europe. Alluding to the Club of Rome's first report, for example, Sicco Mansholt, vice president of the Commission of the European Community, urged the creation of a "European central plan" in an open letter to the commission's president in 1972.[49]

The prominent Soviet geophysicist Yevgeny Fedorov was familiar with the findings of the Club of Rome experts, but he drew different conclusions. Not the "reactionary idea of a global balance," he argued, but the establishment of socialism throughout the world would banish the threat of a crisis in humanity's relationship to nature. It was nonetheless necessary, Fedorov acknowledged, to implement immediate measures "under the circumstances of peaceful coexistence between states with different social order."[50]

As I argued in my book on the early history of the global environmental crisis, American and West German environmental policies were

46 Jewgeni Fjodorow, "Aktuelle Probleme der Wechselwirkung zwischen Gesellschaft und Umwelt," *Sowjetwissenschaft. Gesellschaftswissenschaftliche Beitraege* 3 (1973): 239–51 (translation of an article from *Kommunist* 14 [1972]). See also N. Fedorenko and K. Gofman, "Rationelle Gestaltung der Umwelt als Problem der optimalen Planung und Leitung," ibid., 229.

47 Østerud, *Rivalry*, 13.

48 HStA Düsseldorf, NW 455–716, report of the German embassy in Washington to AA, Aug. 4, 1971.

49 "Leitgedanken für Europa und die Welt," *Frankfurter Rundschau*, Apr. 26, 1972.

50 Fjodorow, "Aktuelle Probleme," 250–1. Later, Fjodorow weakened the ideological interpretation of the environmental crisis claiming an effective international cooperation. See Jewgeni Fjodorow, "Einige Internationale Aspekte der Veränderung der Umwelt," *Deutsche Außenpolitik* 21 (1976): 384–97 (translation from an article in *Kommunist* 13 [1975]).

deeply influenced by scientific projections of long-term environmental degradation.[51] That research also influenced the form that interbloc cooperation on the environment took. Talks about a joint American-Soviet think tank resulted in the establishment of the International Institute for Applied Systems Analysis near Vienna in October 1972.[52] Eastern and Western scientists are still working there today on complex global environmental and energy issues.

Despite continuing disagreement on the status of the GDR, the bilateral détente between the superpowers opened the way for practical cooperation on environmental questions. In May 1972, Nixon and Soviet President Nikolai Podgorny signed a treaty on American-Soviet cooperation that included a provision for collaborating on reducing air and water pollution in Moscow.[53] This agreement reflected the superpowers' desire to improve and regularize communication between them.[54]

Three months after the treaty signing, Innokenti Gerassimov, the director of the National Committee of Soviet Geographers and the Geographical Institute of the Soviet Union's Academy of Sciences, suggested putting environmental problems on the agenda of a European security conference again.[55] Recently, Douglas R. Weiner has ascertained that this academy and even the All-Russian Society for the Protection of Nature had tight links to Soviet foreign policy strategists and supported "the Soviet regime's game of image-making."[56]

Although it was not until summer 1973 that the thirty-five participating countries, including the United States and Canada, reached agreement to start the CSCE process, the West's diplomatic preparations dated back to the beginning of the decade. In December 1970, the West German Foreign Office informed the minister of the interior on the results of the East-West talks on holding a European security conference. To avoid creating new

51 Hünemoerder, *Frühgeschichte*, 201–26.

52 "U.S., Russia, Other Countries Start 'Think Tank' for Peace," *International Herald Tribune*, Oct. 6, 1972; "In Laxenburg schweigen die Ideologen," *Die Presse* (Vienna), Oct. 16, 1972; Willem L. Oltmans, ed., *"Die Grenzen des Wachstums." Pro und Contra* (Reinbek bei Hamburg), 7.

53 "Zwei Abkommen als Auftakt der Besprechungen Nixons in Moskau, "*Frankfurter Allgemeine Zeitung*, May 24, 1972. In addition to the general topic "influence of environmental changes on climate," a confidential annex specified that this included "the study of carbon dioxide, carbon monoxide, oxygen and ozone balance in the atmosphere, the role of suspended dust in the atmosphere and reflectivity of the earth, as well as local climatic changes to urbanisation." BA Koblenz B 106/29303.

54 De Tinguy, *US-Soviet Relations*, 77.

55 *Sowjetunion heute*, August 1972, cited in *Mensch* in *der Natur*, Aug. 31, 1972, 1. Gerassimov had led the Soviet delegation to the international biosphere conference 1968 in Paris. See UNESCO, ed., *Use and Conservation of the Biosphere. Proceedings of the Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere* (Paris, 1970), 266.

56 Weiner, *Corner*, 402–4.

bones of contention between the member states of the European Community and NATO, all suggestions were discussed in the Community's new political committee and the NATO's Western caucus beforehand.[57] The first list of possible topics included, in addition to nonaggression, a proposal to work together more closely on environmental problems. The West German Ministry of the Interior, which was responsible for environmental matters at that time, was therefore asked to assist with the preparations.[58] The ministry, in response, drafted a list of specific issues the CSCE might consider: reducing sulfur emissions, substituting phosphate in detergents, eliminating waste-containing polyvinyl chloride (or PVC), and finding a solution to the problem of eutrophication of inland waters.

The ministry hoped that the proposed talks would result in the establishment of international standards on these issues. In sharp contrast to the 1980s, environmental issues were seen at that time as "neutral topics without political implications."[59] One of the leading officials in the Ministry of the Interior concerned with international environmental questions was Peter Menke-Glueckert. He strongly believed in environmental planning and understood diplomacy. He tried, therefore, to push forward proposals for concrete projects for cooperation on the environment. He believed that beginning joint projects immediately after the conference might help to show the public that the governments were taking cooperation seriously in practice.[60]

After endorsement by the European Community's political committee, the proposal to create a subcommittee on cooperation in environmental questions was sent to the Eastern camp. The EC member states were in general agreement on the goal of expanding their own social, cultural, and economic cooperation. They were also in favor of promoting a policy of détente with the Eastern European countries. Eager to see clear, measurable progress, the EC states wanted the CSCE to adopt precisely

57 On the workings of European political cooperation, see Götz Freiherr von Groll, "Das Debut auf der internationalen Bühne: Die Neun auf der KSZE," in *Die Europäische Politische Zusammenarbeit: Leistungsvermögen und Struktur der EPZ*, ed. Reinhardt Rummel and Wolfgang Wessels (Bonn, 1978), 121–37.

58 With regard to the attitude of the U.S. officials, the Foreign Office remained skeptical about the function of the CSCE, because it was feared that the conference would be used as a propaganda tool by the Soviet Union. BA Koblenz, B 106/34921, circular of AA, Dec. 21, 1970. Sometimes avoiding multilateral commitments, the United States put forward bilateral agreements.

59 BA Koblenz, B 106/34921, draft of a letter to AA, Sept. 22, 1971. The BML desired concrete technical cooperation in the field of nature and water protection. BA Koblenz, B 106/34921, letter from BML, Sept. 23, 1971. In addition to the governmental level, a BMI official proposed testing the willingness of the East to cooperate in solving environmental problems (e.g., in the Pugwash conferences). BA Koblenz, B 106/34921, protocol of a meeting in AA, Dec. 10, 1971.

60 BA Koblenz, B 106/34923, draft declaration of the German delegation to G/5, Nov. 2, 1973.

formulated declarations on every single topic of discussion.[61] The CSCE process reached its first summit with the foreign minister conference in July 1973. In the final recommendations for the planned Helsinki summit conference, the negotiators were assigned to discuss, for example, "questions of the protection and the improvement of the environment and to determine in particular those areas, which are . . . suitable for the development of co-operation . . . like the protection of European seas, waters and the atmosphere, improvement of the environmental and living conditions, particularly in the cities, protection of nature and its resources."[62]

By December 1973, three committees, eleven subcommittees, and two working groups had put forward more than 130 proposals for economic, cultural, and humanitarian cooperation.[63] Although there was little progress on certain issues – family reunification, for example, and advance notice of military maneuvers – despite hundreds of meetings, the subcommittee on the environment reached agreement relatively quickly.[64] Some officials of the West German Ministry of the Interior suspected the Soviet Union of trying to instill a "psychosis of acceleration"[65] to affect the other subcommittees. The subcommittee's agreement on the politically less controversial subject of the environment was later considered a "stimulating motor" for agreement on other, more disputed issues.[66] Although the negotiations went on for another one and a half years, the section of the CSCE Final Act on environmental protection was seen as a success. The Eastern bloc accepted the Western principles of international environmental policy for the first time. That gave rise to hopes in Bonn that cooperation with East Berlin on protecting German rivers might be possible.[67] Scandinavian environmental diplomacy was successful in using the call for specific projects to push for international action on cross-border air pollution; the result was a separate treaty that was signed a few years later.[68]

61 BA Koblenz, B 106/34923, confidential paper of the political committee of the EC: "CSCE: Goals and Strategies of the 'Nine,'" 1973.

62 BA Koblenz, B 106/34922, note in BMI, July 30, 1973.

63 *Süddeutsche Zeitung*, 14–15.12.1973 ("Wenn es in Genf ans Formulieren geht, werden die Differenzen voll aufbrechen").

64 BA Koblenz B 106/34924, report about a meeting in the AA, Dec. 17, 1973.

65 BA Koblenz B 106/34924, report about the state of the negotiations, Feb. 27, 1974.

66 BA Koblenz B 106/34925, report to the minister, May 27, 1974.

67 BA Koblenz B 106/34925, delegation report no. 773 to the AA, Jan. 27, 1975.

68 Norwegian negotiators stressed this issue in nearly every meeting of the new political committee of the EC and the CSE committees. In addition, the Danish side stressed the problem of long-range transport of air pollutants in its first comments to the German draft of the common "working paper environment." BA Koblenz, B 106/34922 (e.g., Telex to AA, Oct. 24, 1973), and "Possible Danish Contribution on Environment," Sept. 11, 1973. My thanks to the anonymous reader who reviewed this essay in manuscript for the reminder of the Scandinavian accomplishments.

The signing of the Helsinki Act, Peter Schlotter has argued, should be viewed as a modest but undeniable success for East–West cooperation on environmental policy.[69] The CSCE, he writes, gave its "political blessing" to cooperation in the framework.[70]

THE LIMITS TO COOPERATION

East and West Germany agreed in the Basic Treaty of 1972 to address technical and humanitarian issues in the process of normalizing their relations. In the field of environmental protection, the Basic Treaty stipulated that they would seek to reach agreements that contributed to protection for both against damage and risk.[71]

Before the Stockholm Conference, the West German delegation feared that the Eastern camp would use the conference to attack the state of the environment in West Germany before the world press. It therefore prepared a secret dossier about particular cases of environmental pollution in the Eastern bloc countries.[72] The scale of environmental degradation caused by heedless industrialization in the East differed in scale from that in the West but not in character. The report contained data about the problems of air pollution caused by the chemical industry in the Soviet Union, the pollution of the Volga from the discharge of industrial liquid waste, the pollution of many rivers by agricultural chemicals, the steady increase of water usage due to the industrialization of Siberia, and the inefficiency of the country's administration structures. The report drew attention to the problem of air pollution in the GDR caused by the use of brown coal and the soot generated by the chemical industry in the Leuna region, but it also mentioned the East German government's comprehensive plans to combat industrial pollution.

Bilateral negotiations on concrete transborder issues began in 1973. Although most of the rivers flowed from east to west across the Iron Curtain, the prevailing winds blew in the opposite direction. Bonn's chief priority was, accordingly, to reduce pollution levels in rivers such as the Elbe and the Werra. It expected that East Berlin would blame air pollution originating in the Federal Republic for environmental damage in the GDR. To secure an agreement on protecting rivers, the West German Ministry of the

69 Schlotter, *KSZE*, 275.
70 Schottler, *KSZE*, 272.
71 Art. 7 of the Grundlagenvertrag of Dec. 21, 1972, and additional protocol to the treaty about the basis of the relations between the Federal Republic of Germany and the GDR.
72 BA Koblenz, B 116/15251, paper "Environmental Pollution in the Sowjetblock (SOWB)."

Interior therefore suggested that negotiations begin with an open exchange of information on reducing air pollution.[73]

A special bone of contention was the exhaust produced by two power plants – one East German, the other West German – situated near the intra-German border. The brown-coal-fired plant at Harbke on the eastern side of the Iron Curtain emitted more than twenty times as much dust as the nearby plant at Offleben across the border. The Offleben plant was equipped with modern pollution-control technology; some of the Harbke plant's equipment, by contrast, dated from prewar days. At the same time, though, the Offleben facility emitted five times as much sulfur dioxide into the atmosphere than Harbke – 150,000 tons per year. Offleben's smokestacks, more than two hundred meters high, transported the problem to the East. Local residents on the western side of the border, consequently, were bothered only by the pollution caused by the Harbke plant.[74]

Another major problem was wastewater from an East German potash mine. As a result of the mining technique used, approximately 40 percent of the potash was diverted into the Werra River.[75] This caused a serious increase in the salinity of the river and prevented its waters from being used for other purposes.[76] Because of the policy of noncommunication under the Hallstein Doctrine, Bonn could not raise the issue of either Harbke or the pollution of the Werra with the East German authorities until after the signing of the Basic Treaty.

Progress on these issues might have been expected in connection with the CSCE process, but once again, foreign policy goals took precedence over environmental concerns. To test the new treaties with the GDR and the Four Power Agreement, Bonn decided to establish the Federal Environmental Agency in West Berlin. This was the first West German federal agency to be headquartered in the divided city that the GDR claimed as its capital, and the decision to locate it there was intended to demonstrate the political ties between West Berlin and the Federal Republic. This act was seen in the GDR as contrary to the spirit of normalization of relations. The GDR protested wherever representatives of the agency participated in international meetings – for example, of the ECE.[77] West German Foreign Minister Hans-Dietrich Genscher upheld the opinion that security and

73 BA Koblenz B 106/35838, letter in BMI, Nov. 16, 1973.

74 BA Koblenz B 106/35838.

75 BA Koblenz B 106/35838, Werra fact sheet.

76 On the ecological impact of the potash industry, see Jürgen Büschenfeld, *Flüsse und Kloaken. Umweltfragen im Zeitalter der Industrialisierung (1870–1918)* (Stuttgart, 1997), 400–6.

77 BA Koblenz B 106/34925, letter in BMI, Dec. 2, 1975.

cooperation had to be demonstrated even in the city that had been the scene of dangerous tensions in the years of the Cold War.[78] This conflict on the political choice of location for the new agency lasted for years.

CONCLUSION

The policy of détente forced politicians in the East and the West to search for issues that could be brought into the East–West dialogue. They sought issues that would facilitate the development of a common rhetoric, and for a couple of years, international environmental cooperation seemed to be such an issue. Invoking the slogan "Only One Earth" enabled the two superpowers to bridge, at least partially, the deep ideological gap dividing them. In contrast to matters of hard politics, like limiting strategic nuclear arms, that were dealt with in bilateral talks between the superpowers, soft issues such as the future of Earth made it possible for the superpowers to demonstrate their willingness to cooperate without having to shift their foreign policy priorities. This particular style of rhetoric and the use of frightening scenarios of the future awaiting humanity accelerated both public concern about the state of the environment in the early 1970s and the media coverage of it.

What lessons can be learned from the differences and similarities between environmental diplomacy and other détente efforts? First, the environmental question, with its international dimension, was a new subject in the early 1970s diplomacy. In sharp contrast to their ideological battles over economics and the free movement of the people, both camps shared the belief that severe environmental problems could not be solved without new forms of cooperation. Second, peace and security in Europe were seen in both the East and the West as a fundamental prerequisite for international environmental cooperation. By contrast, the West's efforts to address family reunion and other humanitarian issues in the CSCE process were regarded by the East as outside interference in internal matters. Third, the call for environmental cooperation made clear that easing political tensions was a process. As a global task, cleaning up the environment demonstrated the importance of close technical cooperation and scientific exchange within organizations like the ECE.

A backlash against the political process of dealing with the environment occurred in the mid-1970s. Environmental politics seemed to be simply too soft as a foundation for lasting détente. People increasingly realized

78 *AAPD* 1975, doc. 287, 1327–9.

that attention to the common interests of mankind did not necessarily serve national economic interests. Many countries experienced harsh economic downturns following the oil price shock of 1973, and many states were unwilling to take costly action on environmental and development issues under such circumstances.[79] The preparations for the UNCHE were marked by conflicts between industrialized and developing countries over the relationship between environmental protection and economic development, and over the question of financial responsibility for cleaning up the environment.[80] In the United Nations, the North-South conflict overshadowed the short-lived East-West unity on the environment. Even in the UN Environment Programme, the common problems of the industrialized north were given less priority.

Although the CSCE became a forum for bargaining, environmental questions lost their function as a door opener and environmental foreign policy discussions between the East and the West lost momentum. Détente, Øyvind Østerud notes, "seems to have declined rapidly from the mid-1970s because of the blind area left by lack of agreement on regional conflicts."[81] In 1979, the pendulum swung again from accommodation to tension in superpower relations. With the war in Afghanistan, a frosty new era in the Cold War began. Nevertheless, a European convention on transborder air pollution was signed in November 1979. This agreement marked an "atmospheric improvement" in environmental politics between the blocs,[82] and it was a first step toward translating the Norwegian government's argument that "the concept of security should also include security against degradation of the environment" into practice.[83] Ironically, environmental problems ceased to be a soft issue in the 1980s, as many industrialized nations grappled with economic stagnation. Although new environmental concerns had an impact on international relations but did not come to bear on the hard political issues of the Cold War in the early 1970s, a new wave of environmental activism around the world and environmental degradation in the

79 Bjoern-Ola Linnér, "The Cocoyoc Declaration. How It All Began: Global Efforts on Sustainable Development from Stockholm to Rio," Paper presented at the 6th Nordic Conference on Environmental Social Sciences, Abo, Finland, June 12–14, 2003, available at http://www.cid.harvard.edu/cidbiotech/events/selinlinnerpaper100603.doc.

80 Ibid.

81 Østerud, *Rivalry*, 19.

82 Schottler, *KSZE*, 274. On the preparation of the convention, see Ilka Bailey-Wiebke, "Gesamteuropäische Zusammenarbeit im Rahmen der ECE unter besonderer Berücksichtigung des Umweltbereichs," in Deutsche Gesellschaft für Friedens- und Konfliktforschung, *DGFK-Jahrbuch 1979/80. Zur Entspannungspolitik in Europa* (Baden-Baden, 1980), 597–608.

83 BA Koblenz, B 106/34922, Statement to the working paper for the CSE environment of the Norwegian Government, Sept. 28, 1973. Scandinavian environmental diplomacy succeeded in maneuvering around Cold War hurdles to address sulfur contamination of Scandinavian lakes.

Soviet Union contributed to a fundamental change in East-West relations. To be sure, these second-wave activists came from environmental groups and took action on the streets, not within governmental institutions. But in 1987, the Soviet leader Mikhail Gorbachev engaged in a public dialogue on environmental issues with the famed dissident Andrei Sakharov.[84] Environmental issues were on the agenda at the CSCE follow-up conference in Vienna that same year. The Vienna meeting produced agreements on reducing sulfur emissions and protecting the ozone layer. In addition, the member states were asked to draw up bilateral and multilateral programs to reduce the pollution of seas and coastal areas and to control the transborder transport of toxic and industrial waste. Two years later, the Bulgarian oppositional group Eco-Glasnost used the attention of international media to demonstrate its protest against some projects of its government.[85]

After the end of the Cold War, climate protection developed into a cornerstone of environmental international diplomacy. Admittedly, the lines of this severe conflict differ from the pattern of the early 1970s.

84 Michail Gorbatschow, "Für eine Welt ohne Kernwaffen und das Überleben der Menschheit," *Tageszeitung*, Feb. 17, 1987; see also the accompanying article, Erich Rathfelder, "Gorbatschows 'Neues Denken.'"

85 On other use of the CSCE framework by independent movements, see U.S. Helsinki Watch Group, *From Below: Independent Peace and Environmental Movements in Eastern Europe and the USSR* (New York, 1987).

PART III

Environmentalisms

10

The New Ecology of Power

Julian and Aldous Huxley in the Cold War Era

R. S. DEESE

In the historiography of the Cold War era, it has long been standard to examine the contentious period following 1945 primarily within the framework of such hard-power narratives as the advent of nuclear weaponry, the strategic division of Europe, and the catalog of proxy conflicts between the Eastern and Western blocs throughout the postcolonial world. Some aspects of soft power, such as cultural prestige and economic largesse, have steadily gained prominence in recent decades. However, in assessing the impact of the biologist Julian Huxley and the novelist Aldous Huxley on the emergence of a global environmentalist movement during the Cold War era, it is necessary to consider a third variety of power, first identified by the economist Kenneth Boulding as "integrative power," the history of which is interwoven with, though distinct from, the strategic and economic aspirations of empires and nations states.[1] In defining and distinguishing integrative power, Akira Iriye writes: "Destructive power entails the use or the threat of force to achieve one's objectives. Productive power works through exchange and economic activity. Integrative power is social and expressed through mutual affection."[2] As public intellectuals with a global audience, both of the Huxley brothers tended to frame their views on the social and political questions of the Cold War era in the integrative language of ecology. Their common tendency to employ metaphors and terms from the life sciences while generally eschewing the contemporary vocabulary of communism and anticommunism may be one of the factors that rendered their work less than au courant amid the ideologically charged culture wars of the mid- to late-twentieth century. Julian and Aldous Huxley managed to ignore many of the ideological shibboleths of Cold War discourse and to

1 Kenneth E. Boulding, *Three Faces of Power* (Newbury Park, Calif., 1989), 171–86.
2 Akira Iriye, "A Century of NGOs," in *The Ambiguous Legacy: U.S. Foreign Relations in the "American Century*, ed. Michael Hogan (Cambridge, 1999), 426.

highlight instead the ecological context in which this global competition for power and influence was taking place. Primarily for this reason, their contemporary discourse on the Cold War era has managed to retain an enduring and sometimes even prophetic salience amid the tightly interwoven ecological and political crises of the early twenty-first century.[3]

In some key respects, both of the Huxley brothers witnessed the beginnings of a broader public acceptance of their ecological ideas during their own lifetimes. By the time Aldous Huxley died in 1963, concern about the impact of industrial civilization on the environment had begun to capture the attention of a broad public audience, thanks primarily to the success of Rachel Carson's *Silent Spring* the year prior. By the time Julian Huxley died in 1975, the dangers of habitat loss and overpopulation that he had warned of for decades had become the stuff of popular culture, as evidenced by the best-selling books of Paul and Anne Ehrlich and by the prominence of such Hollywood films as *Silent Running* (1972) and *Soylent Green* (1973). It is impossible to measure influence precisely in the history of culture and ideas, but their writing, lectures, and correspondence indicate that Julian and Aldous Huxley had each been highlighting ecological issues to a transnational audience throughout the Cold War decades. They had sought to promote a transnational dialogue about these issues from divergent perspectives but with a common sense of urgency since at least the 1940s, when such problems were far less conspicuous in public discourse and popular culture on either side of the Atlantic.

As various transnational conservation efforts grew during the Cold War era into what would become a global environmentalist movement by the 1960s, Julian and Aldous Huxley each played a significant role in the process. Julian Huxley had the greatest impact on building the institutional foundations of the movement through the creation of such transnational

3 An excellent example of Julian Huxley's ability to anticipate the issues of political ecology that might emerge in the twenty-first century is evident in his observation in 1933, "With the gradual exhaustion of oil and coal, better chemical methods, and the improvement of tropical agriculture, more and more of the combustible sources of power . . . will be got from the tropics, manufactured out of plants. This will mean a revolution, a major shift in the economic system of the world. . . . The world will have on its hands a new proletariat, agricultural instead of industrial, tropical instead of temperate, black and brown instead of white." J. Huxley, *What Dare I Think?* (London, 1933), 8–9. Barring the emphasis that Huxley appears to place on race in his analysis, this passage closely anticipates the substance and tone of early-twenty-first century reportage, such as the following: "But even as Brazil's booming economy is powered by fuel processed from the cane, labor officials are confronting what some call the country's dirty little ethanol secret: the mostly primitive conditions endured by the multitudes of workers who cut the cane. Biofuels may help reduce humanity's carbon footprint, but the social footprint is substantial." Patrick J. McDonnell, "Human Cost of Brazil's Biofuels Boom," *Los Angeles Times*, June 16, 2008.

organizations as the International Union for the Conservation of Nature and the World Wildlife Fund. Aldous Huxley, for his part, did more to help shape the quasi-religious and ethical basis of Cold War environmentalism through his pacifism, his eclectic mysticism, and his outline for an integrated vision of life on Earth that in many ways anticipated the Gaia hypothesis of James Lovelock.[4]

In the broadest terms, the divergent visions of human ecology that Julian Huxley and Aldous Huxley articulated during the postwar era epitomized what the environmental historian Donald Worster has called the imperial and the Arcadian strains of ecological thought and activism.[5] For the most part, Julian Huxley articulated the imperial worldview with his calls to sustain natural resources and preserve habitats by bringing them under rational control. At the opposite end of this spectrum was Aldous, whose twenty-five years in Southern California were marked by a far greater affinity for the vast expanses of the Mojave Desert than for the cultural offerings of Los Angeles. As the federally funded aerospace and defense industries grew at an unprecedented rate in the American Sun Belt, Aldous emerged as an almost Thoreauvian spokesperson for the transcendent value of wildness in the face of a Cold War civilization that appeared to him to be bent on self-destruction.[6]

In light of the determination with which Julian and Aldous Huxley sought to resist contemporary trends of intellectual specialization and compartmentalization, it should not surprise us if their conceptions of human ecology sometimes transgress the neat categories of "imperial" and "Arcadian" environmentalism. Julian Huxley's vision of human ecology, for all of its grandiose emphasis on man's destiny as the new director of evolution on Earth, actually placed unprecedented emphasis on the preservation of wild habitats and endangered species. Although some advocates of the deep ecology movement such as George Sessions and Bill Deval have categorized Julian Huxley's ideas as anthropocentric,[7] his work in helping to found the

4 See James E. Lovelock, *Gaia: A New Look at Life on Earth* (Oxford, 1979).

5 Donald Worster, *Nature's Economy: A History of Ecological Ideas*, 2nd ed. (Cambridge, 1994), 2.

6 See A. Huxley, "The Desert," *Complete Essays*, ed. Robert Baker and James Sexton (Chicago, 2002), 5:301.

7 George Sessions, *Deep Ecology for the 21st Century* (Boston, 1995), 102. Proponents of deep ecology, such as the Norwegian philosopher Arne Naess, stressed a more biocentric and intuitive approach to environmental issues. Although they gained prominence in the 1970s, Donald Worster, *Nature's Economy*, 360, points out that there was ample precedent for their thinking among eighteenth-century naturalists and poets such as Gilbert White and William Wordsworth. Worster also questions the relevance of the adjective *deep* in this context: "[A] philosophical movement named 'Deep Ecology' emerged [after 1970] . . . to promote 'biospherical egalitarianism' among species, though no one had ever called for a parallel movement of 'Deep Entomology' or 'Deep Polish Literature.'"

International Union for the Conservation of Nature and the World Wildlife Fund should rank him as one of the pioneers of the more biocentric strain of environmentalism that emerged in the 1960s and 1970s. And although Aldous Huxley's somewhat pantheistic view of nature earned him a place in the intellectual pantheon of the deep ecology movement that emerged in Europe and North America in the two decades following his death, the conception of human ecology that he articulated in his last writings remained thoroughly informed by a strong commitment to the old Fabian vision of a rationally planned economy that he had supported, albeit on a much smaller scale than his brother Julian, since the 1920s.[8]

JULIAN HUXLEY: "THE BIGGEST BUSINESS OF ALL"

As the first director general of UNESCO, the biologist and conservation activist Julian Huxley exhibited a remarkable penchant for alarming the guardians of ideological purity on both sides of the East-West divide. In the Soviet Union, his frank and unsparing assessment of how Lysenkoism was impeding the Soviet life sciences was greeted with official hostility, and his unambiguous call for greater freedom in scientific and cultural exchange in Eastern bloc countries was also unwelcome.[9] In the West, Julian Huxley's blunt rejection of traditional religion and his commitment to the promotion of "evolutionary humanism" as a new science-based value system raised serious alarm among religious conservatives, especially in the United States. The controversies that surrounded Julian Huxley's thinking effectively guaranteed that his tenure at UNESCO would be foreshortened by the U.S. State Department, but they did not appear to limit his profound effectiveness in founding the International Union for the Conservation of Nature, navigating the politics of decolonization to promote wildlife preserves across the world, and helping to found and promote the World Wildlife Fund. In the context of the Cold War, Julian Huxley hoped to promote a new ideology that derived its ethics and aspirations from biological evolution, and he worked without pause to weave local and national conservation movements into an international movement. Among his colleagues in the London-based think tank Political and Economic Planning, for instance, Julian Huxley had distributed a document stamped "Confidential" in which he argued that the creation of a new worldview, grounded in the life sciences and predicated on the evolutionary and ecological context of human civilization, was

8 A. Huxley, *Island* (New York, 1962), 185.
9 See J. Huxley, *Heredity, East and West: Lysenko and World Science* (New York, 1949), 33–4.

essential to creating a coherent intellectual culture for the West as it faced what he described as the ideological zealotry of the Soviet bloc.[10]

Julian Huxley's views on human ecology, or the relationship between human beings and the natural world, centered on his conviction, which he liked to repeat with the almost-desperate enthusiasm of a coach at halftime, that "man has been suddenly appointed managing director of the biggest business of all, the business of evolution. . . . What is more, he can't refuse the job. Whether he wants to or not, whether he is conscious of what he is doing or not, he is in point of fact determining the future direction of evolution on this earth."[11] To contemporary ears, the sheer anthropocentrism of Julian Huxley's overly earnest rhetorical style, little helped by his pilfering from the language of business administration, is perhaps sufficient to explain why he has not earned a lasting place alongside contemporaries of his such as Aldo Leopold or Rachel Carson in the collective memory of the environmental movement.

Although most environmentalists of the postwar era argued that human beings should learn to tread lightly so as not to disturb the ecological stasis of the planet, Julian Huxley cast human beings as the new managers of evolution itself and argued that they would not merely inherit but also shape the new ecologies in which all species on Earth, including their own, would continue to evolve. Although it might not be surprising that the former managing director of the London Zoo came to see the world itself as a vast zoological garden in need of management, there is something deeply disconsolate about this view. If the advent of Darwinian evolution had implied for many the death of the paternal figure of God, Julian Huxley's view that human beings now sat at the controls of "evolution on this earth" seemed to imply the death of the maternal figure of nature. Although the emotional and quasi-religious appeal of environmentalism has in general owed a great deal to the idea that we can somehow return to nature, Julian Huxley argued implicitly that there was no such option for humankind and that any of the possible ecologies of the future, whether they be aesthetically and biologically impoverished as the result of human carelessness or aesthetically and biologically rich as the result of human care, would still be human and not natural, as they would be the result of human choices. In many ways,

10 "The west, confronted with militant communism, is reacting merely negatively, with anticommunist propaganda. It lacks a general positive philosophy of life, though this in the long run is indispensable." J. Huxley, confidential memorandum, September 13, 1951, PEP/PSI Collection Folder 12/197, Political and Economic Planning Papers, Archives, London School of Economics. The ecological worldview that Julian Huxley proposes to fill this gap he calls evolutionary humanism in the 1940s and early 1950s, though he coined the term *transhumanism* to describe it in the late 1950s.

11 J. Huxley, *New Bottles for New Wine* (New York, 1959), 13–14.

Julian's reasoning here anticipates the assessment that environmentalists and historians such as Bill McKibben and William Cronon would also reach, much less cheerfully, decades later.[12]

In large part because of the stunning advances in applied science and technology that it had helped to accelerate, the dawn of the Cold War in the mid-1940s witnessed more than the ascendancy of the United States to the position of global dominance once held by Great Britain. It also witnessed the ascendancy of *Homo sapiens* as the decisive power in determining the future direction of life on Earth. Just a few months after the bombings of Hiroshima and Nagasaki, Julian Huxley gave an address in New York in which he outlined the possibilities of what American newspapers were already calling the Atomic Age. Julian kept his discussion of the weapon itself brief and suggested, as did many politicians and public figures such as Bernard Baruch recommended in the feverish months following August 1945, that somehow such armaments should be placed under UN control. Julian's real area of interest was in how these superexplosives might be used in vast geo-engineering endeavors that anticipated the ideas that the U.S. Atomic Energy Commission would later explore as part of Operation Plowshare in the early 1960s.[13] After proposing the use of "atomic dynamite" to build new dams and to replace the Panama Canal with a new waterway by obliterating a section of Central America, he moved on to even more remarkable adventures in planning:

> Those are easy projects. But there are other more spectacular possibilities. How many people realize that we could alter the entire climate of the North Temperate Zones by exploding a few dozen or at most a few hundred atomic bombs at an appropriate height above the polar regions? As a result of the immense heat produced, the floating polar ice sheet would be melted: *and it would not be reformed.* It is a relic from the last Ice Age, and survives today because most of the heat from the sun is reflected from its surface. If it were melted, most of the sun's heat during the polar summer would be absorbed by the water and raise the temperature of the Arctic Ocean. Ice would form again each winter: but it would not cover nearly so large an extent as now, and would be thin enough to be melted in the succeeding summer.[14]

The science writer Waldemar Kaempffert, who had shared Julian Huxley's passion for ambitious technocratic planning since the days when each of them had filed enthusiastic dispatches from the Soviet Union in the early

12 See Bill McKibben, *The End of Nature* (New York, 1989); and William Cronon, "The Trouble with Wilderness: or Getting Back to the Wrong Nature" in *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon (New York, 1995), 69–90.

13 See Scott Kirsch, *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving* (New Brunswick, N.J., 2005).

14 J. Huxley, "Atomic Energy," Box 65, File 14, Julian Huxley Papers, Rice University (hereafter HP).

1930s, covered Julian's optimistic talk on atomic energy for the *New York Times* and related it to his tireless campaign for the scientific planning of societies and economies to achieve the ultimate goal of global government.[15] Of course, "atomic dynamite" would prove not only much more poisonous than Julian Huxley seemed to realize in December 1945 but also much less amenable to international control. As the half century following Hiroshima would demonstrate, the governments of neither the Western nor the Eastern bloc were particularly responsible in their production and use of these weapons.[16] Thus, Julian Huxley's lecture on atomic energy, like other artifacts of the period immediately following the advent of the bomb, appears naive not only for its low estimation of the ecological dangers posed by these weapons but also for its unwarranted optimism that the new technology could be placed under international control. The absence of any sense of gravitas in Julian Huxley's lecture about the moral questions raised by the new weapons was not atypical in the immediate aftermath of the war, but it does contrast sharply with the musings that his brother Aldous so vividly expressed in his 1948 novel *Ape and Essence*.

The late 1940s were a period of frenetic activity for Julian, though they proved to be a time when his grand vision of global leadership by scientists and technical experts through the organs of UNESCO and other international organizations would run into serious opposition. The U.S. State Department had agreed to his service as the first director general only according to terms that shortened his tenure from the six years prescribed by the UNESCO bylaws to only two. Furthermore, his views on biology and society had aroused the ire not only of religious conservatives in America but also of Lysenkoists in the Soviet Union.[17] In a letter to his cousin Gervas Huxley in 1947, Aldous remarked on the seemingly insurmountable challenges posed by the UNESCO work and the strain they had placed on his brother:

> [Julian] was cheerful on the surface, though basically very pessimistic, in the sense of not seeing how it was going to be possible, in the current nationalistic frames

15 Waldemar Kaempffert, "Science in Review, Julian Huxley Pictures the More Spectacular Possibilities That Lie in Atomic Power," *New York Times*, December 9, 1945 (ProQuest Historical Newspapers, *New York Times* [1851–2003], 77). For an example of Julian Huxley's early enthusiasm for Soviet planning, see J. Huxley, *A Scientist among the Soviets* (New York, 1932).

16 J. R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth Century World* (New York, 2000), 343.

17 Huxley, along with the American biologist H. J. Muller, had long admired the aggressive scientific research policies of the Soviet Union but did not hesitate to criticize the dogmatic traits of Soviet genetics. By the mid-1950s, Julian still held out hope that Soviet biology might free itself from political dogma: "I am interested but sorry to hear what you say about the predominance of Michurinism in the U.S.S.R. On the other hand, there is no question that the real geneticists are coming back." J. Huxley, Letter to H. J. Muller, December 12, 1956, Box 24, Folder 6, HP.

> of reference, to achieve any real unity – and further being able to see how, with the Russians resisting every attempt to mitigate national sovereignty, there could be any change in the patterns which condition all our collective thinking, feeling and action.[18]

Although his ambitious calls for UNESCO to be recognized as a global community of scientists and intellectuals that could help guide and accelerate the future evolution of the human race fell mostly on deaf ears, his smaller dreams for UNESCO did bear fruit. A multivolume world history based on the history of science rather than religious or political history was ultimately published in the late 1950s.[19] As UNESCO's first director general, Julian could boast with some justification that he had led the fight to "put the *S* in UNESCO," thereby turning what had initially been conceived of as a cultural organization into a clearinghouse for scientific research with a special emphasis on ecological endeavors, such as the research on the Man and Biosphere program (MAB) that he helped to initiate.[20] Julian also used his clout as UNESCO director to create the International Union for the Conservation of Nature (IUCN), a branch organization dedicated to the protection of wildlife and habitats in 1947.[21]

When one considers the emphasis on economic reconstruction that naturally dominated the attention of most leaders in the years just following 1945, Julian Huxley's early achievements in rallying official support in Europe for conservation are indeed remarkable. As postwar reconstruction had barely begun, it was impossible to establish such an ambitious program as the IUCN in 1946, but "the Swiss promoters, however, persevered and, exactly a year later on June 30–July 1 1947, they assembled, after better preparation, a conference at Brunen drawn from 24 countries, at which it was agreed to establish" a provisional version of the IUCN. "Julian Huxley, who had meanwhile become the first Director-General of UNESCO, energetically embraced the project, and convened in 1948 at Fontainebleau at which a draft constitution . . . was adopted."[22] Although UNESCO was

18 A. Huxley to Gervas Huxley, November 14, 1947, Box 3, File 26, HP.

19 The first volume of this project – *Prehistory and the Beginnings of Civilization*, volume 1 of the UNESCO History of Mankind – by Jacquetta Hawkes and Leonard Woolley, was published in 1964.

20 On Huxley's influence on MAB, see David Pitt and Paul R. Samson, eds., *The Biosphere and Noosphere Reader: Global Environment, Society, and Change* (New York, 1999), 141–3.

21 As Julian Huxley would later recall, "When I was Director-General of UNESCO, I fought for the principle that the preservation of nature was a legitimate activity for UNESCO to undertake. . . . [W]e took steps to create such an organization for the preservation of nature, and it came into being after a meeting at Fontainebleau in the late 1940s." Krishna R. Dronamraju, *If I Am to Be Remembered: The Life and Work of Julian Huxley with Selected Correspondence* (Singapore, 1993), 187.

22 E. M. Nicholson, *The Environmental Revolution: A Guide for the New Masters of the World* (London, 1970), 195.

already committed to protecting archaeological assets classified as "world heritage" sites, the creation of the IUCN solidified the commitment of UNESCO to also protecting habitats.

In addition to pioneering the protection of wild habitats, Julian Huxley took a leading role in advocating global population control decades before the sensation caused by Paul and Anne Ehrlich's writing in the late 1960s. An outspoken advocate of birth control and sex education at least since his tenure as a professor at Rice University in the 1910s, Julian saw the problems of human ecology as intimately related to the issue of overpopulation. During the 1950s, he maintained a strong commitment to international efforts to promote population control throughout the Cold War era. In 1959, he attended a conference on family planning in New Delhi, along with Jawaharlal Nehru. In his address to the conference, Julian boasted of his early commitment to birth control as he observed the widespread change in public attitudes around the world over the previous several decades. Recalling his early work with Margaret Sanger on this issue in the 1920s, Julian argued, "Public interest in the problem of population has grown in an astonishing way. It was then an unpopular subject, kept alive by a handful of devoted pioneers: today you can hardly open a newspaper . . . without seeing some reference to population pressure and even to the once-unmentionable topic of birth-control." He cited the population policies of Asian nations such as India and Japan and observed that even the pope "has commended the subject of mounting population to the consideration of all good Catholics."[23] In his address to the conference in New Delhi, Julian Huxley reiterated his unwavering faith in the role that institutions, governments, and even religious leaders could play in the promotion of this ambitious reform agenda.

This faith in institutional solutions to social and ecological problems led Julian to indefatigably promote government-sponsored conservation through the establishment of national parks throughout the postwar era. As more European colonies in Africa became independent republics in the 1960s, Julian lobbied their governments to set up national parks. In 1961, he wrote to the minister of natural resources in Zomba, Nyasaland, and framed his arguments for conservation in characteristically pragmatic terms: "If a National Park were established there it could readily be integrated with the National Parks of Eastern Africa. . . . [T]his would undoubtedly bring considerable revenue . . . [and] it would speedily become a source of national prestige for the territory throughout the world."[24]

23 "Population Planning and Quality of Life," New Delhi, 1959, Box 2, Folder 2, Max Nicholson and Julian Huxley Papers, Rice University.

24 J. Huxley to Hastings Banda, October 5, 1961, Box 32, Folder 4, HP.

Julian maintained strong ties to UNESCO long after his tenure as director general had ended in 1948. To René Maheu, the director general of UNESCO, Julian reported in 1961 on the success of a recent conference in Arusha on the preservation of wildlife and habitats in Africa and added, "The IUCN, which is affiliated with UNESCO, is following up the conference . . . by sending a team of two experts to any African country which requests their services." Stressing the need to form partnerships with local organizations and social networks, Julian reported, "There exist in a number of African countries semi-official organizations concerned with National Parks," and he argued that the groups "should be supported with financial and technical assistance wherever possible."[25]

Throughout the 1960s, Julian Huxley continued to work doggedly for the cause of national parks in Africa, touting their benefits as a source of tourist revenue and international prestige. In 1965, he wrote to the British minister of overseas development, Barbara Castle, to promote the establishment of a new national park to protect the unique habitats of Tanzania.[26] He also wrote to numerous African leaders, including Emperor Haile Selassie of Ethiopia, whose secretary reported back that a wildlife conservation board had been established to ensure that wilderness preserves would be "conserved and managed for the maximum benefit of present and future generations."[27] Alluding to his brother Julian's achievements in promoting the preservation of wild habitats in Africa, Aldous would later note in his university lectures: "The great wild species of Africa survive at all solely because there are national parks in various parts of Africa where these animals are carefully protected . . . for the benefit of science and for the delight of people who wish to go outside the all too human world and see what the rest of the creation looks like."[28]

In 1961, the American intellectual and pioneer of environmentalism Lewis Mumford expressed his strong interest in Julian Huxley's ambitious vision of integrating scientific and technological innovation with ecology as outlined in *New Bottles for New Wine*.[29] Mumford, whose ideas about nature and technology had been influenced by the Scottish polymath Patrick Geddes, was part of a transatlantic network of intellectuals such as Walter Gropius, Max Nicholson, and Julian himself who sought to unite technological innovation with ecological sustainability. For Julian Huxley, the

25 J. Huxley to René Maheu, November 1961, Box 32, Folder 5, HP.
26 J. Huxley to Barbara Castle, M.P., April 3, 1965, Box 38, Folder 6, HP.
27 Yohannes Kidane Marian to J. Huxley, November 14, 1965, Box 40, Folder 2, HP.
28 A. Huxley, *The Human Situation* (New York, 1977), 17.
29 Lewis Mumford to J. Huxley, August 9, 1961, Box 32, Folder 2, HP.

creation and expansion of transnational institutions was a natural response to environmental crises. If environmental degradation was a global problem, the solution was to be found in truly global governance. In 1961, Julian Huxley mused in a lecture titled "Human Ecology":

> I would say that we have to get away from the idea of a race, and begin to think in terms of a balance, an ecological idea, the continuing process of adjustment between people and resources. Such a balance, of course, must be a dynamic and moving one. . . . The president of the United States periodically reports on the state of the nation. It might be a good thing if the Secretary-General of the United Nations were periodically to report on the state of the balance between man and nature.[30]

Here, Julian's faith in the power of competent administration applied to even the largest problems comes to the fore. Just as he had once managed the London Zoo as a microcosm of nature in the heart of a great metropolis, Julian now imagined that nature, or at least humankind's relationship to it, might one day be attended to by the secretary-general of the United Nations.

Even after his tenure as the first director general of UNESCO, Julian Huxley exercised a growing influence as a transnational conservationist in the 1950s and 1960s. He threw his support behind Rachel Carson's efforts to ban DDT and helped to found, with conservationist and longtime friend Peter Scott, the World Wildlife Fund (WWF) to fight the rapid rise of species extinction in the postwar era.[31] Over the course of Julian Huxley's evolution from a young professor at Rice University to a global activist, he sought both to influence elites and governments, through organizations such as UNESCO, and to employ a more demotic strategy of influencing public opinion, as he did through film, radio, and speaking engagements in America over the course of three decades. In the late 1920s, Juliette Huxley

30 "Human Ecology – Population and Conservation," lecture delivered at the University of Natal in 1961, Box 11, Folder 11, HP.

31 In the winter of 1960, Julian Huxley wrote a series of articles for the *Observer* on habitat destruction in Africa that led to the formation of the WWF. Max Nicholson spearheaded the formation of this new organization, and Peter Scott designed the first version of the famous panda logo. In his memoirs, Julian Huxley recalled, "The foundation of the IUCN, and of its associated body, the World Wildlife Fund, had for me a gratifying sequel. Late in 1970, at their International Congress in London, they presented me with a gold medal and also a splendid gold watch. . . . I treasure these gifts, but still more the citation, which stated the award was for: 'his outstanding contribution to scientific research related to conservation; for the leading part he played as Director-General of UNESCO in initiating the formation of the International Union for the Conservation of Nature . . . and for his efforts during 1960 and 1961 to arouse public concern about the threat to wild nature and the natural environment that led to the formation of the Wildlife Fund.' This crowned sixty-three years of my passionate interest in conserving wild life and natural beauty: I was very proud." J. Huxley, *Memories* (New York, 1973), 2:249.

had compared her husband to Lord Curzon for his relentless activity.[32] He continued to merit the comparison decades later, as his activity and his ambition showed no sign of diminishing. Even at the age of eighty-five, Julian Huxley remained a prominent spokesperson for the burgeoning environmental movement, lending his voice to the promotion of *A Blueprint for Survival*, a summary of the threats posed by unrestricted industry and overpopulation that became an international bestseller in 1972.[33]

ALDOUS HUXLEY: "IL FAUT CULTIVER NOTRE OASIS"

If Julian Huxley has been largely forgotten in recent decades, his brother Aldous has not. The name Aldous Huxley remains in wide circulation, but primarily in connection with two books that represent only a very small fraction of his prodigious and wide-ranging output. These two books are, of course, *Brave New World* and *The Doors of Perception*, which together have managed to brand Aldous Huxley with the improbable combination of being both middlebrow and dangerous. Middlebrow because nearly everyone who attended high school in the United States during the Cold War decades seems to have been assigned *Brave New World* at some point, and thus very many people feel that they have already digested the only significant Aldous Huxley novel before finishing adolescence. Dangerous because *The Doors of Perception*, which began as a book about one man's medically supervised experiment with mescaline, became an emblem of the drug culture that followed with all of its destructive excesses. In the iconography of popular culture, the name of the generally quiet and retiring Aldous Huxley thus has been wedded to the image and music of the drug-saturated suburban satyr Jim Morrison, and his face is even to be found among the august mourners on the cover of the Beatles' *Sgt. Pepper's Lonely Hearts Club Band*. There is a certain irony in the fact that Aldous would become emblematic of a movement in mass culture that most likely would have left him cold. On his last visit to London in the summer of 1963, when the Beatles and other new rock bands were already a force to be reckoned with in England, Aldous did not sound like he was in step with the emerging counterculture when he confided to his sister-in-law Juliette, "I feel remote. I have nothing in common with the young now – they are only interested in sexual problems."[34]

32 "Think of Lord Curzon . . . but for God's sake don't emulate him. . . . [Y]ou are already running a great risk of it. . . . Of course there is that great and experienced truth, that no man is a hero to his wife; but what if you were the exception?" Juliette Huxley to J. Huxley, ca. 1927, Box 4, Folder 3, HP.

33 Kirkpatrick Sale, *The Green Revolution* (New York, 1993), 29.

34 Juliette Huxley, *The Leaves of the Tulip Tree* (Topsfield, Mass., 1986), 234.

Throughout his career as a writer and then, briefly, as a university lecturer at the Massachusetts Institute of Technology and the University of California, Aldous attempted to wrestle with the very same issues that concerned Julian, namely the integration of religion and science and the reconciliation of the humankind with its natural environment, though he often came to radically different conclusions than his older brother did. Where Julian took the scientific method itself as the basis for both his epistemology and his ethics, Aldous had an early fascination with the mystical traditions of both Eastern and Western religions and was impelled as early as the late 1920s to search for an enduring set of common principles behind the diverse creeds of the world's major religious traditions.[35] And where Julian shared a common fascination with American Progressives and British Fabian socialists for large governmental planning projects such as the Tennessee Valley Authority (TVA), Aldous tended to view such large-scale endeavors in technical and social engineering with an almost reflexive suspicion.

Sybille Bedford, Aldous Huxley's friend and biographer, recalls that he was often fond of saying, "Il faut cultiver notre oasis," in a sly paraphrase of the Voltaire's dictum at the close of *Candide*. In light of the tremendously ambitious and managerial worldview that guided his brother's career, the simplicity and modesty of this idea is striking. Although Julian exhorted the human race to recognize itself as the managing director of the biggest business of all, Aldous exhibited even less faith than the world-weary Candide in the potential of human beings to improve the world around them. After all, a garden is the product of human agency and was, in the thinking of their grandfather, T. H. Huxley, the clearest metaphor for the potential of human civilization.[36] By replacing garden with oasis, Aldous does not go so far as to imply that human beings can make the world a better place through their efforts, but only that they might be able to maintain some blessed corner of it and protect it from destruction. In the late 1940s, Aldous was expressing serious doubts in the novel *Ape and Essence* and in essays such as "The Double Crisis" about even that possibility.

35 "Religions . . . are almost endlessly varied. . . . But a oneness underlies this diversity." A. Huxley, "Jesting Pilate," in *Complete Essays*, 565.

36 Grandfather to Julian and Aldous, the biologist T. H. Huxley had found in the garden a handy metaphor for both the goal of human ethics and the forward march of Western civilization. It was the dominant trope in his 1893 Romanes Lecture "Evolution and Ethics"; in an earlier address at Johns Hopkins in 1876, he described British colonialism and American expansionism as parallel manifestations of "that secular progress by which the descendents of savage Britons and wild pirates of the North Sea have become converted into warriors of order and champions of peaceful freedom, exhausting what still remains of that old Berserk spirit in subduing nature, and turning the wilderness into a garden." T. H. Huxley, *American Addresses, with a Lecture on the Study of Biology* (New York, 1877), 124.

In an age when the doctrine of economic growth without limits had become an established dogma on both sides of the Iron Curtain, the alarms that Aldous Huxley sounded in his essay "The Double Crisis" were hardly well received. In fact, the essay garnered rejection letters from *Foreign Affairs*, *Harper's*, the *Atlantic*, *Life*, and from Norman Cousins at the *Saturday Review of Literature*. In the opening salvo of this essay, Aldous declared:

> The human race is passing through a time of crisis, and that crisis exists, so to speak, on two levels – an upper level of political and economic crisis and a lower level of demographic and ecological crisis. That which is discussed at international conferences and in the newspapers is the upper-level crisis – the crisis whose immediate causes are the economic breakdown due to the War and the struggle for power between national groups possessing, or about to possess, the means of mass extermination. Of the low-level crisis, the crisis in population and world resources, hardly anything is heard in the press, on the radio, or at the more important international conferences.[37]

In his 1946 introduction to *Brave New World*, Aldous Huxley had quoted Leo Tolstoy's observation that the most effective form of censorship was not to suppress a new idea as heresy but merely to draw a veil of silence over it as though it were not important enough to refute. Given his long and lucrative career as a contributor of essays to American magazines, it seems quite possible that "The Double Crisis" was rejected not for lack of import or literary merit but because it ran directly counter to the most cherished economic and political ideas of American industry and government during the first decade of the Cold War. In rejecting the essay, the editor of *Life* magazine wrote, "That article ran head on into an argument on the facts among our editors. The opposite opinion to Mr. Huxley's is widely held here."[38] After being rejected by virtually every major American journal, "The Double Crisis" was eventually published in the UNESCO *Courier* in 1948, the last year of Julian Huxley's tenure as UNESCO director general.

The main argument of "The Double Crisis" is predicated on a Malthusian logic that fails to account for two developments that would at least mitigate if not solve the world's population problem in the postwar era. The first of these trends was the development of new methods to combat nutrient-depletion soil erosion in the postwar decades, such as the application of synthetic fertilizers in the 1950s and 1960s, as well as the increasing adoption of other methods of soil preservation such as crop rotation and organic agriculture. The other trend that Aldous did not take into account was

37 A. Huxley, "The Double Crisis," *UNESCO Courier*, April 1949, 6–9.

38 Oliver Jensen, Editor at *LIFE* Magazine, to John Fischer at *Harper's*, May 31, 1949, Box 5, Folder 1b, Aldous Huxley Papers, University of California, Los Angeles.

the fact that in industrializing societies, population growth tends to fall, especially if industrialization is accompanied, as it usually is, by expanded education and opportunities for women.

A few of the observations that Aldous makes in "The Double Crisis" are, in contrast, remarkably prescient, especially regarding the unequal distribution of certain industrial resources, such as fossil fuels. Aldous observed, "Natural monopolies in raw materials are even more politically dangerous than natural monopolies in food." He reasoned that monopolies of resources such as minerals or fossil fuels, "when located in the territory of a strong nation . . . [,] are a standing temptation to the abuse of military and economic power." When deposits of such resources are located in "a weak nation, they are a standing temptation to aggression from abroad."[39] The political instability engendered by such "natural monopolies in raw materials" would be a pivotal theme in his last novel, *Island*, and it became an even more crucial factor in the subsequent history of oil reserves in the Middle East or mineral wealth in Africa. Furthermore, the solution of funding research to discover more sustainable substitutes for such resources, which Aldous proposed in "The Double Crisis," is remarkable in the way that it foreshadows (in a manner somewhat reminiscent of Julian Huxley's earlier writings on this subject), the twenty-first-century drive to develop viable substitutes for fossil fuels as a hedge against global political instability.

The evolution of Aldous Huxley's thinking about environmental issues after 1945 is apparent in his changing view of romanticism. Where he had sharply criticized the romantic ethos in the interwar decades, he embraced it during the Cold War decades, laying the basis for his articulation of a more biocentric view of human ecology. In the 1920s, Aldous had written an essay with the intriguing title "Wordsworth in the Tropics," in which he took Wordsworth and the other romantics to task for their worship of nature:

> The Wordsworthian adoration of Nature has two principle defects. The first, as we have seen, is that it is only possible in a country in which Nature has been nearly or quite enslaved to man. The second is that it is only possible for those who are prepared to falsify their immediate intuitions of Nature. For Nature, even in the temperate zone, is always alien and inhuman, and occasionally diabolic.[40]

Aldous had once described Wordsworth as an Anglican minister who had substituted landscape for God, but during the Cold War decades, he declared

39 A. Huxley, "Double Crisis," 6–9.
40 A. Huxley, "Wordsworth in the Tropics," in *Collected Essays*, 3.

an unapologetic affinity for the poet of the Lake District. In his lectures at the University of California, he confessed without shame:

> I am an old and unregenerate Wordsworthian; I regard Wordsworth as among the four or five greatest English poets and as a man who contributed insights of enormous importance in regard to what our relationship towards the natural world should be. Wordsworth's whole idea was that man and nature are closely interlinked, that our morality goes right back into our relations with the world, and that our sense of the divine can be most powerfully mediated through our relations with the world of nature.[41]

What the environmental historian Bob Pepperman Taylor has called "the spiritualization of nature" gained a new lease on life from Aldous Huxley, whose credentials as a satirist and social critic gave his newfound reverence for nature an urbane piquancy that the writings of so many of the English romantics had lacked.[42] Where Wordsworth had drawn his inspiration from the Lake District in England, Aldous Huxley, an Angeleno for more than a quarter century, drew his inspiration from the vast desert of the American Southwest. Generations later, the philosophical and quasi-religious impact of Aldous Huxley's writings can be seen in the romantic mysticism of the deep ecology movement. In their seminal book *Deep Ecology*, Bill Deval and George Sessions cite Aldous Huxley first when they catalog the ideas and philosophies that shaped the deep ecology movement.[43] In his study of the strong religious current in environmentalism, the historian Thomas R. Dunlap also points to seminal influence of Aldous's thought, and particularly *The Perennial Philosophy*, on succeeding generations of postwar environmentalists.[44]

One of the points that Aldous stressed in the university lectures that he gave during the late 1950s and early 1960s was the inextricable relationship between biology and politics. Regarding the 1956 Suez crisis, he declared that politicians were ignoring "the fundamental reason Egypt has been so troublesome to the West in recent years: It is a biological reason; these people cannot live on their resources and they must throw their weight around so as somehow to get people who have capital to invest in their country."[45] Closer to home, Aldous also viewed the feverish production of new weapons

41 A. Huxley, *The Human Situation*, ed. Pierro Ferrucci (New York, 1977), 37.

42 Bob Pepperman Taylor, *Our Limits Transgressed: Environmental Political Thought in America* (Lawrence, Kan., 1995), 81–106; see also Thomas R. Dunlap, *Faith in Nature: Environmentalism as a Religious Quest* (Seattle, 2005).

43 Bill Deval and George Sessions, *Deep Ecology* (Layton, Utah, 1985), 80.

44 Thomas R. Dunlap, *Faith in Nature* (Seattle, 2004), 77, 114, 116, 133.

45 A. Huxley, *Human Situation*, 48. Julian Huxley made a similar point about the biological underpinnings of the Suez crisis in 1956 in an unpublished position paper, "The Ecological Idea," 5, PEP/PSI Collection, Folder 12/197, Archives, London School of Economics.

systems in the deserts of the southwestern United States through the prism of the life sciences: "In brand new reservations, surrounded by barbed wire and the FBI, not Indians but tribes of physicists, chemists, metallurgists, communications engineers, work with the frenzy of termites" to create "a steady stream of marvels, each more expensive and each more fiendish than the last."[46] For a countervailing force that might check this destructive juggernaut, Aldous looked deep into the well of evolutionary biology:

> Applied science is a conjurer, whose bottomless hat yields the softest Angora rabbits and the most petrifying of Medusas. . . . But I am still optimist enough . . . to bet that the non-human otherness at the root of man's being will ultimately triumph over the all too human selves who frame the ideologies and engineer the collective suicides. For our survival, if we do survive, we shall be less beholden to our common sense . . . than to our caterpillar and cicada sense.[47]

Writing at the height of the Eisenhower era, Aldous Huxley here articulates a response to the pervasive anxieties of the nuclear arms race that at once echoes Thoreau's famous dictum "In wildness is the preservation of the world" and anticipates the back-to-the-land and deep ecology movements that would emerge in the 1960s and 1970s.

In the initial series of lectures titled "The Human Situation" that he gave at the University of California, Santa Barbara, in 1959, Aldous Huxley noted the centennial of *On the Origin of Species* and argued that the advent of Darwinian evolution remained a revelation of profound significance for Western civilization. But where many nineteenth- and early-twentieth-century students of Darwin had found in his theory of evolution a new justification for laissez-faire economics or imperialism, Aldous found a different meaning in Darwin's theory a century after its first publication. Reviewing the development of Western faith, he argued that primitive religions, with their animistic worldview, had placed humankind in an intimate relationship with nature, whereas later religions, and especially Christianity, had divorced humankind from nature and had even established the pernicious dogma that other living creatures on Earth were mere things, over which humankind could exercise an absolute dominion.[48] By establishing a solid scientific basis for the familial relationship between *Homo sapiens* and the other species on Earth, Aldous reasoned, Darwinian evolution offered

46 A. Huxley, "The Desert," in *Complete Essays*, 5:296.

47 Baker and Sexton, *Complete Essays*, 301.

48 It should perhaps be noted that Lynn White's seminal 1967 essay on Judeo-Christian culture and the domination of nature, "The Historical Roots of Ecological Crisis," begins with a personal remembrance of Aldous Huxley: "About a year before his lamented death he was discoursing on a favorite topic: Man's unnatural treatment of nature and its sad results." White, "The Historical Roots of Ecological Crisis," *Science* 155, no. 3767 (1967): 1203–7.

modern human beings a much-needed chance to escape the alienation from nature that Judeo-Christian theology had imposed on them and to reestablish the connection between human beings and nature that had been so prominent in primitive religion. This return to a greater intimacy with nature would be superior to primitive religion, however, because it would not be based on superstition but on solid science. To describe how he envisioned the evolution of Western thought regarding humanity's relationship to nature, Aldous employed the image of an ascending spiral. Darwinian science reunited the human race in roughly the same relationship with nature as experienced in the age of sacred woods and fertility cults, but this time around, the relationship was on a higher level because it was based on scientific knowledge rather than mere superstition.

More than a decade before *environmentalist* became a common journalistic term for conservationist,[49] Aldous Huxley turned the word inside out, critiquing its old meaning and anticipating the way it would be used in the future:

> In the nineteenth century, the environmentalist school spoke of the environment as conditioning and creating cultures but left out of account altogether the fact that cultures condition the environment – that man has certainly done almost as much to change the environment as the environment has done to mould the course of history.[50]

A perceptive student of American conservationism, Aldous praised the groundbreaking work of George Perkins Marsh at a time when his reputation was just coming out of eclipse among American academics: "The first great classical work on the subject was written by George Perkins Marsh . . . [who] collected all of the European material to date on the subject of man and nature and set it forth in a kind of philosophical context. One of the precursors in the field, it remains an extremely valuable book."[51]

Many of the ideas about ecology that Aldous had expressed in his university lectures also found their way into his last novel, which, though critically unsuccessful, was to have a second life as a blueprint for an ecologically sustainable utopia in the sixties and seventies. In fact, Bill Deval and George Sessions cite *Island* as a work that anticipates the principles of deep ecology.[52] One element in *Island* that Sessions and Deval do not acknowledge, however, is the strong emphasis on eugenics in the government's classification of citizens according to their physical type. Among his admirers in the deep

49 The *Oxford English Dictionary* cites 1970 as the first instance of *environmentalist* being used in this sense.

50 A. Huxley, *Human Situation*, 13.

51 Ibid., 14.

52 Deval and Sessions, *Deep Ecology*, 170.

ecology movement, Aldous Huxley's continuing endorsement of eugenics in the postwar era tends to be ignored, for the most part, along with other hobbyhorses that show up in his writings, such as his passionate endorsement of the Bates method for restoring sight, the Alexander method for improving coordination and personal well-being, and the system devised by William H. Sheldon for classifying human character. In *Island*, Sheldon's methods for identifying the psychological profiles of individuals on the basis of their body types provides one of the unintentionally disturbing moments in what Aldous explicitly intended to be his "good utopia." When Will Farnaby listens to a long explanation of how the small government of Pala identifies and controls such trouble makers as "musclemen" and "Peter Pans" before they can become a danger to the peace and tranquility of the island, a cold and distinctly Orwellian wind blows through the trees in what for all intents and purposes looks like the perfect blueprint for an easygoing hippy commune in the South Pacific.[53]

CONCLUSION

In September 1989, a scant two months before the Berlin Wall came down, the U.S. environmentalist Bill McKibben argued in a seminal essay in the *New Yorker* that the imaginary wall between ourselves and our pristine conception of nature had already collapsed, as there was no place left on Earth that had not been altered by human activity.[54] McKibben's essay was later expanded into an influential book.[55] McKibben's specific argument was informed by very recent research regarding anthropogenic climate change, but the core of his thesis about our concept of nature had been anticipated at the dawn of the Cold War era by both Julian and Aldous Huxley. The Huxley brothers had also been among the first to highlight the geopolitical implications of the rapidly changing relationship between human beings and their biological inheritance. Before many of their contemporaries, they sensed the emergence of the new ecology of power – a state of affairs in which the near-term maneuverings of geopolitics and the long-term trends in global ecology would become inextricably combined. They reasoned that, in the twentieth century, ecological and international affairs had become so thoroughly enmeshed that no student of geopolitics could afford to ignore ecology, and no serious student of ecological issues could afford to ignore the pervasive influence of geopolitics. The combined discourse

53 A. Huxley, *Island*, 185.
54 William McKibben, "Reflections, 'The End of Nature,'" *New Yorker*, September 11, 1989, 49.
55 William McKibben, *The End of Nature* (New York, 1989).

of international relations and global ecology is well on its way to becoming mainstream in this century, but in the mid-twentieth century, Julian and Aldous Huxley were among its earliest and loneliest messengers.

In 1959, Aldous Huxley posed these questions to the students attending his lecture at the University of California at Santa Barbara: "What is our relationship with the planet? What are we doing with the world on which we are living, and how are we treating it?" And he added, "How is it likely to treat us if we go on treating it as we are now?"[56] In his speculations on the answer to that question, Aldous referred to a recent book by the grandson of one of T. H. Huxley's good friends. Nearly a century after his grandfather had published *The Origin of Species*, the physicist Sir Charles Galton Darwin published a slim volume titled *The Next Million Years*, in which he attempted to predict the long-term future of humankind. In perhaps the book's most memorable phrase, he bluntly stated, "Man is wild animal." Because human beings would never submit themselves to the strict selective breeding that had led to the creation of domesticated animals, the human race, in spite of the trappings of civilization, could not truly be described as domesticated. And because humanity is incapable of shaping its own evolution in the same manner that it has shaped the evolution of domestic species, it must submit to the Malthusian logic that rules the evolution of wild animals.[57] Aldous praised *The Next Million Years* as "an interesting little book" but disagreed with its broad conclusions:

> This is a rather gloomy point of view and I don't think it is entirely justified. Sir Charles Darwin does not give credit to the human race for the extraordinary amount of ingenuity it has and its ability to get out of the tight corners which it gets itself into, and perhaps he does not give credit to the human race for its exceptional toughness. The human species is probably the toughest species of all animals. It can exist in every conceivable kind of environment, and it can stand the most appalling strains and stresses, apparently better than almost any other species. Therefore it may be that this long-range view, which has certain philosophical justifications, may prove to be wrong, owing to the remarkable capacity of man to spring surprises.[58]

One of the surprises that Aldous hoped the human race might spring in the near future would be to end what he considered its increasingly destructive relationship to the planet. He was, of course, not alone in desiring this. In 1961, as Aldous was beginning his series of lectures at MIT, his longtime friend and bookseller Jake Zeitlin wrote to say, "I hope you had fun at the

56 A. Huxley, *Human Situation*, 12.
57 Sir Charles Galton Darwin, *The Next Million Years* (New York, 1953), 115–23.
58 A. Huxley, *Human Situation*.

MIT Centennial binge and that you were effective in persuading them not to contribute to the world's final bang."[59]

In assessing the impact of the Huxley brothers on the birth of the global environmental movement during the Cold War decades, the evidence indicates that the divergent views of Julian Huxley and Aldous Huxley helped to create two very different styles of environmental thinking and activism that have each had an enduring legacy. Julian's legacy can be seen not only in the organizations he founded but also in the pragmatic philosophy that informs the joint efforts of transnational nongovernmental organizations, governments, and even some corporations to initiate reforms such as the 1987 Montreal Protocol on ozone depletion and the 1997 Kyoto Protocol on climate change. The philosophical and quasi-religious impact of Aldous Huxley's writings can be seen in the romantic mysticism of the deep ecology movement, in the ethos of community-scale activism that has informed such aspects of the environmental movement as municipal nuclear-free zones and bioregionalism, as well as the Gaia hypothesis that some of his later writings seemed to anticipate.[60]

The Indian historian Ramachandra Guha calls the first two decades after 1945 the age of ecological innocence, stressing that the earlier ecological activism of figures such as George Perkins Marsh and John Muir had largely been obscured by the philosophies of limitless economic growth stressed by governments on both sides of the Iron Curtain and by the political and strategic exigencies of the Cold War itself.[61] Like many historians of environmentalism, Guha identifies Rachel Carson's *Silent Spring* as the single greatest factor in making ecology a major theme in public discourse on both sides of the Atlantic.[62] Both of the Huxley brothers were among the earliest public figures to lend support to Carson's findings. Julian wrote the introduction to the British edition of *Silent Spring*, and Aldous, who was already making ecology a major theme in his lectures at the University of California and MIT, remarked in a letter to Julian about the threat posed by DDT and other chlorinated hydrocarbons to birds in the United Kingdom,

59 Jacob Zeitlin to A. Huxley, Box 1, Folder 2c, Jacob Zeitlin Papers, University of California, Los Angeles Library, Special Collections.

60 "The truth, as we are beginning to realize, is that even things should not be treated as *mere* things. They should be treated as though they were parts of a vast living organism." A. Huxley, *The Politics of Ecology, The Question of Survival* (Santa Barbara, Calif., 1963), 6.

61 Ramachandra Guha, *Environmentalism: A Global History* (New York, 2000), 63–8.

62 "Translated into twelve languages, *Silent Spring* had a striking impact on the resurgence of environmentalism throughout Europe. . . . In Britain the book provoked a furious debate in the House of Lords; outside that august body, it came to the attention of the biologist Julian Huxley." Guha, *Environmentalism*, 73.

"We are losing half the basis for English poetry."[63] This brief exchange epitomizes the vision that Julian and Aldous Huxley shared in spite of all their differences.

Their grandfather, T. H. Huxley, for all his panache as an iconoclast and defender of Darwinism, was deeply concerned with finding some way to preserve what he saw as the moral inheritance of Western civilization. His grandsons shared that paternal anxiety about the preservation of culture but were also concerned with saving the natural world from destruction. Even in the last years of his life, Aldous Huxley described himself as being, in the tradition established by his grandfather, "a cheerleader for evolution," whereas the elder Huxley brother was so acutely aware of his grandfather's legacy that one of his peers made the at once unkind and unforgettable observation that Julian "was so busy trying to be a Huxley that he couldn't be himself."[64] Although the Huxley brothers valued this intellectual inheritance, the crises of the twentieth century would compel them to radically reinterpret the vision of evolution and ethics that their grandfather had advanced at the close of the Victorian age.

The high-water mark of the British Empire had inspired T. H. Huxley to invent a moral cosmology for the human race that was conceived in the image of empire itself, but the exigencies of the Cold War decades inspired the Huxley brothers to search for a new paradigm. In an era of total warfare, exponentially more powerful armaments, and growing environmental devastation, the old ecology of power that had informed T. H. Huxley's classic *Evolution and Ethics* was now irrevocably inverted. Where T. H. Huxley had conceived of human civilization as a sheltered garden in the midst of dangerous wilderness, it seemed now that the rare flower requiring vigilant protection was the wilderness itself, and that human civilization had come to represent the blind and arbitrary constellation of forces outside the garden wall.

63 J. Huxley, preface to *Silent Spring*, by Rachel Carson (London, 1963), 20.

64 In a letter to Timothy Leary, Aldous Huxley wrote, "Become a cheerleader for evolution. That's what I did and my Grandfather before me." David King Dunaway, *Huxley in Hollywood* (New York, 1989), 354. More than a decade after her husband's death, Juliette Huxley included the "so busy trying to be a Huxley" quip and ascribed it to the popular author Jerrard Tickell. J. Huxley, *Leaves of the Tulip Tree*, 205.

11

Atmospheric Nuclear Weapons Testing and the Debate on Risk Knowledge in Cold War America, 1945–1963

TOSHIHIRO HIGUCHI

Modern environmentalism in the United States has frequently been described as a product of the peace and prosperity Americans enjoyed at home in the decades following World War II. The Cold War, so the argument goes, was a long peace for the United States that saw an acceleration of industrialization, suburbanization, and consumption; the resulting reshaping of the relationship between humanity and nature spurred environmentalist awareness.[1] It is easy, however, to forget that the Cold War was not simply a metaphoric war and that military activity played a large part in the environmental history of the Cold War era.

Warfare has been central to human interactions with nature, as Richard Tucker, Edmund Russell, and Arthur Westing have demonstrated.[2] This insight holds true for the Cold War, and perhaps no facet of that conflict better illustrates the environmental consequences of military activity than atmospheric nuclear testing. Between 1945 and 1963, when the United States, the United Kingdom, and the Soviet Union agreed to ban atmospheric and underwater nuclear weapons tests, a total of 459 nuclear bombs were detonated in the atmosphere.[3] Scholars have usually treated atmospheric nuclear testing as an arms control question,[4] as a cultural symbol

1 Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement*, rev. ed. (Washington, D.C., 2005); Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955–1985* (Cambridge, 1987).

2 Richard P. Tucker and Edmund Russell, eds., *Natural Enemy, Natural Ally: Toward an Environmental History of Warfare* (Corvallis, Ore., 2004); Author H. Westing, *Warfare in a Fragile World: Military Impact on the Human Environment* (London, 1980).

3 Robert Norris, "Known Nuclear Tests Worldwide, 1945–98," *Bulletin of the Atomic Scientists* (hereafter *BAS*) 54, no. 6 (1998): 66.

4 Studies focusing on the arms control aspects of atmospheric testing tend to bypass the fallout controversy altogether. Charles Albert Appleby, "Eisenhower and Arms Control, 1953–1961: A Balance of Risks," Ph.D. diss., Johns Hopkins University, 1987; Benjamin P. Greene, *Eisenhower, Science Advice, and the Nuclear Test-Ban Debate, 1945–1963* (Stanford, Calif., 2007); Jeffrey W. Knopf, *Domestic Society and International Cooperation: The Impact of Protest on US Arms Control Policy* (Cambridge, 1998),

of fear,[5] or as the focal point of a biomedical controversy,[6] but not as an environmental problem in which the risk analysis became complicated by the very nature of the pollution itself. Of the few works that cover both arms control and fallout questions, Robert Divine's classic study remains the best treatment on the U.S. case, and Matthew Evangelista's groundbreaking work provides a rare glimpse into the Soviet side of the story.[7] My goal here is not simply to update their accounts but rather to illuminate how the gradual recognition of the complicated environmental factors in the fallout diffusion process shaped the debate over risk knowledge.

As the nuclear power with the longest and most extensive record of atmospheric nuclear testing, the United States found itself at the center of the fallout controversy. The United States, with the arrival of the Eisenhower administration in 1953, had solidly grounded its national security strategy on nuclear forces to be constantly updated by technological innovation.[8] The pursuit of national security led, ironically, to the creation of environmental insecurity in the form of radioactive fallout.[9] To contain that insecurity, Washington attempted to impose an assessment of the risk posed by radioactive fallout that would serve as a standard for its own citizens and the international community.

108–57; P. F. I. Pharo, "A Precondition for Peace: Transparency and the Test-Ban Negotiations, 1958–1963," *International History Review* 22, no. 3 (2000): 557–82; Susanna Schrafstetter and Stephen Twigge, *Avoiding Armageddon: Europe, the United States, and the Struggle for Nuclear Nonproliferation, 1945–1970* (Westport, Conn., 2004), 85–131; Martha Smith-Norris, "The Eisenhower Administration and the Nuclear Test Ban Talks, 1958–1960: Another Challenge to 'Revisionism,'" *Diplomatic History* 27, no. 4 (2003): 503–41.

5 Paul Boyer and Spencer R. Weart add a cultural dimension to our understanding of fallout, offering a sharp insight in its symbolism of fear in the nuclear age. Boyer, *Fallout: A Historian Reflects on America's Half-Century Encounter with Nuclear Weapons* (Columbus, Ohio, 1998), 61–86; Weart, *Nuclear Fear: A History* (Cambridge, Mass., 1988), 183–214.

6 Those that address the health issues associated with nuclear weapons testing usually do not discuss the political context of the East-West rivalry or environmental dynamics of radiation contamination. Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947–1974* (Berkeley, Calif., 1994); Christopher J. Jolly, "Thresholds of Uncertainty: Radiation and Responsibility in the Fallout Controversy," Ph.D. diss., Oregon State University, 2004; Carolyn Kopp, "The Origins of the American Scientific Debate over Fallout Hazards," *Social Studies of Science* 9, no. 4 (1979): 403–22.

7 Robert A. Divine, *Blowing on the Wind: The Nuclear Test Ban Debate, 1954–1960* (New York, 1978); Matthew Evangelista, *Unarmed Forces: The Transnational Movement to End the Cold War* (Ithaca, N.Y., 1999), 45–89.

8 For the nuclear strategy of the Eisenhower administration, see Campbell Craig, *Destroying the Village: Eisenhower and Thermonuclear War* (New York, 1998); John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of American National Security Policy during the Cold War*, rev. ed. (New York, 2005), 125–96.

9 Here I borrow a sociological insight from Ulrich Beck and Anthony Giddens, both analyzing the reflexivity of modernity in which the pursuit of material comforts and safety has ironically led to the creation of many modern risks, ultimately undermining the project of modernity. See Beck, *Risk Society: Towards a New Modernity* (London, 1992); Giddens, *The Consequences of Modernity* (Stanford, Calif., 1990).

Determining the risk of fallout contamination proved to be both scientifically and politically controversial.[10] The fallout controversy centered on two questions: What is an acceptable risk? And who should determine it? By examining three groups of participants in the controversy – scientists, government officials, and grassroots campaigners – I illustrate how Washington claimed a mandate to construct risk knowledge regarding radioactive fallout and how that claim came under challenge both at home and abroad.

ASSESSING THE HAZARDS OF FALLOUT

"Testing of atomic explosives is usually carried out in beautiful surroundings," said Edward Teller, the American physicist known as the "father of the H-bomb." "There is a good reason for this: the radioactive fallout. Because of the fallout, the test site must be isolated."[11] The reason for isolation was simple: to protect humans from high-level radiation, the dangers of which had been well known since the time of the Manhattan Project.[12] But however sincerely government officials and scientists may have pursued that aim, they did not take into account the role of the environment in mediating between human beings and radioactive fallout.[13] Nuclear weapons tests were "not only a matter of physics and engineering," as the botanist and antinuclear activist Barry Commoner once explained, "but a gigantic experiment in ecology as well."[14]

The realization that the environment was by no means a passive diluent of fallout came about through an accident. In the summer of 1946, following an underwater atomic detonation at Bikini Atoll in the Pacific, Lauren Donaldson and his team of marine biologists discovered an astonishing fact. Radioactivity was concentrated not in the skin of the fish, which had come into contact with contaminated water, but in their digestive tracts.[15] This discovery prompted a series of follow-up surveys in the region after 1947 to observe the long-term effects of radiation on fish and other

10 For the political-cultural dimension of risk discourses, see Mary Douglas and Aaron Wildavsky, *Risk and Culture* (Berkeley, Calif., 1982); Sheila Jasanoff, *Risk Management and Political Culture* (New York, 1986).

11 Edward Teller, *Our Nuclear Future: Facts, Dangers, and Opportunities* (New York, 1958), 80.

12 Barton C. Hacker, *The Dragon's Tail: Radiation Safety in the Manhattan Project, 1942–1946* (Berkeley, Calif., 1987).

13 J. Newell Stannard, *Radioactivity and Health: A History* (Richland, Wash., 1988), 770.

14 Speech, "Is Science Getting Out of Hand?" March 30, 1963, in Box 14, Barry Commoner Papers, Manuscript Division, Library of Congress, Washington, D.C.

15 Neal O. Hines, *Proving Ground: An Account of the Radiobiological Studies in the Pacific, 1946–1961* (Seattle, 1962), 38–49.

marine organisms.[16] In a 1951 letter to the U.S. Atomic Energy Commission (USAEC), Donaldson stressed that his ecological research was no less important than physics and engineering: "It is essential . . . that studies evaluating biotic contamination keep pace with the changes in weapon design, materials used, and efficiencies obtained."[17]

As Donaldson and others were trying to zero in on the unknown ecological mechanisms of radioactive contamination, USAEC scientists had determined that strontium 90 (Sr-90) was the isotope in fallout that posed the greatest threat to human health.[18] Constituting about 5 percent of the total fission-origin fallout, Sr-90 is a beta-particle-emitting isotope with a twenty-seven-year half-life. Similar in chemical structure to calcium, Sr-90 is easily taken up by organisms together with calcium and passed along food chains up to humans. Concentrated in bone, Sr-90 can cause terrible diseases such as bone cancer and leukemia. To predict the likely distribution of Sr-90 in the event of a nuclear war, Willard F. Libby, an atomic chemist and USAEC commissioner, proposed that a worldwide survey be conducted to determine the level of Sr-90 contamination in the biosphere, hydrosphere, atmosphere, and lithosphere that had been produced by nuclear weapons tests.[19] In the summer of 1953, the USAEC endorsed the idea and launched Project Sunshine. Sampling air, water, soil, plants, animals, dairy products, and human bones, this secret project was an unprecedented attempt to track all stages of radioactive contamination.[20]

Project Sunshine led to the realization that fallout was transported beyond test sites by a complex geophysical dynamic. An operating hypothesis had once held that fallout, once leaving the danger zone, would dissipate quickly and evenly as it was borne away by winds and ocean currents. In 1954, for example, the USAEC argued that radioactivity collected by ocean currents in the danger zone would become "harmless within a few miles" and "completely undetectable within 500 miles or less."[21]

16 Memorandum, "Resurvey of Bikini," April 18, 1947, in Folder: A3–1, Box 156, Joint Task Force I, Bikini Scientific Resurvey Group Numeric File, 1947–48, Records of the Defense Nuclear Agency, National Archives at College Park (hereafter NACP), College Park, Md.

17 Hines, *Proving Ground*, 130.

18 Draft, "Gabriel," August 13, 1953; Memo, "Summary Outline of Gabriel Program," August 13, 1953, both in Folder: Sunshine – Gabriel – General Files 1951 thru 1953, Box 1, Division of Biology and Medicine, Records Relating to Fallout Studies, 1953–64 (hereafter RRFS), Records of the Atomic Energy Commission (RAEC), NACP.

19 Ibid.

20 Hacker, *Elements of Controversy*, 181–4; U.S. Congress Joint Committee on Atomic Energy, *Nature of Radioactive Fall-Out and Its Effects on Man* (Washington, D.C., 1957), 558.

21 G. C. Spiegel to Tomlinson, April 23, 1954, in Folder: Japan d. Fukuryu Maru 1954, Part 2, Box 422, Special Assistant to the Secretary for Energy and Outer Space, Records Relating to Atomic Energy Matters, 1944–63 (hereafter RAEM), Records of the Department of State (hereafter RDOS), NACP.

That hypothesis was called into question by another test detonation at Bikini. In March 1954, a U.S. hydrogen bomb test at Bikini Atoll accidentally showered radioactive "snowflakes" over American servicepeople, Marshallese natives, and the crew of a Japanese fishing boat.[22] The so-called Bikini incident demonstrated that the range of dangerous local fallout reached as far as two hundred miles – a distance far from local in the ordinary sense of the word. Worse yet, radioactivity was also detected beyond the local range as well. The Japanese started reporting "radioactive rains" that contaminated vegetables and meteoric water throughout the nation thousands of miles away from Bikini.[23] By early 1955, the Japanese oceanographic survey and American follow-up research discovered that differences in temperature in the ocean's layers blocked the rapid vertical diffusion of radioactivity. Remaining near the surface for the most part, radionuclides were being carried by ocean currents northwestward from Bikini toward the Philippines, Taiwan, and Japan.[24]

It was also soon discovered that the sky, too, stored fallout from nuclear weapons testing and distributed it worldwide. Again, an optimistic hypothesis had postulated that radioactive dust would dissipate evenly and remain in the stratosphere for several years before descending to earth with much of its radioactivity depleted.[25] In 1956, however, Lester Machta, of the U.S. Weather Bureau, put forward a competing theory. Fallout, he argued, remains clustered in the stratosphere, leading to the creation of narrow but high-level radiation strips on the earth.[26] In addition, the geographical distribution of radionuclide deposits was found to vary according to rainfall.[27] By 1960, scientists had learned that the vertical air exchange between the stratosphere and the troposphere occurred much faster than had been expected and varied with the season and latitude. Fallout could descend to the earth at high northern latitudes within several months, not years as had been previously believed.[28] All in all, the implications were clear: geophysical forces spared no place on earth from radioactive contamination

22 For the Bikini incident, see Ralph E. Lapp, *The Voyage of the Lucky Dragon* (New York, 1958).

23 For example, see Mitsuo Taketani, ed., *Shi no hai* (Tokyo, 1954), 13, 140–7.

24 Kenkichi Komano and Toshio Taniguchi, *Warera suibaku no umi e: Shunkotsu maru Bikini hōkoku* (Tokyo, 1954); *Operation Troll*, NYO-4656, March 1956, USAEC New York Operations Office, Health and Safety Laboratory; K. D. Nichols to R. B. Carney, January 31, 1955, in Folder: Japan 1. Troll, 1955–56, Box 425, RAEM, RDOS, NACP.

25 See, e.g., W. F. Libby, "Radioactive Fallout and Radioactive Strontium," *Science* 123 (1956): 657–60.

26 L. Machta et al., "World-Wide Travel of Atomic Debris," *Science* 124 (1956): 474–7; U.S. Congress Joint Committee on Atomic Energy, *Nature of Radioactive Fall-Out*, 148.

27 For example, see Edward Hardy and Lyle T. Alexander, "Rainfall and Deposition of Strontium-90 in Clallam County, Washington," *Science* 136 (1962): 881–2.

28 Stannard, *Radioactivity and Health*, 975.

and created dangerous "hot spots" where residents might be exposed to unusually high levels of environmental radiation.

After geophysical forces transported and introduced radioactive dust particles into the biosphere beyond test sites, ecological-biological mechanisms took over the diffusion process. In monitoring this phase, the USAEC hypothesized that the rain-soil-grass-cow-milk chain would be the most important ecological path of Sr-90 intake among humans. Basing its safety assessment on sampling the Sr-90 flow in this food chain, the commission sought to reassure the public by asserting that only a small portion of strontium in soil would be absorbed by grass roots, and that cows would serve as an additional layer of metabolic screening.[29] Some scientists were eager to go beyond mere monitoring and tried to apply this knowledge to solving the fallout question. According to Libby, the screening of Sr-90 through grass and cows could be manipulated as an additional defense against fallout. Increasing the amount of calcium in soil, he reasoned, would reduce the amount of strontium taken up by plants and livestock.[30]

This hypothesis rested, however, on the culturally specific assumption that milk and other dairy products would be the main source of calcium – and Sr-90 – ingested by humans. This milk-centered paradigm behind the USAEC's safety statement was soon criticized by Japan, India, and other non-milk-drinking nations. Indeed, Japanese scientists announced the finding in 1957 that brown rice, the main source of calcium in most Asians' diets, contained up to ten times as much Sr-90 per unit of calcium as milk. This irregularity seemed to indicate a much faster route of Sr-90 absorption than in the case of milk. Rice plants, the Japanese scientists reasoned, might absorb Sr-90 from rain via their leaves rather than through their roots from the soil; Sr-90-contaminated rice would then be eaten directly by humans.[31]

Even in the United States, the milk-based radiation safety calculation became tenuous. In reevaluating the risk factors, one scientist described a finding of his as "a little shocking": "About 200 miles north of here [Washington] several hundred thousand Puerto Ricans and Negroes never see milk. There are other parts of the South where you don't see as much milk."[32] A striking diversity in dietary habits persisted even as rapidly expanding trade and communications were weaving ever-closer ties between nations. Consequently, some groups of people were more exposed

29 For example, Libby, "Radioactive Fallout and Radioactive Strontium."

30 W. F. Libby, "Beneficiation of Soils Contaminated With Strontium-90," *Science* 128 (1958): 1134–5.

31 Mitsuo Taketani et al. to Libby, June 4, 1957, in Folder: Fallout – May thru June 12, 1957, Box 309, General Correspondence, Records of the Joint Committee on Atomic Energy (hereafter RJCAE), National Archives Building, Washington, D.C. (NADC).

32 Minutes, NACOR Meeting, March 8, 1962, p. 70, in Carton 5, Bureau of Radiological Health, Subject Files, 1966–67, Records of the Public Health Service (hereafter RPHS), NACP.

to radiation contamination in food than others. As one scientist pointed out, "In spite of a smoothing influence because of the existence of modern transportation over much of the free world, dietary differences exist and are easily recognizable and in some instances affect major segments (numerically) of the world's population."[33]

The possibility that geophysical and ecological diffusion processes could affect the level of risk posed by radioactive fallout ran counter to prevailing ideas about radiation safety. Earlier, it had been assumed that fallout, once emitted into the stratosphere, would be diffused uniformly in the environment. It was therefore believed that a single safety standard, taking account of the biomedical and genetic effects of radiation, would suffice. By the time the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) issued its first report of the hazards of fallout in 1958, however, growing numbers of scientists had come to believe that fallout distribution was uneven on account of environmental and human factors. In its report, UNSCEAR endorsed the argument that plant-eaters were potentially exposed to more Sr-90 than milk drinkers.[34] One USAEC scientist declared himself "a little surprised" when even the British came to accept the idea of risk differential between a plant-based diet and a milk-based one.[35]

The attempt to establish definitive safety standards suffered a further blow when a series of biomedical and genetic findings undermined the idea of a radiation safety threshold.[36] After the Bikini incident had highlighted the danger of fallout, geneticists publicly disputed the idea that a "maximum permissible dose" (MPD) of radiation existed and that exposure to radiation below that limit would not pose a threat to human health. Any increase in the level of radiation to which humans were exposed beyond naturally occurring background radiation, biologists and medical researchers realized, could cause additional damage to human genes, which in turn could lead to birth defects, disability, or premature death. By 1956, the U.S. National Academy of Sciences had accepted the no-threshold theory for the genetic effects of exposure to radiation.[37] The concept of threshold was still upheld

33 Memo, "Comment on Lamont Fallout Program," October 8, 1959, in Folder: Bulletin – January 15, 1956, Box 5, RRFS, RAEC, NACP.

34 *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation* (New York, 1958), 12, 14.

35 Durham to Hickenlooper, October 22, 1958, in Folder: 13.10 UN Scientific Comm on Radiation 1958 Part 1, Box 237, RAEM, RDOS, NACP.

36 For the discussion of the MPD, see Jacob Darwin Hamblin, *Poison in the Well* (New Brunswick, NJ, 2008), 51–60, 66–72, 99–116; Jolly, "Thresholds of Uncertainty"; J. Samuel Walker, *Permissible Dose: A History of Radiation Protection in the Twentieth Century* (Berkeley, Calif., 2000).

37 U.S. National Academy of Sciences, *The Biological Effects of Atomic Radiation: A Report to the Public* (Washington, D.C., 1956), 3–4.

for somatic effects, but Edward B. Lewis, a biologist at California Institute of Technology, soon called this assumption into question as well. In May 1957, he published a study of statistical data about radiologists and survivors of the Hiroshima and Nagasaki bombings. In it, he found no evidence of a safe threshold at least as far as the risk of leukemia was concerned.[38] As uncertainty about the threshold hypothesis grew, the International Commission on Radiological Protection (ICRP) repeatedly revised MPD levels downward.[39]

Far from providing a foundation for consensus, the growing body of scientific evidence deepened the uncertainty about fallout hazards and called attention to a series of political and ethical questions that needed to be addressed. With the members of the scientific community divided on how to judge fallout hazards, policy makers in Washington took up the problem of risk assessment.

THE POLITICS OF A GLOBAL RISK STANDARD

Even as a growing body of scientific evidence was complicating the understanding of radiation risks, Washington remained confident that it had the political power and scientific authority to set international standards for radiation hazards compatible with its national security policy. Indeed, it was the United States that sponsored the establishment of UNSCEAR in December 1955. First broached by the Federation of American Scientists after the Bikini incident, the idea of creating a UN body to address radiation hazards was taken up by the Eisenhower administration as a means to counter the call for an immediate suspension of atmospheric testing. As Henry Cabot Lodge Jr., the U.S. ambassador to the United Nations, argued in a memo to Secretary of State John Foster Dulles, establishing such a body would focus attention on scientific facts and would dispel the pressure for a testing moratorium.[40] Confident about U.S. prominence in science, the State Department approved Lodge's idea, predicting that UNSCEAR's findings would provide "internationally-acceptable proof [of] US contention [that] there have been no health hazards resulting [from] atomic testing."[41]

38 E. B. Lewis, "Leukemia and Ionizing Radiation," *Science* 125 (1957): 965–72.

39 Merril Eisenbud and Thomas Gesell, *Environmental Radioactivity: From Natural, Industrial, and Military Sources*, 4th ed. (San Diego, 1997), 42–3, 48.

40 Lodge to John Foster Dulles, "Atomic Radiation," May 3, 1955, in Folder: 13.5b Studies on Effects of Radiation and Fallout, 1955, Box 232, RAEM, RDOS, NACP.

41 Draft telegram to USUN, New York, enclosed to Smith to Wainhouse, "UN Collection of Radiation Data," April 19, 1955, in Folder: 13.5b Studies on Effects of Radiation and Fallout, 1955, Box 232, RAEM, RDOS, NACP.

At the same time that it was trying to combat anxiety about fallout by seeking a global consensus on radiation safety standards, the U.S. government also sought to convince the international community that atmospheric nuclear testing should be considered first and foremost as an arms control issue. There was consensus in Washington that "the United States should not agree to a test moratorium except as a part of a comprehensive safeguarded disarmament agreement."[42] Washington was reluctant to agree to a test ban that did not make provision for verification, as it feared deception on the part of the Soviet Union.[43] Indeed, arguments centering on the "technical difficulty" of enforcement repeatedly trumped President Dwight Eisenhower's personal desire to see nuclear weapons testing stopped.[44]

The fallout controversy moved to the center of American political life during the 1956 presidential campaign. As the scientific community was still at odds over the health hazards of radioactive fallout, Democratic candidate Adlai Stevenson seized upon the disagreement among scientists and called for a ban on testing hydrogen bombs, which were powerful enough to inject Sr-90 into the stratosphere and spread it across the world.[45] Alarmed by Stevenson's move, the Eisenhower administration was forced to take action to appease public concerns about the health risks of fallout. One option was to make public plans to develop a "clean bomb" that would release smaller quantities of Sr-90 and other hazardous fission products than existing nuclear bombs.[46] Although some officials opposed disclosing those plans, Teller strongly endorsed doing so as a propaganda weapon to silence the call for a test ban.[47] In July 1956, USAEC chair Lewis Strauss announced with much fanfare that the commission was working on a clean bomb, which was "of importance not only from a military point of view but from a humanitarian aspect."[48]

42 Memo, May 23, 1955, enclosed to Smith to Lay, June 6, 1955, in Folder: #20 Moratorium on Tests (2), Box 6, Executive Secretary's Subject File Series, National Security Council Staff Papers, 1948–61, White House Office (hereafter WHO), Dwight D. Eisenhower Library (DDEL), Abilene, Kansas.

43 Deborah Welch Lawson, *Anatomy of Mistrust: US-Soviet Relations during the Cold War* (Ithaca, N.Y., 1997).

44 Greene, *Eisenhower, Science Advice, and the Nuclear Test-Ban Debate*.

45 For the Stevenson campaign on Sr-90 and the test ban issue, see Divine, *Blowing on the Wind*, 86–112.

46 For the detailed discussion of the clean bombs, see ibid., 81–3, 147–52, 192–3; Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953–1961: Eisenhower and the Atomic Energy Commission* (Berkeley, Calif., 1989), 346–8, 398–402; Toshihiro Higuchi, "'Clean' Bombs: Nuclear Technology and Nuclear Strategy in the 1950s," *Journal of Strategic Studies* 29, no. 1 (2006): 83–116.

47 Teller to Starbird, June 5, 1956, enclosed to McCool to the Commissioners, June 7, 1956, DOE/NV, No. 0074094, U.S. Department of Energy Nevada Operations Office (hereafter DOE-NOO), Las Vegas, Nev.

48 Press Release by Lewis L. Strauss, July 19, 1956, reprinted in *BAS* 12, no. 7 (1956): 263.

The idea of using technology to solve the problem of radioactive contamination soon fell victim to cold, hard reality, however. American military strategy and tactics relied on both clean and dirty bombs. Lethal radioactive contamination might be necessary, for instance, to deny ground to the enemy.[49] American officials feared, moreover, that emphasizing clean weapons might seriously handicap other areas of the country's weapons program, including the development of small but not necessarily clean intercontinental ballistic missile warheads. They worried, as one USAEC official noted, that "pressure would come from the United Nations or other sources to limit tests in the future to 'Clean Weapons.'"[50] By mid-1958, national security calculations and the technological difficulty of reducing fallout without losing firepower dampened the enthusiasm for a clean bomb in Washington.[51]

"Self-regulation" emerged as another option in the search for ways to address growing public anxiety. This idea was put forward by the United States' closest ally and fellow nuclear power, Great Britain. In the fall of 1956, the British government found itself under heavy public criticism following its announcement of plans to test a hydrogen bomb. It sought, in response, a way to limit nuclear testing without banning it entirely.[52] On the basis of recommendations put forward by the British Medical Research Council, Whitehall decided in December to sound out the United States about a limitation proposal. As an interim measure to contain Sr-90 without impeding weapons development, the British proposed that an annual worldwide yield quota of fifteen megatons derived from fission be imposed and divided among the United States, the Soviet Union, and Britain.[53]

Washington vehemently opposed the idea of a voluntary limit on testing. It insisted that fallout adrift beyond testing sites, not the total radioactivity released into the atmosphere, was what posed an international health threat

49 Memorandum of Conversation, "Atomic Energy Items: (1) French Request (2) Test Limitation," March 23, 1957, in Folder: CF 861, Box 127, Executive Secretariat, Conference Files, 1949–1963, RDOS, NACP.

50 Chuck Hansen, *The Swords of Armageddon: History of the U.S. Development of Nuclear Weapons since 1945* (Sunnyvale, Calif., 1995), 5:199.

51 See, e.g., memo, "Cancellation of Invitation . . . ," December 15, 1958, in Folder: 1958, Box 10, Records Relating to the State Department Participation in the Operation Coordinating Board and the National Security Council, 1947–1963, RDOS, NACP.

52 Lorna Arnold, *Britain and the H-Bomb* (New York, 2001), 124–5. For the history of the British nuclear disarmament movement, see R. K. S. Taylor, *Against the Bomb: The British Peace Movement, 1958–1965* (New York, 1988).

53 Memo, "Limitation of Nuclear Tests," E137, n.d.; "C.P. (56) 343 – Nuclear Weapons Tests," E143, October 24, 1956; "Extract from Minutes of Cabinet Defense Committee Meeting, December 20, 1956, DC (56) 11th Meeting," n.d., all in DEF 7/2289, National Archives: Public Record Office (hereafter TNA-PRO), Kew, United Kingdom.

and that there was no way to measure that fallout accurately. Moreover, Washington argued, the progress in developing a clean bomb had made it extremely difficult to estimate the yield derived from fission, as opposed to that from fusion, by field observation.[54] Beyond the technical problems, the Eisenhower administration feared that "the public would think wrongly that a danger level had already been reached" and that imposing a fallout ceiling would fuel the argument that "atomic retaliation above this level in wartime was unacceptable."[55] At a March 1957 Anglo-American summit in Bermuda, Strauss avoided the fixing of a numeric quota and instead proposed a general statement about self-restraint.[56] In the joint communiqué, Eisenhower and Prime Minister Harold Macmillan simply pledged to continue nuclear tests "only in such manner as will keep world radiation from rising to more than a small fraction of the levels that might be hazardous."[57]

Washington's confidence in its ability to set fallout safety standards for the rest of the world did not go unchallenged by its Cold War rival. While the U.S. delegates at UNSCEAR downplayed the hazards of radioactive fallout, their Soviet counterparts tried to underline a fundamental difference between peaceful use of atomic energy and fallout from weapons testing. Noting that X-rays and isotopes used in medicine as well as radiation hazards for industrial workers and scientists were strictly controlled and the purposes of their activities considered beneficial, the Soviet delegation pointed out that the radioactive waste products of atomic test explosions "defy regulation and there are no scientific grounds for considering them as beneficial to human populations."[58] The Soviet argument earned support not only from the delegations of the other socialist nations but also from the Mexican and Belgian representatives as well.[59] The final report reflected the general consensus that environmental contamination could not be controlled and acknowledged that the hazards of radioactive fallout were, by their very nature, "beyond the control of the exposed persons."[60]

Faced with international pressure, the U.S. delegates attempted to salvage the situation by insisting that the final report explicitly state that nuclear

54 Memo, "Limitation of Nuclear Tests," February 20, 1957, DEF 7/2289, TNA-PRO.

55 Memo, "Limitation of Nuclear Tests, Note for Meeting," n.d., DEF 7/2289, TNA-PRO; Memorandum of Conversation, "Atomic Energy Items . . . ," March 23, 1957.

56 *FRUS, 1955–1957* (Washington, D.C., 1992), 27:741.

57 *Public Papers of the Presidents* (hereafter PPP): *Dwight D. Eisenhower, 1957* (Washington, D.C., 1958), 212.

58 USSR Proposal for Para 56 Chapter C.D. (Radiological Data), February 17, 1958, in Folder: 13. Radiation General Jan-March, 1958, Box 246, RAEM, RDOS, NACP.

59 New York to Washington, no. 905, February 21, 1958, in Folder: 13. Radiation General Jan-March, 1958, Box 246, RAEM, RDOS, NACP.

60 *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation*, 41.

testing was a matter of national decision.[61] The Soviets countered by calling for the insertion of a statement against testing. In the end, UNSCEAR adopted a compromise. Its final report envisioned "the cessation of contamination of the environment by explosions of nuclear weapons" as one of the "steps designed to minimize irradiation of human populations," and it recognized the principle of national sovereignty in general terms. "Considerations involving effective control of all these sources of radiation," the report noted, "involve national and international decisions which lie outside the scope of [UNSCEAR's] work."[62]

As UNSCEAR was working on its final report, Moscow made an unexpected move. In a speech before the Supreme Soviet on March 31, 1958, Foreign Minister Andrei Gromyko announced that the Soviet Union would unilaterally suspend further nuclear tests.[63] This announcement dramatically bolstered Moscow's standing and dealt as devastating a blow to America's international reputation as the launch of Sputnik had several months earlier. Privately, Eisenhower acknowledged that the United States was losing the battle for world opinion. "As in the case of Sputnik, world opinion, even if not well founded, is a fact; world anxiety exists over tests, and causes tension."[64]

Despite mounting pressure, the Eisenhower administration refused to follow the Soviets and unconditionally suspend U.S. nuclear testing. The impasse was finally broken when the Soviet Union agreed to send a delegation of scientists to meet with their American and British counterparts to explore reliable methods of enforcing a test ban. The conference, which took place in Geneva during the summer of 1958, determined that it would be "technically feasible" to create a system to detect violations of a test ban. The United States thereupon announced its intention to suspend testing while the scientists in Geneva prepared a verification system.[65]

Although the United States successfully reemphasized the arms control aspect of nuclear testing, the process leading toward a test ban signaled Washington's failure to win international recognition of its assessment of fallout risks. Moreover, it continued to refuse to recognize health concerns

61 Memorandum of Telephone Conservation, June 9, 1958, in Folder: 13 Radiation, General June-July 1958, Part 1 of 2, Box 246, RAEM, RDOS, NACP.

62 *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation*, 41.

63 For insights in the Soviet decision on the test moratorium, see Evangelista, *Unarmed Forces*, 53–7.

64 Memorandum of Conference with the President, March 24, 1958 – 4:00 pm, March 28, 1958, in Folder: Atomic Energy Commission, Vol. 2 (2), Box 3, Alphabetical subseries, Subject series, Office of the Staff Secretary (hereafter OSS), WHO, DDEL.

65 For the Geneva technical conference, see Kai-Henrik Barth, "Detecting the Cold War: Seismology and Nuclear Weapons Testing, 1945–1970," Ph.D. diss., University of Minnesota, Minneapolis, 2000, 131–61; Divine, *Blowing on the Wind*, 225–31.

as a reason for a test ban. As the Eisenhower administration was considering its options in anticipation of the conclusion of the Geneva conference, Dulles insisted that the rationale for a change of policy in favor of a test ban had to be arms control, not health. In a letter to Macmillan, Dulles explained that casting a moratorium as a step for disarmament would "put the Russians under pressure to do something in this field, as otherwise they will carry the responsibility for the resumption of testing [by Britain and the United States]." This was part of the reason the United States did not want to agree to a test moratorium on terms that implicitly acknowledged the health hazards posed by atmospheric testing. Dulles wrote: "If we did that, then indeed we might have burned our bridges behind us."[66]

Once describing the nuclear armament problem as "a chess game" in which the free world must avoid finding itself "checkmated" by the Soviet Union,[67] Dulles tried to salvage some room for maneuver after Washington declared its own moratorium on testing. The moratorium nevertheless signaled the end of the one era in which the United States had exercised its scientific and political leadership to set a global risk standard.

THE POLITICS OF A DOMESTIC RISK STANDARD

The deepening uncertainty about the risks of radioactive fallout that undermined U.S. efforts to control a risk discourse in the international arena also brought an end to the domestic consensus on the dangers the country faced in the Cold War. Growing skepticism toward Washington's safety assessments prompted the formation of the National Committee for a Sane Nuclear Policy (SANE). In August 1956, Norman Cousins, the editor of *Saturday Review*, met the biologist Barry Commoner, who informed him in detail about the dangers of fallout and the human costs of nuclear testing.[68] From Graham DuShane, a professor of zoology at Stanford University, Cousins later learned that the USAEC had consistently "put the burden of proof on those who would show damage."[69] Indeed, in the inner policy circle, the defense officials and the USAEC then prevailed with an argument

66 New York to Washington, no. DULTE 2, August 21, 1958, in Folder: Nuclear Testing – Cessation [August 1958 – July 1960] (1), Box 21, Alphabetical subseries, Subject series, OSS, WHO, DDEL.

67 Memorandum of Conversation, "Call by Dr. Matsushita, Special Envoy to United Kingdom," April 21, 1957, in Folder: MC-Japanese, Jan-June, 1957, Box 2, Bureau of Far Eastern Affairs, Memoranda of Conversation, 1957, RDOS, NACP.

68 Milton S. Katz, *Ban the Bomb: A History of SANE, the Committee for a Sane Nuclear Policy, 1957–1985* (Westport, Conn., 1986), 16.

69 Minutes, June 21, 1957, in Folder: Minutes, resolutions, etc. Provisional (ad hoc) Committee, June 21, 1957–September 24, 1957, Box 4, Series A, Papers of SANE Inc. (hereafter SANE Papers), Swarthmore College Peace Collection (hereafter SCPC), Swarthmore, Pa.

that "so long as continued technical studies do not reveal solid basis, these fears [on genetic damage] do not constitute justification for abandoning our tests."[70] This doctrine about the burden of proof allowed the government to continue nuclear tests as long as the scientific community remained split over the nature and degree of radiation hazards.

The disagreement among the scientists, however, did not deter Cousins from acting. "When important scientists disagree," he argued, "we must be concerned."[71] Whereas Washington insisted that nuclear weapons testing should continue until the risk in doing so was proved to exist, Cousins argued that the possibility of risk was sufficient reason to suspend testing until it was proved that the risk did not exist. "What we do not know is more important here than what we know," he insisted.[72]

Determined to check nuclear testing, Cousins and the other founders of SANE framed the peril of radioactive contamination as a moral issue of natural rights. In SANE's statement of purpose, they declared:

> Neither the United States, Soviet Union, nor Great Britain has the moral right to poison the air or contaminate the land that belongs to other peoples. These countries have the right to take whatever risks they wish in the pursuit of their own security, but no country has the right to seek security at the expense of another.[73]

As SANE was urging to the public to reinterpret the problem of radioactive pollution in terms of natural rights, the radical pacifists who had gathered as the Committee for Non-Violent Action (CNVA) sought to translate that compelling moral message into action. Beyond their usual opposition to nuclear testing as a form of preparation for war, the CNVA activists saw the hazards of radioactive fallout as a moral crisis that called for civil disobedience. On the eve of a sit-in at the Nevada Test Site in August 1957, CNVA issued a manifesto declaring that the scientific debate over the extent of the danger posed by fallout was "beside the point": "As long as there is any question of danger to life anywhere, or real or possible menace to children yet unborn, no argument can justify such risks."[74]

As SANE and CNVA challenged the government's assessment of fallout hazards by invoking moral arguments, some scientists opened a new line of

70 Memo, May 23, 1955.

71 Minutes, October 1, 1957, in Folder: Minutes, resolutions, etc. Executive Committee 1957–1959, Box 4, Series A, SANE Papers, SCPC.

72 Ibid.

73 Memo, "The Purpose and Program of the National Committee for a Sane Nuclear Policy," n.d., in Folder: Statements, . . . 1957–1958, Box 2, Series A, SANE Papers, SCPC.

74 Memo, "A Call to Non-Violent Action against Nuclear Weapons," n.d., in Folder: Projects Nevada Vigil 1957, Box 11, Committee for Nonviolent Action Papers, SCPC.

critique by calling attention to the ethics of the presentation of scientific data in risk analysis. The best example of this critique was Linus Pauling's response to Edward Teller's defense of the government's nuclear policy.[75] Teller maintained that the theoretical number of casualties from fallout was statistically too small to be verifiable. Should past tests cause an additional 10,000 deaths from leukemia and bone cancer, Teller said, "statistical methods are not able to find the difference between 6,000,000 and 6,010,000."[76] Reducing commonly accepted risks associated with modern life such as car accidents, the argument ran, would have more measurable benefit than eliminating radioactive fallout.[77]

For Pauling, Teller's presentation of the problem of risk assessment was fundamentally misleading. During a television debate with Teller in the spring of 1958, the Nobel laureate chemist attacked his opponent's argument that the genetic damage from fallout caused an increase of one-tenth of 1 percent in the number of mutations. He pointed out that Teller, intentionally or not, "[did] not mention the *number* of defective children that will be produced by a one-tenth per cent increase in the number of mutations; it is one thousand five hundred a year" (emphasis added).[78] Teller may have been content to discuss a theoretical risk in terms of fractions of a percentage point, but Pauling felt a moral impulse to speak of numbers of people to rescue those potential victims from the abstraction of probabilities.[79]

If the debate over the quantification of risk might have struck many laypeople as esoteric, the problem of monitoring radiation proved much more germane and closer to the concerns of ordinary citizens. Invisible, odorless, and tasteless, nuclear fallout is imperceptible to the human senses. Yet it was ubiquitous, if unevenly distributed around the globe, during the era of atmospheric nuclear testing – in the air people breathed, in the water they drank, and in much of the food they ate. Scientific monitoring of environmental radiation was therefore imperative.

When Project Sunshine was finally declassified in early 1957, many scientists realized that the sampling efforts had been hampered by the secrecy

75 For details about Pauling, Teller, and their respective political and moral positions concerning nuclear testing, see Paul Harold Rubinson, "Containing Science: The U.S. National Security State and Scientists' Challenge to Nuclear Weapons during the Cold War," Ph.D. diss., University of Texas at Austin, 2008, 66–176.

76 Teller, *Our Nuclear Future*, 120.

77 For instance, see ibid., 24; Eugene P. Wigner, "Fallout: Criticism of a Criticism," *BAS* 16, no. 3 (1960): 108.

78 *Fallout and Disarmament: A Debate* (San Francisco, 1958), 8.

79 Body counts as a mode of persuasion have been in use to justify the progress and success of warfare as well. See, e.g., Eric V. Larson, *Casualties and Consensus: The Historical Role of Casualties in Domestic Support for U.S. Military Operations* (Santa Monica, Calif., 1996).

surrounding the project and that the resulting statistical data on Sr-90 was incomplete.[80] Against this backdrop, Herman M. Kalckar, a Johns Hopkins University biochemist, proposed that a study be carried out to measure Sr-90 levels in infants' teeth around the world to assess the fallout hazard to the most sensitive segment of the population. Barry Commoner and the Greater St. Louis Citizens' Committee for Nuclear Information (CNI) responded by launching the Baby Tooth Survey in December 1958.[81] Appealing for voluntary donations of children's teeth to aid science and the welfare of the future generations, CNI collected 67,500 teeth in two years and a total of 110,000 by the end of four years.[82]

In launching this remarkable grassroots initiative, Commoner aimed not only to compile more accurate scientific data than hitherto available but also to create a partnership between scientists and citizens. Such a partnership was necessary, he believed, because all citizens, not just scientists, should have a say in deciding the trade-offs between national security and environmental security.[83] There is, he wrote in a 1958 article, "no scientific way to balance the possibility that a thousand people will die from leukemia against the political advantages of developing more efficient retaliatory weapons." Therefore, scientists must disclaim "any special moral wisdom" on the fallout question and instead focus on public education to enable the citizen to "decide for himself whether nuclear tests should go on or be stopped."[84] CNI's collaborative monitoring project successfully engaged many citizens and raised their awareness of the potential environmental and human costs of the security provided by nuclear weapons.

The call for a broader fallout monitoring system was soon taken up by American consumers. Living amid unprecedented prosperity and passionate about the private pursuit of happiness, American consumers might seem unlikely opponents of Washington's nuclear weapons policy. But once they learned that they were exposed to nuclear fallout in the food on their tables, the environmental costs of national security ceased to be a remote, abstract issue. The government's program of monitoring food-borne fallout, however, did not reassure them. In mid-1957, the United States had only five sampling stations nationwide to check for radioactive contamination in

80 For the adverse effects of secrecy on Project Sunshine, see Hacker, *Elements of Controversy*, 182–4.

81 H. M. Kalckar, "An International Milk Teeth Radiation Census," *Nature* 182 (1958): 283–4.

82 *Nuclear Information* 4, no. 1 (1961): 1–2; ibid., 5, no. 5 (1963): 1–2. For details, see Michael Egan, *Barry Commoner and the Science of Survival: The Remaking of American Environmentalism* (Cambridge, Mass., 2007), 66–72.

83 Barry Commoner, *Science and Survival* (New York, 1967), 118–20.

84 Barry Commoner, "The Fallout Problem," *Science* 127 (1958): 1024.

milk.[85] Frustrated by the government's reluctance to expand its monitoring network, the Consumers Union launched its own fresh milk survey in the summer of 1958. "It seems wholly right for a consumer testing organization to undertake to evaluate a new constituent of our food, even one not proclaimed on any label," an article in *Consumer Reports*, the Consumers Union's widely read magazine, explained.[86]

The method the Consumers Union employed in its survey was simple yet highly effective in challenging the government's safety assurances. It randomly selected one bottle of milk at each of fifty grocery stores widely dispersed across the United States and Canada and measured the Sr-90 content of each sample. "That a private organization of limited means can carry out such a program suggests that an expanded monitoring network should be economically feasible under Federal, state, or even community or dairy auspices," the *Consumer Reports* article noted.[87] Asked by a congressional committee about this survey, the acting surgeon general acknowledged that "lack of coverage" was one of the weaknesses of the government's monitoring program.[88] By launching its own sampling initiative, the Consumers Union undermined the government's monopolistic claim to authority in assessing the threat of radioactive fallout.

The Consumers Union consumers quickly expanded the scope of monitoring efforts. In 1960, aware that risk of exposure to radioactive contamination varied with dietary habits, the organization asked the home economics departments of colleges and universities in twenty-four cities in the United States and one in Canada to send a sample of a typical teenager's daily food consumption – three meals and snacks – for testing. The study found that milk was the major but not sole source of food-borne fallout. On average, milk accounted for about half of Sr-90 intake. Results varied sharply from city to city. Once again, the Consumers Union publicly demonstrated the shortcomings of official monitoring efforts.

The consumers' movement spearheaded by the Consumers Union was, in the conservative social climate of the 1950s, heavily gendered. The typical consumer was a woman, the housewife dedicated to caring for her family. Although women were not welcomed as participants in discussion of political issues deemed "men's politics" in Cold War America, the conservative gender role assigned to them legitimatized not only their concerns

85 U.S. Congress Joint Committee on Atomic Energy, *Nature of Radioactive Fall-Out*, 565.
86 "The Milk All of Us Drink – And Fallout," *Consumer Reports* 24, no. 3 (1959): 102.
87 Ibid., 103.
88 Acting Surgeon General to the Joint Committee on Atomic Energy, May 17, 1959, in Folder: Fallout – Strontium 90 – Milk, Box 312, General Correspondence, RJCAE, NADC.

about Sr-90 in milk and other foodstuffs but also, ironically, their political activism to halt fallout pollution.[89] Fears of radiation contamination intensified sharply in September 1961, when the Soviet Union unexpectedly resumed atmospheric testing of nuclear weapons after a three-year moratorium. Dagmar Wilson, a children's book illustrator and member of SANE in Washington, began with her friends to canvass women across the country. The result was a nationwide women's strike on November 1, 1961. More than fifty thousand women left their homes and workplaces that day to send a clear signal to the nation's male leaders.[90] Their message was summed up in an open letter written by Wilson addressed to President John F. Kennedy: "American women today are most concerned that there be *no more contamination*," the letter declared. "We want to see an end to nuclear testing by *any* country" (emphasis in original).[91]

Building on the success of the November 1 action, Wilson and her supporters launched a campaign called Women Strike for Peace (WSP). They grounded their protest primarily on their social duty and moral authority as housewives and mothers. But the arguments they employed also reflected a sophisticated understanding of the limitations of the government's assessment of fallout risks. As one WSP memorandum noted, "Until there is clear statistical evidence that radioactive fallout is causing health damage, the problem will not emerge fully into public debate. Unfortunately it may take five years or more before such 'proof' is produced, while in the meantime the damage is being irremediably done, according to the less conservative estimates of the more alarmed scientists."[92] "As mothers whose children may become expendable through a statistical approach," the WSP members raised their voices against the supposedly scientific use of statistics by the government to deflect criticism and put the burden of proof on opponents of nuclear testing.[93] For them, protesting against nuclear weapons testing was a matter of self-defense against the tyranny of the government's risk assessment.

Confronted with the Soviet Union's resumption of atmospheric testing, policy makers in the Kennedy administration were split on the question of

89 K. A. Cuordileone, *Manhood and American Political Culture in the Cold War* (New York, 2005); Amy G. Swerdlow, *Women Strike for Peace: Traditional Motherhood and Radical Politics in the 1960s* (Chicago, 1993), 234–6.

90 Ibid., 15–16.

91 Wilson to Kennedy, December 1, 1961, in Folder: Literature 1961, Box 1, Series A-2, Papers of Women Strike for Peace (hereafter PWSP), SCPC.

92 Memo, "A Report on Radioactive Iodine," August 1962, in Folder: Literature May 1962 – December 1962, Box 2, Series A-2, PWSP, SCPC.

93 Memo, "Report on Health Hazards from Fallout," December 1, 1961, in Folder: Literature Sept 1961 – April 1962, Box 2, Series A-2, PWSP, SCPC.

whether the United States should follow. All were in complete agreement on one point, however: a national security decision should not rest on the issue of radioactive contamination. Arguing against the U.S. resumption of testing above ground, Arthur Schlesinger Jr., Kennedy's trusted adviser, believed that the essential point of international concern was "not so much the fallout problem . . . as it is a spreading fear that the arms race is getting completely out of control."[94] Kennedy nonetheless seems to have taken fallout dangers very seriously. In a letter urging the president to resume the tests, Secretary of State Dean Rusk voiced his sympathy with "the concern" Kennedy had expressed "at having even one individual affected by radioactive fallout." But, he continued, "I believe that the hazards from fallout produced by such testing as we may carry out are minimal as compared with the hazards which might be caused by misunderstandings about our nuclear strength."[95] Faced with two kinds of hazard, Kennedy finally gave the green light to the resumption of testing. The threat to national security again outweighed the threat of radioactive contamination.

Kennedy evaded the fallout question when he announced his decision to resume atmospheric testing "for purely military reasons" in February 1962.[96] The WSP and other concerned groups were determined to draw attention to the ignored risk of radioactive contamination. Contacting other peace groups, the WSP called for a boycott of fresh milk not only as a symbolic protest but also as a preventive measure to safeguard children's health.[97] Building on the theme of the welfare of future generations, SANE, too, reemphasized radiation hazards and mobilized pediatricians, including the famous Benjamin Spock.[98] Together, the antinuclear groups projected the uncertain risk of fallout onto the compelling cultural image of women and children and demanded that these potential victims no longer be excluded from the discourse of national security. The WSP declared: "We the irradiated feel we should have a voice in deciding whether a risk was 'undue' or not."[99]

The mothers' protest could not halt the vicious cycle of the nuclear test race. But their voice caught Kennedy's attention when he sought to rally public support for his renewed pursuit of a test ban. In July 1963, when

94 *FRUS 1961–1963*, 7:282.

95 Ibid., 320–1.

96 *PPP: John F. Kennedy, 1962* (Washington, D.C., 1963), 128.

97 Amy G. Swerdlow, "The Politics of Motherhood: The Case of Women Strike for Peace and the Test Ban Treaty," Ph.D. diss., Rutgers University, 1984, 415–20.

98 Lynn Z. Bloom, *Doctor Spock: Biography of a Conservative Radical* (Indianapolis, 1972), 240–6; Katz, *Ban the Bomb*, 74–6.

99 Memo, "What You Don't Know Can Hurt You . . . A Report on the June 3–6 Fallout Hearings," n.d., in Folder: Literature circ 1963, Box 2, Series A-2, PWSP, SCPC.

negotiations in Moscow led to a test ban treaty except for underground explosions, Kennedy addressed the nation in a television speech. In it, he justified the partial test ban partly as an answer to concerns among mothers. He admitted that the number of the future generations suffering from the fallout hazards might be statistically small. "But," he continued, "this is not a natural health hazard – and it is not a statistical issue. . . . Our children and grandchildren are not merely statistics toward which we can be indifferent."[100] Responding to Kennedy's call for support, the WSP, SANE, and many other antinuclear groups marshaled public opinion in favor of the ratification of the treaty.[101]

Kennedy's expressions of concern notwithstanding, public anxiety about fallout did not figure in the administration's defense of the test ban treaty before the Senate. When Glenn T. Seaborg, a prominent chemist who had become chair of the USAEC in 1960, spoke of the treaty's benefits before the Senate Foreign Relations Committee, Senator Richard B. Russell of Georgia did not hide his "surprise" that Seaborg "did not refer to any advantages to be gained from lessened fallout" in light of the importance of the "mother vote."[102] Seaborg did not assign primary importance to the "fallout peril": "I don't rate [fallout] as great a problem as some of the other reasons for the test ban."[103] National security considerations alone, Seaborg and other administration officials stressed, should inform the debate on the treaty's ratification. On September 24, 1963, the Senate voted eighty to nineteen in favor of the treaty.

Ironically, the government began to extol the treaty's environmental benefits only after it became clear that it had done little to check the arms race. The tempo of U.S. testing actually accelerated when it was moved underground as a result of the Partial Test Ban Treaty: 338 nuclear devices were detonated in the eight years between 1964 and 1971, as compared to 347 during the previous nineteen years.[104] Indeed, it had already become clear by the summer of 1964 that the treaty was not going to put an end to the arms race. When President Lyndon B. Johnson issued a statement marking the first anniversary of the Senate's ratification of the treaty, he stressed its importance for reducing environmental insecurity: "We can live in strength without adding to the hazards of life on this planet. We need

100 *PPP: John F. Kennedy, 1963*, 603.

101 Wittner, *Struggle against the Bomb*, 2:425–8.

102 U.S. Congress, Senate, Committee on Foreign Relations, *Nuclear Test Ban Treaty* (Washington, D.C., 1963), 214.

103 Ibid., 219.

104 Norris, "Known Nuclear Tests Worldwide, 1945–98," 66.

not relax our guard in order to avoid unnecessary risks. This is the legacy of the nuclear test ban treaty and it is a legacy of hope."[105]

CONCLUSION

Throughout the fallout controversy, scientists, government officials, and citizens were confronted by two closely linked questions: How could risk be determined? And who would be the final arbiter in assessing risk? The hazard model endorsed by the scientific community rested on the assumption that fallout would appear widely and uniformly through the biosphere and that an ample margin of biomedical safety existed. As a series of findings revealed the complex functioning of geophysical and ecological mechanisms and their interaction with human diets, risk assessment became more complicated. Support for the hypothesis of no threshold of safety grew as well. In the revised model, no one on earth was considered absolutely unaffected by the effects of fallout, and some people were thought to be exposed to a higher level of hazard on account of where they lived or their dietary habits. Atmospheric nuclear testing thus raised a number of ethical and political issues – not least the question of harm done to bystanders in the Cold War arms race – that extended beyond the usual scope of scientific inquiry.

As uncertainty grew and the scientific community found itself increasingly divided on the risks posed by fallout, the U.S. government attempted to win international recognition for its risk assessment by employing a mix of scientific diplomacy and propaganda. Washington strove to make its risk assessment acceptable to the international community through its sponsorship of UNSCEAR. The United States' claim to authority in setting the terms of discussion about the dangers of fallout came under increasing challenge, both scientific and political, as international support for a limitation of or ban on atmospheric testing grew. By the time Washington suspended testing in 1958, its refusal to endorse a test moratorium as an environmental health measure had dealt a considerable blow to its international standing.

Washington's claim to authority in determining the risks involved in nuclear testing came under challenge at home from a grassroots coalition of scientists and citizens. Linus Pauling and others had opened a new line of argument in the antinuclear campaign by calling attention to the ethics of the presentation of scientific data in risk analysis. It was, however, independent radiation-monitoring initiatives that did the most to raise American

105 *PPP: Lyndon B. Johnson, 1964* (Washington, D.C., 1965), 908.

public awareness of the environmental insecurity resulting from the pursuit of national security. The sampling programs launched by Barry Commoner and the Consumers Union breached the government's knowledge monopoly and claim to exclusive authority in assessing the danger of radioactive pollution. The threat of Sr-90 contamination of food, especially of fresh milk, spurred women to take action and to make their voices heard in the male-dominated political debates of the Cold War era. Activists from these different groups worked together and collectively challenged the government's self-proclaimed mandate to decide on behalf of everyone in the country how far fallout risks were acceptable.

As we know, the partial nuclear test ban proved to be, in keeping with its name, only a partial success in terms of both arms control and the environment. It did not halt the nuclear arms race between the superpowers. Far from eliminating environmental insecurity, moving testing underground gave rise to concern about a panoply of potential problems ranging from radiation contamination of the oceans and groundwater supplies to explosion-triggered earthquakes and tidal waves. But if the broad-based movement that arose in response to the first global environmental crisis of the Cold War did not succeed in all its goals, it spurred ongoing efforts in the decades that followed – by scientists, government officials, and ordinary citizens alike – to reconsider the environment risks that came with the pursuit of national security.

12

The Evolution of Environmental Problems and Environmental Policy in China

The Interaction of Internal and External Forces

BAO MAOHONG

The history of environmental problems and policies in China is typically dealt with from one of two perspectives. The internalist perspective views the evolution of China's environmental problems and policies as primarily the result of China's political economy. Most scholars, including Judith Shapiro, Elizabeth C. Economy, Vaclav Smil, and the researchers associated with the Japanese Society for the Chinese Environment take this approach.[1] The externalist perspective, in contrast, sees international trade and environmentalism as the main forces shaping Chinese environmental history. This perspective is taken by scholars who focus on China's environmental diplomacy and international trade. In my opinion, the two perspectives represent extremes that do not reflect the reality of the recent environmental history of China. Elsewhere, I have set China's environmental history in the context of the transformation of its political economy and society.[2] Expanding on that study, I consider the Cold War context of China's environmental problems and policies in this essay. I argue that the evolution of environmental problems and policies in China has resulted from the interaction of internal forces and external forces.

1 Judith Shapiro, *Mao's War against Nature: Politics and the Environment in Revolutionary China* (Cambridge, 2001); Elizabeth C. Economy, *The River Runs Black: The Environmental Challenge to China's Future* (Ithaca, N.Y., 2004); Vaclav Smil, *China's Environmental Crisis: An Inquiry into the Limits of National Development* (Armonk, N.Y., 1993); Japanese Society for China Environment, ed., *Handbook of China's Environment: 2005–2006 Version* (Tokyo, 2005).

2 Bao Maohong, "The Evolution of Environmental Policy and Its Impact in People's Republic of China," *Conservation and Society* 4, no. 1 (March 2006): 35–54.

SOCIALIST CONSTRUCTION AND ENVIRONMENTAL DAMAGE, 1949–1972

China was economically and socially backward at the time of the founding of the People's Republic of China (PRC):

> Agriculture and handcraft industry accounted for 90 percent of the national economy, modern industry for only 10 percent. The main component of industry was light industry, including textile and food production. Heavy industry was very scarce, and some machinery, such as automobiles, tractors, and aircraft, could not be produced in China. Although agricultural development was the foundation of China, the level of agricultural productivity was very low. The highest yield of grain was only 277.4 billion *jin* [two thousand *jin* is equal to one ton].[3]

To prove its superiority to Kuomintang (KMT) and to end the misery caused by the country's backwardness, the Chinese Communist Party (CCP) was determined to create a completely new economic system that would promote rapid growth and improve living standards. However, the CCP, shaped by its long struggle with the KMT, did not understand how to create a socialist society and had no experience in developing a national economy. Even more harmful was the containment policy toward the PRC that the United States implemented early in the Cold War. After the outbreak of the Korean War in 1950, the United States pushed the fighting to the Korean-Chinese border on the Yalu River and sent its Seventh Fleet to the Taiwan Strait. The KMT government in Taiwan, planning to seize the opportunity to attack the PRC's mainland China, raided several PRC-controlled islands near the mainland. It was against this background that the PRC turned to the Soviet Union for assistance and guidance.

CCP chairman Mao Zedong thus urged his cadres "to study seriously the advanced experience of the Soviet Union" and "to set off a new upsurge of learning from the Soviet Union." On February 14, 1950, China and the Soviet Union signed the "Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance." The treaty not only stabilized the border between the two countries and provided China with political and military insurance but also played an important role in China's economic development. The PRC implemented the Soviet model of centralized economic planning with the help of economic assistance and technical advisers from the Soviet Union. Following the Soviet example, the PRC built 156 key heavy industry facilities, including iron- and steelworks, power plants, and mines.

3 Chen Xi, "156 Engineering Programmes and Modernization of Industry in China," *Literature of Chinese Communist Party*, no. 5 (1999).

Soviet-Chinese trade increased quickly. The Soviet Union exported industrial products, machinery, and agricultural equipment to China in exchange for metal ore and other raw materials. Given the country's low level of industrialization, this economic development strategy was able, of course, to bring about rapid change and lay a solid foundation for comprehensive industrialization. The resource-intensive industry and raw material export this strategy promoted was, however, bound to create serious environmental problems. Mao's views on humanity's relationship to nature combined Soviet materialism, summed up in the slogan "Man Can Change Nature" and Joseph Stalin's "Remaking Nature Plan," with his own revolutionary romanticism.[4]

Industrialization brought about industrial pollution and ecological damage. The Capital Iron and Steel Company offers a typical example. The Shijingshan Steel Works, Capital Iron and Steel's precursor, had stopped production during the civil war. With Soviet assistance, it was reopened in 1956. The plant, located on the windward side of Beijing, soon became the main polluter in the city; its potential environmental impact had not been considered before it was built.[5] Another typical example is the Sanmenxia Hydropower Station. Throughout the dynastic era, Chinese authorities had emphasized the need to bring rivers under control. Sayings such as "When a great man emerges, the Yellow River will run clear" had been handed down from one generation to the next. It was not a surprise, then, that Mao and the CCP tried to control the floods of Huang River. Keeping with Soviet practices, the Soviet hydraulic engineers brought in for the project designed the Sanmenxia Dam with both power generation and flood control in mind. The hydroelectric project was opposed by the hydraulic engineer Huang Wanli, who had been educated in the United States and chose to return to serve his country.[6] Huang's criticism came, however, at a time when China held the Soviet Union in high regard. During the antirightist movement, not surprisingly, Huang was labeled a rightist who opposed the CCP and socialism. Although the construction of Sanmenxia Dam provided much-needed electric power, it also resulted in insurmountable environmental damage and losses both in the vicinity of the dam and on the lower reaches

4 On Soviet attitudes, see M. I. Goldman, *The Spoils of Progress – Environmental Pollution in the Soviet Union* (Cambridge, 1972); Boris Komarov, *The Destruction of Nature in the Soviet Union* (New York, 1980); Ann-Mari S. Ahlander, *Environmental Problems in the Shortage Economy: The Legacy of Soviet Environmental Policy* (London, 1994).

5 To keep its promise on holding green Olympics games in Beijing in 2008, the Capital Iron and Steel Company was moved to Hebei Province in 2006.

6 It was in May 1956 when Prof. Huang raised an opposition proposal on Sanmenxia Dam to the Planning Committee of the Huang River Valley. This paper was lately published. See Huang Wanli, "Proposal on the Planning Method of Sanmenxia Reservoir," *China Water Conservancy*, no. 8 (1957).

of the Huang River. Serious siltation not only reduced the dam's capacity for generation and flood control but also resulted in flooding in the Wei River valley as well as in the Huang running dry in its lower reaches several times.[7] Furthermore, the dam changed the water environment of North China.

All levels of government in the Soviet Union had responded to the serious environmental pollution and ecological damage brought by rapid industrialization by enacting environmental protection laws.[8] Such laws were not, however, enacted in China before 1972. Moreover, the CCP and the Chinese government did not recognize environmental pollution or ecological damage. Socialist industrialization, Chinese authorities believed, would not cause pollution. Thus, China did not have an environmental policy during this period.

After Nikita Khrushchev delivered his famous secret speech at the Twentieth Congress of the Communist Party of the Soviet Union (February 14, 1956), the CCP, too, began to rethink Stalin's cult of personality. Stalin was still esteemed by the Chinese communists but no longer uncritically venerated. The CCP began to explore its own road of development. At a meeting of the politburo in April 1956, Mao declared:

> We had to imitate the model of Soviet Union because we did not have experience of constructing socialism in China. That, however, limited our own enthusiasm and creativity. Now that we have our own initial practice and have from the experience and lessons of the Soviet Union, we should do our best to find our own road to constructing socialism, emphasizing proceeding from the concrete national situation, emphasizing the role of Chinese creativity by using our brains, emphasizing the collaboration of high level leaders and ordinary people.[9]

At the Moscow Conference the following year, the CCP argued, "The East Wind suppresses the West Wind." The socialist group of states, in other words, is superior to the capitalist group, and the Chinese road to socialism is superior to the Soviet Union's.

It was also in 1957 that Chinese economic development began to run into difficulties. The response was the launch of the Great Leap Forward in 1958. Ironically, it was the reforms Khrushchev had announced on the occasion

7 In 1999, it ran dry for forty-two days. Elizabeth C. Economy, *The River Runs Black: The Environmental Challenge to China's Future* (Ithaca, N.Y., 2004), 69.

8 Lenin signed more than one hundred files on protecting and using natural resources reasonably. From the 1950s to the 1970s, every aligned republic published its own Law on Nature Protection. Maohong, "Environmental Problem and Environmentalism in Former Soviet Union," *Journal of Shaanxi Normal University*, no. 4 (2003).

9 Wu Lengxi, *Ten Years Long Debate between China and Former Soviet Union* (Literature Press of Central Committee of CCP, 1999), 23–4.

of the fortieth anniversary of the Bolshevik Revolution that gave Mao the idea of the "great leap."[10] He was very impressed with Khrushchev's bold economic plan, especially the goal of catching up with and then surpassing the United States in the next fifteen years. At the second session of the Eighth Party Congress (May 5–23, 1958), he announced that China would overtake Britain and the United States economically in only fifteen years. Later, that proposed target was moved up: Mao thought that China could catch up with the United States in five years and overtake it in seven.[11] The Great Leap Forward set out to reach that target. The strategy adopted was embodied in slogans such as "The foolish old man removes the mountain: reform China," "Create farmland by encircling the lake," "With many people, our strength is greater," "Cultivate on the top of the mountain, plant rice at the center of lake," "Actively smelt steel and iron," "How much courage you have, how much the yield it has," "Don't worry about not doing, just worry about not thinking," "To struggle against the heavens is endless joy, to struggle against the earth is endless joy, to struggle for the people is endless joy."

One of the key features of the Great Leap Forward was the mobilization of the masses to increase steel production. More than 90 million people were involved in the mass movement to smelt iron and steel. Some six hundred thousand backyard furnaces for smelting steel and iron, fifty-nine thousand small kilns, four thousand small power plants, and nine thousand small cement factories were set up. The number of industrial enterprises jumped from 170,000 in 1957 to 600,000 in 1959.[12] Concerned about urban planning and construction, the PRC blindly followed the imperative "Transform the consuming city to the producing city." That resulted in the construction of a number of polluting industrial facilities in residential areas or in natural landscapes. Those facilities definitely harmed local environments. Small factories not only discharged a range of waste products but also wasted large quantities of mineral and forest resources. The disastrous effects have still not yet been cleaned up. The historically rich city of Xi'an, for example, began to have serious problems with water pollution and a rising water table. Farmland in the area suffered increasing salinization. Suzhou, a well-known garden city, endured monthly dust falls of one hundred to four hundred tons per square kilometer per month; the figure reached one thousand tons monthly in some places.

10 Stephen Uhalley Jr., *A History of the Chinese Communist Party* (Stanford, Calif., 1988), 116.
11 Xie Chuntao, *The Roaring Waves of Great Leap Forward* (Henan People Press, 1990), 25.
12 Li Zhou and Sun Ruomei, *Environmental Problems in China* (Henan People Press, 2000), 3.

In the countryside, a movement to increase agricultural production under the slogan "Take grain as the key link" was launched. As part of the effort to increase grain output quickly, a nationwide campaign against the sparrow – regarded as one of the "four pests" (rats, sparrows, flies, and mosquitoes) – was carried out. Article 27 of "The Outline of National Agricultural Development" called for the elimination the four pests everywhere possible in five, seven, or eleven years. According to an incomplete set of statistics, the first drive to eliminate sparrows in Shanghai lasted three days and claimed 88,171 birds. A second drive there eradicated 598,001 sparrows in two days. Between March and November 1959, 1.96 billion sparrows were killed across the country.[13] The elimination of sparrows resulted in serious insect infestations in several cities and rural areas. Nature, following its own laws, began to take revenge on the arrogant Chinese.

The Great Leap Forward brought about the so-called Three Years of Natural Disaster and serious economic decline, which forced the CCP and central government to adjust their economic policy. The international situation soon inspired further mobilization with major environmental consequences. Mao's critique of Peng Dehuai at the Lushan Conference and the immense changes in the international situation resulted in the militarization of Chinese economic policy. The country's relations with India and the Soviet Union began to deteriorate. After a large-scale rebellion occurred in Tibet in 1959, Sino-Indian relations turned from friendly cooperation to antagonistic conflict. Sino-Soviet relations steadily worsened after Moscow announced its decision to withdraw its advisers and suspend economic assistance. As tensions increased, both countries expanded their military presence along their shared border. In combination with the United States, which had been mounting an economic and military blockade against the PRC, the Soviet Union tried to prevent China from developing nuclear weapons and even threatened a nuclear attack on China.

It was in this grim situation that Chinese leaders made the strategic decision to "Prepare for War, Prepare for Famine, For the Sake of the People." Under this strategy, China would build a defensive third front to resist American imperialism and the Russian revisionists. Drawing a lesson from Hitler's decision to concentrate on attacking the Soviet Union's densely clustered industrial centers during the Second World War, the Chinese leadership decided to change the geographic distribution of industry as part of establishing the Third Front. The principle used in choosing sites for

13 Xie PanGao, "The Hard Experience of Reversing a Case of Sparrow," *Years of All Chinese People (YanHuang ChunQiu)*, no. 12 (1998).

Third-Front facilities was "in the mountains, dispersed, in caves, and hidden." Construction of the facilities, launched in 1965, resulted in serious air and water pollution.[14] To increase production while safeguarding border areas, the central government established the Production-Construction Army Corps and sent educated urban young people to work in rural areas. The duty of the Production-Construction Army Corps was "to militarize the frontier, oppose imperialism, oppose revisionism, protect the frontier, and build up the frontier." Its officers and troops would hold "gun in one hand and pickaxe in the other." The corps was involved in projects such as clearing forests, draining marshes, and plowing grasslands to create farmland.

In September 1957, the Central Committee of the CCP and the State Council approved plans for a series of water supply and conservation projects in rural areas. In 1963, Mao proclaimed that farmers across the country should "Learn from Dazhai in agriculture" – that is, that they should follow the example of the hardworking, self-reliant villagers of Dazhai who built terraces on their own initiative to increase agricultural production. Rural China quickly became a massive construction site as Chinese farmers attempted to "reform the heavens and change the earth." They sought to "squeeze land from rock peaks, get grain from rocks," and in extreme cases, they did so at the cost of destroying forests and grasslands. These campaigns did in fact increase grain production, but the long-term environmental consequences are now becoming apparent. Nationally, forest coverage has decreased by at least 25 percent, and total lake surface area was reduced by more than 1.33 million hectares. Overirrigation led to the salinization of the soil in many areas, and the opening of so-called wastelands to agriculture resulted in the desertification of between a quarter and a third of the country's natural grasslands. Agricultural expansion reduced the numbers of flora and fauna species and has contributed to an increase in natural calamities, plant diseases, and insect problems.[15]

Mao's revolutionary romanticism was summed up in the slogan "Man must conquer heaven." Humans, in other words, could change nature and force it to serve them by giving full scope to their subjective initiative. Socialism could plan and manage the biosphere rationally and eventually control the process of evolution. Marxism emphasized the value of labor

14 On the environmental costs of the third-front construction, see Shapiro, *Mao's War*, 154–9; Judith Shapiro, "Environmental Degradation and Security in Maoist China: Lessons from the War Preparation Movement," in *Confronting Environmental Change in East & Southeast Asia*, ed. Paul G. Harris (London, 2005), 72–86.

15 Bao Maohong, "The Two Open-Up the Northwest and Environment since 1949 in China," paper presented at the Winter symposium of Korean Asian History Society, Mukpo, February 8, 2007.

and ignored the value of nature; nature had value exclusively when incorporated in the production process by humans. Guided by these ideas, the CCP and central government believed that environmental damage was an unavoidable cost China would have to bear if it were to surpass the United States in the "four modernizations" – modern agriculture, modern industry, modern defense, and modern science and technology. The forests of smokestacks and countless dams were regarded as symbols of industrialization and progress. There was a blind faith in progress and the possibility of unlimited development. Intellectuals wrote many poems that sang the praises of remaking nature.

The Zhenbao Island incident prompted China to reconsider its relations with the United States and made it receptive to Washington's interest in a strategic partnership against the Soviet Union.[16] While Beijing and Washington were engaged in secret talks, trade and nongovernmental contacts between the two countries expanded rapidly. On October 25, 1971, the PRC resumed all of its legal rights in the United Nations. Sino-Japanese relations also improved rapidly during this period. Although it would take several more years of complex negotiations for China and the United States to establish normal diplomatic relations, they had already found common ground in their rivalry with the Soviet Union. The Sino-Soviet rift and Sino-American rapprochement opened a window onto environmental movements abroad for the Chinese government and the CCP.

THE BEGINNINGS OF CHINESE ENVIRONMENTAL POLICY, 1972–1978

The beginnings of environmental policy in China experienced were circuitous. Before 1972, the Chinese government, lacking clear awareness of environmental problems, did not have policies to protect the environment. In the decades since, China has developed an environmental policy by drawing lessons from the experience of capitalist countries and applying them to the environmental situation in China.

Why did Chinese leaders fail to recognize that environmental problems existed in China? The reason was ideology: the CCP thought socialism was superior to capitalism. Socialist countries, in the CCP's worldview, were adept at comprehensive planning that took all factors into account in the

16 Zhenbao Island is a small island on the Chinese side of the Ussuri River, the border between China and the Soviet Union. From March 2 to March 17, 1969, Soviet forces attacked the Chinese troops stationed on the island. This military conflict had serious consequences. The Soviet Union planned to use nuclear weapons to hit China, and China prepared to be involved in the resultant world war. On October 20, 1969, border negotiations were held between China and the Soviet Union and their relations mitigated.

interest of satisfying the needs of the masses. In the capitalist countries, by contrast, profit was pursued without regard to public welfare or cost to the environment. Environmental problems simply could not occur in socialist China according to this way of thinking. How, then, was the serious environmental deterioration that had occurred in the Soviet Union to be explained? In a word, *revisionism*.[17] Saying that China had a problem with pollution would be regarded as bringing shame on the construction of socialism in the country. In a context where criticism was not permissible, people had to sing the praises of China's clean and beautiful environment despite clear indications of environmental deterioration.[18] Moreover, the CCP held to the idea of human centrism and believed firmly in progress. It dismissed the population-bomb theory as pessimistic. Science and the struggle to increase production, Mao insisted, were ongoing, constantly developing processes that could not be stopped at a specific level. Humankind, accordingly, had to keep pursuing knowledge, innovation, and invention. Rejecting rigidity and pessimism, Mao stressed the importance of humankind and its capabilities. Humans advance social progress and create social wealth. They increase scientific knowledge and develop technology. And they continuously change the environment in which they live through their hard work.[19] Obviously, Mao's ideas did not help the Chinese in recognizing the harmful consequence of environmental pollution.

Although China did not implement an environmental protection policy per se, it did enact measures to address particular environmental problems, particularly in the areas of sanitation and soil erosion control. In 1957, the State Council announced plans to reduce soil erosion. Five years later, the Ministry of Public Health and the National Committee of Construction issued sanitation standards for factories aimed at curbing the effects of industrial pollution. To improve the quality of urban water supplies and reduce infectious diseases, the ministry prohibited the construction of factories in areas windward of water sources or residential zones. These measures might be regarded as the first steps toward the development of an environmental policy except that they were never actually implemented while the motto "Man must conquer heaven" prevailed.

Fortunately, this situation changed in 1972. Several factors had brought about a change in environmental consciousness. First, several serious accidents that directly affected a number of high-ranking officials helped bring

17 The Institute of Technological Information of China Academy of Sciences, ed., *The Survey of Pollution in Foreign Countries* (People Press, 1975), 88.

18 Qu Geping, *We Need a Change* (Jilin People Press, 1997), 2.

19 Wang Zhijia, ed., *China's Environmental Diplomacy* (China Environmental Science Press, 1999), 111.

environmental problems to the leadership's attention. In March 1972, for example, Beijing residents who had eaten fish caught in the Guanting Reservoir, the city's main water source, became ill. An investigation found that the reservoir had been polluted by sewage from the cities of Xuanhua, Zhangjiakou, and Datong. It was also around this time that a substantial decline in marine life in Dalian Bay on China's northeastern coast became evident. Some five thousand *mu* (fifteen *mu* equal one hectare) of mud-flats along the bay were found to be contaminated with pollutants. In Jilin Province, factories discharged 320 million tons of wastewater daily into the Songhua River, leaving behind more than 200 tons of mercury in silt. Fish and shrimp disappeared from the Songhua, and there were numerous cases of Minamata disease among people who lived along the river.[20] Although most Chinese leaders did not recognize that "socialist production" was responsible for pollution, a few pragmatic officials, confronted by the severe reality, began to realize that China, too, had environmental problems.

A turning point came after Vice Premier Li Xiannian returned from a visit to the Philippines. China, he declared during a symposium, had to recognize and address its environmental problems because they were an objective reality, and anyone who refused to recognize reality was not a true Marxist. Environmental protection in Manila was excellent, according to Li. The skies over the city were blue, and green space was abundant. Beijing, by contrast, was plagued by industrial pollution and automobile exhaust, and the health of its residents was at risk.[21] Li's comments are the first indication of a transformation in communist ideology – of a shift from idealism toward realism. Some high officials among the realists subsequently seized on the issue of environmental protection in the struggle for political influence.

Some leaders came to realize that China was confronting not a simple sanitation problem but a complex environmental situation. This change of thinking was reflected in Premier Zhou Enlai's stance on the composition of China's delegation to a UN conference on the environment. Zhou rejected the suggestion that the Ministry of Public Health organize the delegation and wanted representatives of the Ministries of Industry, Agriculture, and Water Conservation to be included.[22] Zhou, at least, clearly saw that China's environmental problems required a comprehensive action that went beyond

20 Songliao Conservancy Committee of Ministry of Conservancy, ed., *Annals of Songhua River* (Jilin People Press, 2003), 4:71–3.

21 Han Guang, "The Hard Experience, Brilliant Cause," in *The Twenty Years of Chinese Environmental Protection Administrative*, ed. Zhang KunMin (China Environmental Science Press, 1994), 354.

22 Qu Geping, "Zhou Enlai, the Founder of China's Environmental Protection Cause during the Turbulent Years," *Beijing Youth Newspaper*, January 8, 2006.

the jurisdiction of any one ministry. Like other leaders, Zhou saw environmental protection as an opportunity to affirm the superiority of the socialist system. The capitalist nations cannot solve environmental problems because they are hindered by private ownership, anachronistic relationships of production, and the drive for profit, he argued in a meeting to report on the UN conference. "We can definitely overcome industrial pollution because we practice socialist economic planning that serves the people."[23]

A second factor contributing to the Chinese leadership's recognition of the country's environmental problems was the thaw in Sino-American and Sino-Japanese relations in the early 1970s. Contact with foreign visitors and new access to the foreign press increased Chinese officials' awareness of both the advanced capitalist countries' environmental problems and their increasingly active environmental movements. In 1970, Zhou talked with a Japanese journalist about the problem of pollution and Japan's antipollution efforts. He invited the journalist to speak before a group of Chinese officials, who were then asked by Zhou to discuss the speech. Zhou's written comments on this discussion might rank as the first official document on environmental protection in the People's Republic.[24] Having finally acknowledged that pollution could indeed occur in China, officials decided to take action. Foreign experts were invited to China, and delegations were sent to the capitalist countries to learn about advanced pollution control measures. A delegation with representatives of the National Construction Committee, the Chinese Academy of Science, Beijing's municipal government, among other organizations and bodies, traveled to Britain in June 1973, for example, to attend an international symposium on pollution control and to visit sites in London, Manchester, and Sheffield. They not only visited construction sites and learned about new technologies but also met with activists who were fighting against an airport project in London.[25] Such exchanges with foreign experts and activists played an important part in the beginning of the Chinese environmental protection movement and beyond.

The third and most important factor was the UN Conference on the Human Environment, the 1972 Stockholm Conference. United Nations Secretary-General Kurt Waldheim formally invited China to participate in

23 Gu Ming, "Premier Zhou Concern[ed] about Environmental Protection Cause," in Zhang KunMin, *Twenty Years*, 344.

24 Qu Geping, *Dream and Expectation: The Past and Future of China's Environmental Protection Cause* (China Environmental Science Press, 2000), 37.

25 Wang Wenxing, "Memory of Two or Three Things during the Initiative Stage of China Environmental Protection Cause," in Zhang KunMin, *Twenty Years*, 370–1.

the conference. Beijing set great value on the invitation, seeing the conference as an opportunity to reestablish political and economic ties with the rest of the world.[26] Moreover, environmental issues were not directly tied to the ideological struggle: with common sense, compromise between the capitalist and the socialist nations would be possible. The Chinese government sent the largest delegation to attend this conference. Addressing the delegation before the conference, Zhou instructed the members not to overstate China's achievement, to acknowledge that China had environmental problems, and to learn from the experience of the advanced industrial nations. They should voice China's support, he said, for all peoples harmed by pollution, in the Third World and in the capitalist countries alike, as part of the "environmental justice movement."

Agreement with the general trend of international environmentalism did not, however, prevent China from using the Stockholm Conference as a forum for promoting its revolutionary philosophy. With the support of several Third-World countries, the Chinese delegation put forward the argument that capitalism imperialism – the pursuit of profits and resources in the developing nations – was a major cause of pollution and ecological damage. The advanced industrial nations should, consequently, pay for the transfer of environmental protection technology to the developing nations and contribute more money toward global environmental protection. China would, in the meanwhile, support the proletariat in capitalist countries and the citizens of the developing nations in the fight against the environmental damage caused by capitalism and imperialism. The Chinese delegation also used the occasion of the Stockholm Conference to condemn the United States for the environmental destruction it had caused in Southeast Asia by invading Vietnam, Laos, and Cambodia and by its use of biological weapons in the region.[27]

The Stockholm Conference undoubtedly played a major role in increasing Chinese awareness of environmental issues during the Cultural Revolution. High officials finally recognized that atmospheric pollution, water pollution, solid waste pollution, and ecological damage had reached serious levels in China.[28] The widespread improvement of environmental consciousness made Chinese leaders realize, "We could not follow the old way of capitalist industrialization. We should not follow a zigzag course, we should not take a wrong path. . . . While we were taking the economic

26 Yuka Kobayashi, "The 'Troubled Modernizer': Three Decades of Chinese Environmental Policy and Diplomacy," in Harris, *Confronting Environmental Change*, 94.

27 Ding Jinguang, *International Environmental Diplomacy* (China Social Science Press, 2007), 222–4.

28 Qu Geping, *Dream and Expectation*, 39.

construction, we should come to grips with environmental problems, and not do something that would harm our descendants."[29] In the wake of the Stockholm Conference, Chinese leaders decided to set up an institute of environmental science and an agency to monitor pollution. Scholars were commissioned to translate classic works on environmental protection. And in August 1973, the First National Conference on Environmental Protection took place in Beijing.

The conference had three important consequences. First, the fact of China's serious environmental problems was formally acknowledged, which was in itself an achievement during the turmoil and revolutionary fervor of the Cultural Revolution. Second, the conference formulated guiding principles for Chinese environmental policy: "Plan comprehensively, distribute rationally, use synthetically, turn harm to benefit, depend on the masses. Everybody starts work; protect the environment; bring benefit to people." Third, the conference drafted China's first environmental protection guidelines, "Some Regulations on Protecting and Improving the Environment," and established the country's first official environmental protection organization, the Leading Group on Environmental Protection in the State Council. The group subsequently drafted the country's first regulations governing solid waste, air pollution, and water pollution.

The year 1973 also saw the recruitment of a group of experts to draw up the "Ten-Year Program for Environmental Protection." The policies recommended included the following:

- The Three Synchronizations, which required that new factories or factories undergoing modification be equipped with pollution control facilities and provided for a design review and construction supervision process. This was the first environmental law the Chinese government drafted on its own, giving environmental protection a Chinese character.
- Limited Time Treatment system, which set deadlines for work units to develop treatment plans for sources of pollution. This policy was aimed at widespread practices, but in practice only enterprises that had access to advanced treatment technology and the funds to invest in treatment facilities could be expected to comply with immediate effect.
- The Synthetic Utilization System: Beijing enacted financial and tax policies to encourage enterprises to reduce waste. Scrap and waste material was to be supplied free of charge to enterprises that could make use of it. Enterprises that used scrap and waste would be eligible for tax benefits. Waste treatment was to be given priority in the allocation of fuel and raw materials.

29 Speech by Zhou Enlai and Qu Geping, "Zhou Enlai: The Founder of Chinese Environmental Protection during Cultural Revolution," *Beijing Youth Daily*, January 8, 2006.

- The establishment of working groups or organizations for overseeing transbranch or transregional pollution management. Representatives of the nine ministries of the State Council, for example, formed a working group to deal with the pollution of Baiyangdian Lake.[30]

The objective of each of these policies was to bring pollution under control within five years and to solve the pollution problem in ten.

China's early environmental policy, in sum, was based on using planning and administrative structures to control pollution. This approach was a product of its time. Although comparison with the capitalist countries made clear the serious extent of China's environmental problems, Chinese leaders did not copy the market-oriented environmental policies employed in the West for the simple reason that China's economic and political system was very different from those of the advanced industrial nations of the West. The administrative measures China adopted were not, however, effective. Loose oversight and very limited funds for investment meant that the policies set out in the Ten-Year Program were often not implemented. Fewer than 40 percent of medium-sized and large enterprises, for example, complied with the three synchronizations.[31] In the chaotic conditions of the Cultural Revolution, Beijing could not impose its will on the provinces. In the end, the goals of the first era of environmental policy were not achieved.

THE ERA OF REFORM, 1978–1989

A new era opened after the death of Chairman Mao, the arrest of the "Gang of Four" in 1976, and the implementation Deng Xiaoping's reforms and open door policies in 1978. The establishment of Sino-U.S diplomatic relations in 1979 helped China to join the capitalist world system. Confronting the new international situation, Deng replaced Mao's famous declaration that "war and revolution are the theses of the times" with the observation that "world war could not be launched at this time." The core issue facing China, in Deng's view, was development.[32] Echoing Mao and Zhou, Deng argued that socialism should aim to surpass capitalism in productive capacity and wealth. More concretely, he set the goal of achieving *Xiaokang* – a Confucian term meaning "moderate prosperity" – by the end of the twentieth

30 Baiyangdian Lake, with an area of 366 square kilometers, is located in XinAn County, Hebei Province. Its name means "the bright pearl in North China Plain." The rivers that flow into the lake come from several provinces.

31 Zhang KunMin, *Twenty Years*, 16. In fact, because of the lower environmental standard, serious environmental pollution took place in these enterprises after many years.

32 Deng Xiaoping, *The Selected Works of Deng Xiaoping* (People Press, 1993), 96, 105.

century and to catch up with the developed countries by 2050.[33] With these targets in mind, China's foreign policy under Deng was guided by national interest rather than ideology. To gain access to capital, technology, and resources, the country opened its doors to all nations of the world.

The market-oriented reforms instituted after 1978 produced an economic miracle, but China was also turning into the world's dump. High input, high exhaustion, high output, high speed – the Chinese approach to economic growth also resulted in high levels of pollution, serious environmental damage, rapid resource depletion, and low economic efficiency. China became the world leader in the consumption of construction materials as well as in waste gas emissions and wastewater discharge. The number of city dwellers suffering pollution-related illnesses rose quickly, and rural "cancer villages" appeared in many counties. This development strategy not only damaged the environment but also destroyed the natural base of development for future generations. It was definitely not sustainable.

Serious environmental pressure forced the Chinese government to take action.[34] One indirect consequence of Deng's open-door policy was a change in ideology in regard to environmental protection. China began to import any useful environmental protection technologies and management policies regardless of their origin. It was also forced to adopt international environmental regulations in connection with foreign aid and investment. Asian Development Bank and World Bank regulations stipulated that environmental impact statements had to be submitted with loan applications for development projects. This strict regulation forced China to adopt impact assessments as part of its environmental protection policies. Another idea taken over from abroad was the environmental nongovernmental organization (ENGO). To obtain financial support for the Ussuri Watershed Land Use Planning Project established by the National Committee on U.S.-China Relations, a nonprofit organization in the United States, the Chinese government set up a nongovernmental Chinese counterpart. This ENGO satisfied American regulations even though its members were all from former governmental organizations.[35] And although some scholars have called it a front ENGO, it did promote the development of ENGOs in China.

China pursued opportunities for both bilateral and multilateral environmental cooperation. In 1980, China and the United States signed the Protocol on Sino-U.S. Environmental Protection Cooperation. Similar

33 A Confucian term, *Xiaokang* means a condition of moderate prosperity, which translated to per capita income of more than US$1,000.

34 Economy, *River Runs Black*.

35 National Committee on U.S.-China Relations, *Annual Report*, 1995, 14.

agreements with Japan, Finland, Germany, Britain, Holland, Mongolia, the Democratic People's Republic of Korea, Denmark, Canada, and other nations followed. China also singed international treaties on issues such as wildlife protection and preserving the ozone layer.[36] Becoming a party to international environmental treaties pushed the Chinese government to draw up its own environmental policies and laws, and international environmental cultural exchange helped lay a solid practical foundation for its efforts to do so.

China's environmental policy evolved rapidly after the Cultural Revolution in response to its internal needs as well as to external influences. The symbolic beginning of this new stage in the country's environmental history was the adoption of a new constitution by the Fifth National People's Congress in 1978. It included the following clause on environmental protection: "The state should protect the environment and natural resources, prevent pollution and other environmental disruption." This was the first constitutional provision for environmental protection in Chinese history, and it laid the legal foundations for an environmental protection policy. On the basis of this clause, the Eleventh Standing Committee of the Fifth National People's Congress promulgated the Law on Environmental Protection in the People's Republic of China. Simultaneously, the Central Committee of the CCP approved new administrative policies touching on environmental protection. Committees at all levels of the CCP were instructed "to eliminate pollution and to protect environment" as part of the effort "to build socialism and realize the four modernizations." The strategic role of environmental protection in the process of modernization was reaffirmed during China's second national conference on environmental protection, which met from December 31, 1983, to January 7, 1984.

Existing environmental protection policies were supplemented in this period with several new measures. In 1983, the government inaugurated the Three Simultaneities and Three Unifications policy. This policy held that economic construction, urban and rural construction, and environmental construction were to be synchronized with the design, operation, and development of construction projects to produce unified economic, social, and environmental benefit. The focus of Chinese environmental policy, in other words, shifted from treating existing pollution toward trying to balance economic development and environmental protection. Another new policy was the introduction of environmental impact assessments. They were used, above all, to control new sources of pollution and to minimize

36 Zhang KunMin, *Twenty Years*, 328–34.

the harmful effects of development projects. A third new policy was the waste discharge register and permit system. Operating on the principle of prevention first through the incorporation of prevention and treatment, this policy unified end-of-pipe treatment and all-process treatment. Fourth, a pollutant discharge fees system, modeled on the polluter-pays principle advocated by the Organisation for Economic Co-operation and Development, was put into place. The primary responsibility for pollution treatment was thereby shifted to the enterprises that generated pollution. The polluter-pays principle was also extended to development, resource utilization, and environmental protection: those who develop should protect, those who cause damage should restore, and those who use resources should compensate. Finally, the management system was strengthened. In the context of limited investment and backward technology, intensifying the management system was a good way to confront environmental problems. New management measures included, for example, the introduction of annual assessments of urban environmental quality.

Environmental protection in the period 1978–89, in sum, was characterized by the instrumentalization of law for environmental protection. In addition to the constitutional provisions and laws described herein, the National People's Congress enacted eleven other laws dealing with specific environmental issues or natural resources, including laws on forestry, grasslands, fisheries, mineral resources, land management, wildlife protection, water and soil conservation, and protection of maritime environments. The State Council issued more than twenty environmental protection regulations. Local governments and the Environmental Protection Agency issued many local and professional regulations. Another new characteristic of environmental protection in this period was the use of economic instruments and market principles. The enforcement of these new measures was bolstered by the participation of the CCP at all levels of government as harmonious development replaced simple treatment as the focus of Chinese environmental policy.

CONCLUSION

During the Cold War, we can conclude, China's environmental problems and policies were not shaped solely either by its internal economic development or by its participation in international trade and engagement with international environmentalism. They developed, rather, in the interaction between internalization and externalization. The country's environmental problems and policies developed in conjunction with the process of globalization that integrated China in the international community. Of course, environmental problems and policy are related to ideology and social system; however, environmental problems are fundamentally a result of industrialization. Given China's industrial growth and expanded engagement in the world economy since the end of the Cold War, its environmental problems and policies deserve further study.

PART IV

Epilogue

13

The End of the Cold War

A Turning Point in Environmental History?

FRANK UEKOETTER

The Blitz Experience is one of the key attractions of London's Imperial War Museum. This display has visitors huddle together in a re-created air-raid shelter and uses not only sounds (radio reports, sirens, exploding bombs) but also smells to evoke the experience of an attack on London during World War II.[1] To the best of my knowledge, no one has tried to create a similar display about the Cold War, and the reasons are not difficult to understand. Of course, the Cold War had a deep impact on popular culture, but there was no sensual drama to its key military event: the standoff between two huge, nuclear-armed empires. In East and West alike, every citizen knew that if the Cold War were to turn hot, it would probably last only a few hours. The awareness that global destruction could come at the push of a button only added to the horror.

This aspect of the Cold War experience is worth recalling for two reasons. First, it helps us to understand the ironies involved in any discussion of turning points in the history of the Cold War. For all the evidence that the essays in this collection muster, the significance of the Cold War for the environment clearly pales in comparison with the potential turning point that the Cold War could have been had someone pushed that button. Second, the awareness of the threat of nuclear devastation helps us to understand why the end of the Cold War was such an odd finale to the age of mutually assured destruction. Although citizens had lived with the thought that a global turning point of truly apocalyptic dimensions might be imminent, the end of the Cold War occurred in an utterly different and unspectacular fashion. In a series of accelerating stages, a powerful empire, ready to inflict global devastation, collapsed from within. It is often said that the Soviet bloc collapsed without a shot being fired. That assertion

1 For information on this exhibition, see http://london.iwm.org.uk.

might ignore the experience of Romania, but it does capture the prevailing sense of amazement on all sides. It is revealing that the phrase "the end of history," given currency by Francis Fukuyama in 1989, instantly became a global buzzword, although few of those who used it understood, or indeed cared about, its Hegelian implications.[2] For most observers, the events of the late 1980s and early 1990s signaled an end rather than a turning point, as the latter would have implied a clear idea about what might happen next. Of course, it was expected that the countries of Eastern Europe would get rid of the communist old guard, hold elections, and liberalize their economies. Beyond that, however, nobody really had much of a plan. The collapse of communist rule, in other words, not only brought about a change of political regimes but also created an ideological vacuum.

Against this background, it seems that it was not simply coincidence that environmentalism flourished globally in the late 1980s and early 1990s, to some extent filling the vacuum. Environmental historians tend to see events around 1990 as merely further steps in the long-term rise of environmental awareness. But such a view ignores the unprecedented global scale of the boom in environmental awareness and activism as the Cold War came to an end. The environmental boom of the 1970s had been mainly an American affair, with the rest of the world following up in often-lukewarm fashion. To be sure, some events resonated globally, perhaps most important the publication of the Club of Rome's "Limits to Growth" report.[3] The environmental boom of the 1990s was notably different in that it produced not only words but also political action: never before had so many countries pledged themselves so emphatically to taking action to protect the environment as did so in the years around 1990. The end of the Cold War, and specifically the political vacuum that it produced, was arguably instrumental for this remarkable development. At a time of uncertainty and disorientation, environmental issues presented themselves as one of the few safe concerns. What could be wrong, after all, about taking care of the global commons?

This development was all the more remarkable because the 1980s did not start off auspiciously from an environmental standpoint. In the United States, the environmental movement was put on the defensive when President Ronald Reagan launched a full-scale attack on environmental regulation; the ensuing dispute at times took on the air of a life-and-death

2 See Francis Fukuyama, *The End of History and the Last Man* (New York, 1992).

3 See Donela H. Meadows et al., *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (New York, 1972).

struggle.[4] The situation looked more promising in West Germany, where a widespread fear of "forest death" (*Waldsterben*) – of damage to trees from acid rain – led to popular cries for strict measures to curb air pollution. West Germany was largely an exception among the Western European states, as neither Margaret Thatcher nor François Mitterrand had much by way of an environmental agenda. It was only in the second half of the 1980s that it became fashionable for politicians throughout the West to claim green credentials; even the Reagan administration eventually came to embrace environmental issues. President George H. W. Bush made an effort to claim green credentials by appointing William K. Reilly, a former president of the Conservation Foundation and the U.S. branch of the World Wildlife Fund, as head of the Environmental Protection Agency. In 1990, the U.S. Congress passed the Clean Air Act Amendments with broad bipartisan support.[5] It is worth noting that the vote came twenty years after the passage of the original Clean Air Act; the similarity between the original act and the amendments highlights a tradition of environmental awareness that went far back into the Cold War era. What occurred in the 1980s was the result less of a fundamental change in how environmental problems were perceived than of the increased attention they received. In short, the end of the Cold War was a window of opportunity for environmental action rather than the underlying cause of the flurry of environmental initiatives at that time.

Remarkably, the environment also emerged as a political issue in Eastern Europe, though the sequence of events was quite different. Political leaders in Eastern Europe showed little concern for the environment, be it for ideological reasons or simply for lack of cash. Dissidents, however, frequently stressed environmental issues. Indeed, environmental issues seem to have a played a role in the demise of socialist rule. The Soviet government's initial attempt to cover up the Chernobyl disaster ran counter to its promise of glasnost and thereby opened the way for radical environmentalist criticism. At the Eighth Congress of the Soviet Union's Union of Writers, held in the wake of the Chernobyl incident in late June 1986, intellectuals condemned the environmental toll of socialist rule with unprecedented candor.[6] In East Germany, opposition groups set up an environmental library (*Umweltbibliothek*) in September 1986.[7] To be sure, dissidents often seized

4 Samuel P. Hays, with Barbara D. Hays, *Beauty, Health and Permanence: Environmental Politics in the United States, 1955–1985* (Cambridge, 1989), 491–526.

5 Marc Allen Eisner, *Regulatory Politics in Transition*, 2nd ed. (Baltimore, 2000), 167, 184.

6 Douglas R. Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachëv* (Berkeley, Calif., 1999), 425.

7 Ehrhart Neubert, *Geschichte der Opposition in der DDR 1949–1989* (Bonn, 1997), 629–32.

on environmental issues for merely tactical reasons. Under the conditions of totalitarian socialist rule, the environment was a low-risk topic, at least compared to the dismal economic situation or the pervasive suppression of human rights. "Environmental activism was one sphere of citizen politics tolerated by the Soviet Party-state, perhaps because from the *apparat*'s perspective it looked so little like serious 'politics,'" Douglas Weiner notes in his environmental history of the Soviet Union.[8] Oftentimes, civic activists could point to laws that prohibited environmental destruction and thereby gave an aura of legitimacy to their claims. All they were doing was calling attention to violations of the law, they could claim, and thus contributing to socialism's march of progress. With the benefit of hindsight, it is clear that Eastern Europe was lagging behind the West in environmental awareness and activism, but from the perspective of 1990, it seemed that there was a pan-European and indeed global boom of environmental awareness.

The first result of this global trend was the Montreal Protocol on Substances That Deplete the Ozone Layer of September 1987, which sought to cut down on the use of ozone depleting chemicals like chlorofluorocarbons and halons globally. The mere existence of such an agreement was astounding in itself. During the Cold War, forceful diplomatic initiatives usually ended up caught in the quagmire of the East-West conflict. The 1972 UN Conference on the Human Environment at Stockholm provides a case in point: as Kai Hünemörder's essay in this volume shows, member states of the Warsaw Pact ultimately decided not to attend the supposedly global meeting despite intensive efforts to get them on board.[9] When the representatives of twenty-four countries met in Stockholm in 1982 under the auspices of the UN Environment Programme to form a working group on a framework convention on ozone-depleting substances, there was strong opposition to the move on both sides of the Iron Curtain. It is characteristic that the Toronto Group, formed in 1983 to push for an agreement, comprised three neutral countries – Sweden, Finland, and Switzerland – in addition to NATO members Canada and Norway. However, the rules of international diplomacy changed with the thawing of the Cold War, allowing the international community to agree on an unprecedented measure, namely the almost-complete phaseout of a certain group of chemicals. To be sure, the Montreal Protocol envisioned only a 50 percent cut within ten years, but the signatories agreed in 1990 to tighten the regulations significantly and aim to cut emissions entirely by 2000.[10] The Basel Convention

8 Weiner, *Corner*, 429.

9 See Kai Hünemörder, Chapter 9 in this volume.

10 Richard Elliot Benedick, *Ozone Diplomacy. New Directions in Safeguarding the Planet* (Cambridge, Mass., 1998).

on the Transboundary Movement of Hazardous Wastes of 1989 reinforced the trend toward an international environmental policy.[11]

There was an even larger window of opportunity at the national level. A well-documented case is the last-minute decision of the East German government in the late summer of 1990 to pass a far-reaching national parks law before unification with West Germany that autumn. Following the collapse of one-party rule in the German Democratic Republic in the fall of 1989, the environmental toll of socialism had been exposed in shocking detail. The country's pollution problems were appalling. Lignite-fueled power plants poured sulfur into the air. Waste from factories in the so-called chemical triangle around Bitterfeld contaminated the air, water, and soil. One lake in the region, for example, was notoriously dubbed "Silver Lake" (*Silbersee*) on account of the effluent from a film factory that was dumped in it. Turning large tracts of East Germany into protected areas thus seemed to be almost an act of compensation for the damage done during the forty years of socialist rule. It also made sense. Whereas cleaning up industrial sites and waste dumps would be a long-term project, creating nature reserves could be accomplished quickly – at least during a period of revolution when, as in 1989–90, so many things were in flux that it was difficult to organize opposition to bold governmental initiatives. The East German government approved the initiative at the close of the cabinet's final meeting on September 12, 1990, only three weeks before unification. Five new national parks were thus created at a stroke, bringing the total for united Germany to eight.[12]

The shift in sentiment toward greater environmental awareness was all the more notable because the end of socialist rule also spelled the end of an ideology that viewed nature solely as an object of human control. The desire to control nature was certainly not unknown in the West, as the essay by Kristine C. Harper and Ronald E. Doel in this volume demonstrates.[13] However, as Paul Josephson argues in his contribution, war against nature assumed the status of state doctrine in the Soviet Union; a similar argument has been made about Maoist China.[14] That ideology was probably moribund by the 1970s, but environmentalists still needed to come up with a convincing response. Ernst Friedrich Schumacher's declaration that "small is

11 Eisner, *Regulatory Politics*, 215.

12 Andreas Dix, Rita Gudermann, "Naturschutz in der DDR: Idealisiert, ideologisiert, instrumentalisiert?" in *Natur und Staat. Staatlicher Naturschutz in Deutschland 1906–2006*, ed. Hans-Werner Frohn, Friedemann Schmoll (Bonn-Bad Godesberg, 2006), 607.

13 See Kristine C. Harper and Ronald E. Doel, Chapter 4 in this volume.

14 See Paul Josephson, Chapter 1 in this volume. On China, see Judith Shapiro, *Mao's War against Nature: Politics and the Environment in Revolutionary China* (Cambridge, 2001).

beautiful" became the rallying cry for critics of large technological projects and has since become so much of a commonplace that vociferous opposition to almost any large-scale project is taken as a given. The Stalin Plan of 1948 is now generally considered the epitome of technological hubris. China's communist leaders found it impossible to quell the debate within the country over the Three Gorges Dam. Of course, the so-called Washington Consensus that came to prevail has mixed environmental merits as well, but from an environmental perspective, it was clearly a step forward when notions of comprehensive, large-scale planning and war against nature were dumped into the dustbin of history.

It will remain for future researchers to decide whether the environmental initiatives of the European Community also stemmed from this impulse. To a certain extent, the community's environmental policy was a result of a different story line, namely the reinvigoration of the European policy under European Commission President Jacques Delors and the end of the much-touted "eurosclerosis" of the 1970s and early 1980s.[15] The Single European Act of 1986, the cornerstone of the reform package engineered by Delors, gave the European Community formal authority on environmental issues for the first time and thereby conferred official status to a patchwork of environmental initiatives that the community had pursued since the 1970s. The European Community jumped at the opportunity created by the Single European Act and enacted a number of landmark directives, including the Nitrates Directive of 1991 and the Habitats Directive of 1992. In 1990, the European Community began discussing a carbon or energy tax; the idea was ultimately abandoned, however. After a prolonged dispute over its location, the European Environment Agency opened in Copenhagen in 1994.[16]

The boom in environmental policy initiatives culminated in the UN Conference on Environment and Development in Rio de Janeiro, commonly referred to as the 1992 Earth Summit. Many participants fondly recall the enthusiasm of those present and the determination to save the global commons. In the end, the meeting produced three important treaties: the Framework Convention on Climate Change, the Convention on Biological Diversity, and the lesser-known Convention to Combat Desertification. At the same time, though, the Rio summit also demonstrated the ambiguities

15 Gerhard Brunn, *Die Europäische Einigung von 1945 bis heute* (Stuttgart, 2002), 239.

16 Anita Wolf-Niedermaier, "Umweltpolitik," in *Europa von A bis Z. Taschenbuch der europäischen Integration*, ed. Werner Weidenfeld, Wolfgang Wessels, 7th ed. (Bonn, 2000), 338n; Clive Archer, *The European Union: Structure and Process*, 3rd ed. (London, 2000), 125–8.

of the environmental boom around 1990. Passing bold declarations at an international meeting was one thing; following up with forceful policies, it soon became clear, was something else. It took five years to advance from the Framework Convention to the Kyoto Protocol on Climate Change of 1997, which took effect in 2005. As of 2009, the expensive follow-up meetings on the Convention on Biological Diversity had still not produced an effective global treaty and had done little to raise environmental awareness. The Convention to Combat Desertification has fared no better, and counterdesertification programs have received only a fraction of the funding that has been made available for climate and biodiversity policy. Even Brazil, which had so proudly hosted the Earth Summit, did not follow up rigorously. In anticipation of the summit, the Brazilian government had announced an ambitious plan to protect the country's rain forests. Although certain polices were changed or abandoned, the plan has thus far failed to halt the destruction of the Amazon.[17]

The Rio Earth Summit can be seen as the highpoint of the environmental boom that accompanied the end of the Cold War. The summit's prospects for success were significantly reduced, as John McNeill has noted, by tensions between North and South.[18] The dispute between rich and poor countries was, however, probably in itself a mirror of two broader global trends that were increasingly hampering environmental initiatives toward the end of the twentieth century. The one was globalization: with declining transport costs and shrinking tariff barriers, economic competition among nations increased markedly and created a strong incentive to favor short-term gains at the expense of long-range sustainability. The other trend was the gradual erosion of the regulatory capacities of nation-states, a trend that led Charles Maier to argue that the 1970s and 1980s saw the end of the "age of territoriality."[19] Governments, he contends, were increasingly at a loss to implement forceful environmental policies as they found themselves confronted with brutal economic competition. Both trends were obviously linked with the end of the Cold War. In Europe, the collapse of the Iron Curtain was a major step toward globalization, as Eastern European countries became strong competitors as a result of their low labor costs. But in the end, globalization and the decline of the powers of nation-states were

17 John Hemming, *Tree of Rivers: The Story of the Amazon* (London, 2008), 305–7.

18 John R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth Century* (London, 2000), 354.

19 See Charles S. Maier, "Consigning the Twentieth Century to History: Alternative Narratives for the Modern Era," *American Historical Review* 105 (2000): 807–31.

influenced and shaped rather than caused by the Cold War context – an important difference that this volume has emphasized throughout.

It is indicative of the power of globalization that even strong supranational bodies like the European Union found it hard to follow up on their environmental pledges. Characteristically, implementation of the aforementioned European directives quickly gave rise to a prolonged (and ongoing) battle. The Habitats Directive of 1992, for example, had been implemented only in part as of this writing, and it has had, at best, a mixed impact so far. The expansion of protected areas led to a spate of conflicts with property owners. The bitterness that often resulted will drag on conservation efforts for years to come. In the eyes of many European farmers and forest owners, the Habitats Directive is emblematic of an overreaching and irresponsible environmental policy. It is striking how much the environmental agenda, both within the European Union and beyond, remains wedded to the themes and perspectives of the late 1980s and early 1990s: from global warming to genetic manipulation, change in policy discussions has been glacial at best. In short, although the spirit of the 1992 Earth Summit has mostly dissipated, we are still struggling to live up to the hopes and aspirations that it mirrored.

So was the end of the Cold War a turning point in environmental history? If it was, then it was a halfhearted turning point. It was first and foremost a discursive turning point. Modes of discussion and thinking changed, as did the rules of international diplomacy and policy. But translating new ideas and new initiatives into action proved difficult. It is hard, though, to say how this could have been otherwise. The global environmental boom lasted barely half a decade, a rather short period of time in political terms. Pushing modern societies toward sustainability is a huge political challenge, and it seems that the political initiatives of the late 1980s and early 1990s were little more than modest steps toward that end.

It would probably overstate the point to invoke Fernand Braudel here. Braudel saw environmental developments as processes of *longue durée* and political events as merely "surface disturbances, crests of foam that the tides of history carry on their strong backs," thus suggesting a futility of human policy against the background of natural history.[20] Modern politics is closely dependent on symbols as well as money and expertise, and there can be little doubt that the Rio summit and the spirit that it reflected have become enduring icons all over the world. For all the shortcomings of the policies

20 Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II* (London, 1972), 1:21.

enacted thus far, the recent resurgence of global warming activism shows that the environmental dreams of 1990 can still move and inspire people. The end of the Cold War begat a green promise that societies all over the world have tried to live up to, making for a turning point in aspirations and hopes rather than in humanity's ecological footprint. But in the end, that merely underscores how much we need an environmental history of the Cold War.

Index