Hexagon Series on Human and Environmental Security and Peace 4

Facing Global Environmental Change

Environmental, Human, Energy, Food, Health and Water Security Concepts

Bearbeitet von
R. K. Pachauri, Luc Gnacadja, Hans Günter Brauch, Navnita Chadha Behera, Michael Zammit Cutajar, Achim Steiner, Patricia Kameri-Mbote, Sàlvano Briceno, Joy Ogwu, Vandana Shiva, Stavros Dimas, John Grin, Úrsula Oswald Spring, Béchir Chourou, Czeslaw Mesjasz, Heinz Krummenacher

1. Auflage 2009. Buch. xcvi, 1544 S. Hardcover
ISBN 978 3 540 68487 9
Format (B x L): 20,3 x 27,6 cm
Gewicht: 3962 g

2 The International System, Great Powers, and Environmental Change since 1900

J.R. McNeill

2.1 Introduction

This chapter examines an aspect of the relationship between the international system and environmental change. Political scientists have recently created a new sub-field, called 'environmental security', in which they argue that environmental stresses add to security risks. Without disputing the validity of that literature, indeed complementing it, this chapter puts the matter the other way around: security risks put added stress on the environment, thereby creating something of a vicious circle. In particular, the unusually high security anxiety of the 20th century helped drive unusually rapid and large-scale environmental change since 1900. The evidence offered in support of this argument concerns nuclear weapons programmes, pollution-intensive industrialization efforts, pro-natalism, among others.

One of the major influences upon modern environmental history has been, and remains, the struggle for survival and power in the international system. This chapter argues that historically international struggle has generally selected against ecological prudence in states and societies, and that the rigorous struggle of the 20th century selected rigorously against ecological prudence. Further, it argues that preparation for war and economic mobilization for war had stronger environmental consequences than did combat itself. After brief consideration of the scale and scope of environmental change and its causes (2.2) and of the evolution of the international system (2.3), the chapter focuses on environmental impacts of war and preparation for war (2.4).

2.2 Environmental Change and Its Causes in the 20th Century

Environmental change has always been part of the human experience. Since they first harnessed fire several hundred thousand years ago, hominids and humans have changed the world's ecology. But in modern and contemporary times we have done so on a scale unprecedented in human history and with very few analogues in earth history. Humankind undertook a gigantic, uncontrolled experiment on the earth, altering land cover, atmospheric chemistry, biodiversity, biogeochemical flows, and much else (McNeill 2000; Steffen et al 2005, see table 2.1).

Why did this tremendous flux occur when it did and how it did? The reasons are many, complex, and overlapping. Population growth, often cited as the principal driving force behind all manner of environmental change, did indeed matter. The expansion of human numbers from about 1.5 billion in 1900 to about 6.3 billion in 2005 is obviously unprecedented, destined never to be repeated, and replete with environmental consequences. But the energy system mattered even more. First, because it was based on fossil fuels: after 1890 they provided more than half of the energy used around the world. Fossil fuels are dirty. The carbon dioxide they emitted into the atmosphere promoted climate change. The sulphur dioxide they emitted fell as acid rain, damaging the biota of rivers and lakes, and possibly damaging forests as well. But the pollution consequences of burning fossil fuels were only part of the larger picture. Digging coal, drilling for oil, and transporting oil were messy affairs too. Fossil fuels allowed new technologies that exponentially increased the volume and pace of mining, to the point where it became rewarding to shear off mountain tops in search of coal, or to crush millions of tons of rock in quests for a few grams of gold. Fossil fuels allowed the chain saw, without which tropical deforestation, so characteristic of our times, could not have taken place nearly so quickly. And of course fossil fuels are not the only component of the 20th century's energy system: hydroelectricity required dam building, often done on the gigantic scale; and nuclear energy, with its accidents

Table 2.1: Co-efficients of Change, from the 1890's to the 1990's.

Indicator	Coefficient of change
World population	4
Urban proportion of world population	3
Total world urban population	13
World economy	14
Industrial output	40
Energy use	13-15
Coal production	7
Oil production	240
Carbon dioxide emissions to atmosphere	15
Carbon dioxide concentration in atmosphere	1.3
Sulphur dioxide emissions to atmosphere	13
Lead emissions to atmosphere	8
Freshwater use	9
Marine fish catch	35
Cattle population	4
Pig population	9
Goat population	5
Sheep population	1.8
Horse population	1.1
Cropland	2
Pasture area	1.8
Irrigated area	5
Bird and mammal species	0.99 (1 % decrease)
Fin whale population	0.03 (97 % decrease)
Blue whale population (Southern Ocean only)	0.0025 (99.75 % decrease)

Source: McNeill 2000: 361-2; see: Dutch Ministry for the Environment (RIVM), at: <http://arch.rivm.nl/ env/ int/hyde/index.html>.

and waste storage problems, had significant ecological effects too, although so far rather less calamitous than often feared.

The ideological fixations of modern times have also contributed to the pattern of twentieth-century environmental history. Under the tutelage of the economists, and inspired by routine self-interest, public servants and private individuals consistently sought to foment economic growth and secure monetary gain. They regarded the natural world as a storehouse of raw materials, without intrinsic worth. They saw little value in such abstractions as balance, stability, or resilience in ecosystems. The reigning ideas about appropriate individual and state behaviour promoted rapid environmental change, and justified it in the name of various higher goals: economic growth, political stability, social mobility. The environment changed so much because prevailing ideas changed so little.

These were the most important reasons why the 20th century had the environmental history that it did (McNeill 2000: 267–356). But there were others, among which was politics. It was conventional politics, not environmental politics that mattered most. Even after 1966, when countries began to create environmental agencies, departments, and even ministries, real environmental policy was made elsewhere, in the powerful branches of government: e.g. the ministries of finance, trade, industry, and defence. In every country at all times these were more powerful than the environment ministry (or department or agency), and they made de facto environmental policy as accidental by-products of their own affairs. One concern they all shared, to greater or lesser degrees, was 'state security'. It is this I shall focus on here, only a part of the overall picture.

2.3 The International System and Its Imperatives

The quest for 'state security' has been in force, and affecting ecology, since states were first organized.[1] Throughout most of the history of states, however, the rigour of state security concerns has been blunted by the success of large empires. Most people lived in circumstances either of imposed peace managed and maintained by the technocrats of a bureaucratic empire, or else in an anarchic world in which states can scarcely be said to have existed. Enduring systems of competing states – the international anarchy we tend to regard as normal – have been rare. Typically, they quickly collapsed into imperial unification or reunification. Notable and durable exceptions include the era of warring states in China (c. 770 BC to 221 BC) and Greece from the first *poleis* (ca. 800 BC) to Alex-

1 Westing (1980: 14) provides a list of 26 wars with a capsule description of their ecological cost.

ander the Great's unification (336 BC). In these times and places interstate struggle doubtless took its toll on landscapes, although details are obscure.[2] But in these cases the scales of military and bureaucratic operations were comparatively small, and the technologies involved rudimentary. Consider the technology of destruction. Before 1800 the only powerful means of ecological damage were deliberate fire and the capacity to tear apart irrigation works, causing deliberate floods. So the ancient eras of anarchic competition in international systems were limited in their ecological impact. Modern times have seen the resurgence of international anarchy combined with ever-growing scales of operations and technological sophistication.

The current competitive international system has not yet collapsed or unified, but instead has evolved and grown so as to be effectively global. It originally emanated from the stalemate in sixteenth-century Europe among the Hapsburg, Valois, and Ottoman dynasties. None succeeded in re-establishing a pan-European empire, which eccentricity marked Europe off from the rest of the world. This extraordinary failure was codified by the Peace of Westphalia in 1648, and a self-consciously self-regulating system of competing states was born, ratcheting up the rigour of intersocietal and interstate struggle. The constant competition of this system obliged (surviving) European states to evolve ever more formidable political, fiscal, and military capacities, which by the nineteenth century created states more powerful than those anywhere else in the world.

But in the 19th century (1815–1910) the Great Powers managed their competition almost peacefully, thanks to diplomatic skill, a fairly stable balance of power, and British economic and naval hegemony. In effect they almost banished war to Asia and Africa (and various frontiers in the Americas), where it prevailed with heightened regularity in part because of colonial pressures from the Great Powers. These conflicts required minimal mobilization on the part of the Great Powers: colonial wars were cheap, mainly because of technological and organizational edges enjoyed by European states, but also because they often were fought by colonial troops. But the situation changed with the rise of a united Germany after 1870, and acutely when German industrialization allowed greater German assertiveness after 1890. So the 20th century would be different, an era of high anxiety for great powers, beginning with the run-up to World War I.

In the 20th century the rigour of struggle ratcheted up on account of the mounting requirements of competitiveness and the heavy costs of defeat in an age of total war. By 1914, only an all-out effort gave any chance of survival in the European international system; by 1939–45, losers in the competition risked annihilation. Higher stakes brought forth more strenuous effort and greater disregard for goals other than immediate political and physical survival. By 1945–90 even peacetime seemed to require the utmost preparedness for war. The international system selected for those characteristics that promised power in the present moment: technological sophistication, mass industrial and agricultural production, and ideological conformity (on fundamental questions at least, and in some societies on more than that). The health of soils, waters, and air took a distant back seat.

2.4 International Struggle and Environmental Change

Intersocietal competition affected the environment directly through warfare and less directly through the preoccupation with military power: that is, through war and through preparation for war.

2.4.1 The Deeper Past

Until the 20th century, combat did not produce vast environmental consequences except in extraordinary circumstances. When men fought with clubs, spears, arrows, swords, lances, pikes or muskets, they could do little to landscapes. Indeed, the more destructive wars so disrupted agriculture that they produced a fallowing effect, as in Brittany in the 100 Years' War, or in Germany during the Thirty Years' War.[3] Forests and wildlife recovered when and where farmers and herders could not conduct their daily business. So did fisheries when naval war, pirates, or privateers confined fishermen to port. The built environment, of course, has always been vulnerable to destruction in war, usually through fire. Victors have torched countless cities; retreating armies have scorched earth aplenty. The Mongols, in their thirteenth-century

2 In the Second Punic War the Roman efforts to defeat Hannibal led to ecological damage in southern Italy that, according to one observer, was visible more than 2,000 years later (Toynbee 1965, II: 11–35). Caesar's legions energetically burned the forests of Gaul (Demorlaine 1919; Corvol/Amat 1994). For the ecological consequences of political-military struggle in ancient China see Elvin 2004.

conquest of Iraq, devastated a flourishing irrigation network, flooding arable lands, creating (or re-creating) swamps. While the Mongols' efforts edged Iraq more nearly to a state of nature, from the cultivators' point of view – not initially shared by the Mongols – this was environmental damage on a large scale.[4] From any point of view it amounted to vast and enduring environmental change. But such cases were quite rare, essentially confined to landscapes of irrigation.

Preparation for war, rather than combat, typically provoked more serious environmental changes. In Europe for instance, the navy-building programmes of Venice and Genoa in the 11th through 16th centuries, and then of Britain, France, and Spain in the 17th and 18th centuries severely depleted the supply of tall fir and spruce and stout oak in Mediterranean and Atlantic Europe. All states developed forest conservation programmes so as to save more specialized timber for navies, but this proved inadequate in every case. By the 18th century Europe's wooden navies sought ship timber in Indonesia, India, Brazil, Canada and elsewhere around the world (Appuhn 2000; Merino Navarro 1981: 181–267; Albion 1926; Bamford 1956; Lane 1965; Miller 2000).

2.4.2 Combat's Environmental Consequences in the Twentieth Century

In the 20th century, while the technology of destruction grew vastly more powerful, preparation for war, as in remoter times, wrought greater and more lasting environmental change than did war itself. The direct environmental effects of warfare since 1914 have been vast but usually fleeting. The battle zones of WWI's western front created small deserts, where little but rats, lice, and men could live – and few men lived for long. But these zones are hard to detect today, except where carefully preserved: elsewhere their recovery and assimilation to the French and Belgian countryside is nearly complete. The more mobile campaigns of WWII produced less concentrated damage to landscapes (except for cities),[5] although certain episodes were destructive enough. For example, in 1938 Chinese troops, in an effort to forestall Japanese advance, deliberately breached the dikes that held the Hwang Ho in place, flooding broad areas of North China and killing people (almost all Chinese), drowning crops, sweeping away bridges, roads, over 4,000 villages and millions of tons of soil: a disaster to be sure, but one soon made invisible by the careful labour of millions of Chinese peasants.[6] By 1947 the Hwang Ho dikes were repaired. The 'war erosion' of the Russian and Ukrainian plains (1941–45) is perhaps the next greatest example of combat-derived environmental change (cities excepted) from WWII, and in the grand sweep of Soviet soil history it ought probably to be considered trivial (Sobolev 1947; Alayev/Badenkov/Karavaeva 1990). In general, the theatres of operations in World War I and II involved ecologically, economically, and socially resilient places, so the environmental impacts of combat lasted comparatively briefly. Bomb craters remain here and there, forests are still recovering, and the destabilizing effects of tank tracks on dunes in the North African desert linger, but very little of significance in the way of combat-derived environmental change will prove lasting.

The environmental impact of the 1991 Gulf War, a subject viewed with great alarm at the time because of its conspicuous oil fires and spills, now seems not as great as many first feared. It is too soon to comment on its durability, which for marine ecosystems at least may prove considerable. About 10 million barrels of oil flowed into the Gulf, the equivalent of 40 Exxon Valdez spills. The fires, despite initial alarms, appear to have had a negligible impact on the atmosphere and climate (Westing 2003; Hawley 1992; Hobbs/Radke 1992). In Kuwait the war enriched desert environments. So much lethal ordnance remained amid the shifting sands of the Kuwaiti desert that all prudent Kuwaitis refrained from pre-war pastimes of hunting and joyriding. Bird populations grew

3 See: Cintre (1992: 119–127). Between 1420 and 1440 the Breton marches lost 20–80% of their population, almost all settled land was abandoned for decades and returned to second-growth forest. See also: Duby (1968: 296–302), where he says the 100 Years' War led to a resurgence of forest in wide areas throughout France. On the Thirty Years War, see Makowski and Buderath (1983). I am grateful to David Blackbourn for this reference.

4 The Mongols did rebuild the water system in Baghdad and eventually saw the attractions of higher revenues from irrigated farming. Details can be found in Christensen (1993).

5 Hewitt (1983) reports that about 750 square kilometres of German and Japanese cities were flattened by aerial bombing in WWII.

6 The Dutch used a similar tactic to forestall a French invasion in the 1670's, inflicting great flood damage on their own country, and many marauding or occupying armies have purposely flooded other people's lands.

a hundred-fold after the war. Grasses flourished to the point where they reminded some observers of prairies. Similar, if temporary, consequences arose from the desert campaigns in Libya and Egypt in 1942–3.[7] Thus, in exceptional cases the heavy use of explosive ordnance in conventional war has permitted more rapid recovery from environmental damage.

One perhaps durable effect of the 1991 Gulf War is the near elimination of the marshes that for several millennia had spread over the lower reaches of the Tigris-Euphrates. These were home to people disloyal to Saddam Hussein in his war with Iran in the 1980's, and who rose in revolt against him in 1991. They were crushed. As a coup-de-grâce, the Iraqi dictator ordered the draining of the marshes beginning in 1993 (based on a plan drawn up in 1989), a form of ecological warfare that destroyed birds, fish, reed beds and a way of life for a few hundred thousand people. Attempting to destroy the ecological and economic basis of life of one's enemies is a practice with a long pedigree. In the twentieth century, energy-intensive machinery made such projects far easier than in times past. In this case, with the fall of Saddam, it is possible that engineers will attempt to create the marshes anew. If they succeed, the episode of the Iraq marshes will be just another case of fleeting environmental damage from war (Nicholson/Clark 2002).

2.4.3 The Impacts of Guerrilla War

As a rule, more enduring environmental change came from the guerrilla wars of the 20th century. They were disproportionately important in environmental change because they invariably involved systematic attempts at habitat destruction, similar to that which Saddam Hussein undertook from 1993. Guerrillas inevitably sought to hide from the firepower of their enemies, and except in urban settings that meant hiding in forest and bush. After the dawn of air reconnaissance and bombing (the 1920's, practically speaking), hiding in remote areas proved insufficient: vegetation cover was required. Those fighting against guerrillas found it expedient to destroy that vegetation.

In some instances, this produced durable consequences for vegetation and soils, notably in drier, mountainous regions with high erosion potential, such as those around the Mediterranean. The anti-guerrilla campaigns in the Rif Mountains of Morocco (1921–26), in the mountains of north-western Greece (1942–49), and in the Algerian Tell (1954–61) all entailed widespread forest burning, often through air power. All these wars left scars still visible today, and reduced both the biomass and the economic potential of these districts (McNeill 1992). The consequences may last for centuries. The numerous wars in Africa since 1970, often intersocietal but not international, have led to heightened rates of desertification and ecological damage of many sorts. These too are likely to be durable in their effects, as for climatic, geological, economic, and social reasons the resilience of the affected ecosystems is weak. Ethiopia is perhaps the saddest example of this, but much the same situation prevails in Mozambique, Angola, Chad, and Somalia (Kreike 2004; Timberlake 1987: 162–173; Rubenson 1991). In Vietnam, where defoliation figured prominently in American tactics, the durable results of war are less conspicuous but no less real: geology, climate, and human agency have combined to permit quick repair of most but not all of the damage. Bomb craters (about 20 million all told) and deforested zones remain throughout the country, testament to the American anti-guerrilla effort (Westing 1976, 1984; De Koninck 1999). Guerrilla wars in Central America in the 1970's and 1980's also accelerated forest clearance and added to the chemical poisoning of waterways (Rice 1989; Faber 1992).

2.4.4 Impacts of War Refugees

Additionally, both conventional and guerrilla warfare routinely disrupted local ecologies through the mass migration of refugees. As thousands or millions left war zones, their impact in disturbing or managing their home environments was lost. This at times proved ecologically helpful, but in some cases, such as terraced mountains, mass emigration led to accelerated erosion because terraces fall apart without constant upkeep. Whatever the consequence of war refugees' departure, their arrival somewhere else almost always proved stressful, ecologically as well as in other respects. A careful study of the environmental effects of 3.5 million Afghan refugees in northwest Pakistan in the 1980's provides a grim picture. Suddenly heightened demand for arable land and fuel wood, and the Afghans' inevitable ignorance of local ecol-

7 Reported anonymously in Environment (35,4, May 1993: 22); on Egypt and Libya: Said 2003, who recounts tragic consequences of lingering landmines in Egypt; and Westing (1980: 110). Westing (1980: 154) also reports parallel events in the North Atlantic fisheries, where WWII temporarily halted harvesting, and so stocks flourished until peace permitted renewed fishing.

ogy, combined to devastate Pakistan's largest remaining forest zone (Allan 1987). Africa's decolonization and postcolonial conflicts since the 1950's created refugees in their millions, obliged to occupy landscapes which they often understood poorly and in which they hoped to have no long-term stake.

Previous centuries of course featured war refugees. But the twentieth century was distinctive for the number of refugees (~30 million in the 1990's), greater than in the past because human numbers grew so much greater, and because warfare became much more dangerous. Moreover, only rarely in the 20th century could war refugees find unoccupied lands into which to move; much more often they had to crowd into landscapes already thickly settled. Thus their impacts were probably greater because ecological buffers had already been worn thin in the lands obliged to accept them (Jacobsen 1994; Westing 1994).

2.4.5 Impacts of Preparation for War

Combat in general, whether guerrilla or conventional, even including refugee impacts, had a lesser impact than the business of war production and preparing for war. This was because more societies prepared for war than actually fought wars; because many societies saw fit to maintain their preparedness for decades on end, while wars themselves were (usually) comparatively brief; and because most of the big economies and populous societies were deeply involved in the geopolitical turmoil of the 20th century. It was also true because, with the transportation systems and integrated markets that had developed since 1870 or so, the demand for war materiel, and thus the impacts of economic mobilization for war, reached into nearly every nook and cranny of the globe.

Preparedness for war implied maximizing immediate production, putting much of it at the disposal of the state, and mobilizing as much labour as quickly as possible. Powers great and small sacrificed the quality of their soils, waters, and urban air in concentrated efforts to maximize production and stockpiles of food, rubber, oil, steel, uranium, soldiers, and other strategic substances. In the First World War the British government encouraged farmers to plough every imaginable acre. Labour shortage prevented farmers from caring for their lands as they would have wished. British grain production increased by 30 per cent in the course of the war, but much marginal land was damaged in the process (Horn 1984). Britain's war efforts of course extended to the Empire, to Australian wheat fields, Canadian forests, and South African mines. During WWII in colonial Southern Rhodesia (now Zimbabwe), for example, the British revived the practice of forced African labour on white settlers' farms, trying to maximize production of food and tobacco, and bled the African farms of their labour supply. African farms thus lacked the labour needed to manage soils and wildlife, while settlers' farms extended cultivation at the expense of surrounding bush (Johnson 2000).

Fascist states regarded preparation for war during peaceful interludes as a sacred duty. In the 1920's, Mussolini, well informed about food shortages in Germany and Austria in the latter stages of World War I, thought that Italy needed to be self-sufficient in grain. He launched a 'Battle for Wheat', and did not care that this policy promoted forest clearance of sloping and otherwise marginal lands, accelerating the erosion of Italian soils over subsequent decades.[8] He also tried, with scant success, to make Italy energy-independent, which involved promoting dam-building in the Alps for hydropower.

Crash programmes of economic mobilization proliferated in wartime and in times when war loomed on the horizon. Such programmes often amounted to a form of environmental roulette, but societies, whether fascist and militarist in orientation or merely anxious about war, played willingly because the ecological bills fell due much later than the political and military ones did.

2.4.6 Military Pro-natalism

International competition encouraged maximization not merely of food and energy harvests, but of the human crop as well. Emperors and kings for many centuries typically encouraged reproduction, in part because they wanted to ensure a ready supply of army recruits. Modern states sometimes made it a staple of policy. Fascist Italy, Third Republic France, Ceausescu's Romania, Mao's China and the Syria of Hafez al-Assad all sought to raise birth rates in order to provide more troops to fight possible enemies: military pro-natalism. Normally populations have responded desultorily to their leaders' efforts to get them to re-

8 Mussolini may have had an equally unintended impact, this time beneficial, upon Italian landscapes, by his campaign to reduce the populations of Italian goats. He regarded the goat as an unfascist animal (McNeill 1992).

produce more exuberantly. Romanians under the dictator Nicolae Ceausescu were the great exception, a product of special circumstances. In 1965 Romania was very much a Soviet satellite, but Ceausescu had in mind a rather more independent foreign policy than Moscow wished. He concluded that Romania needed more people, preferably 30 million by the year 2000, so he banned all forms of birth control and abortion. He set his secret police the task of ensuring that Romanian women were not shirking their reproductive duties. Romania's birth rate doubled in 1966, before tapering off. After Ceaucescu's overthrow in 1989, women went on a reproduction strike, so Romanians fell well short of the population target he set (Kligman 1998; Chesnais 1995: 171–8).

Mao, like Ceausescu, usually thought more people meant more security. From the time of the Korean War (1950–53) he anticipated a nuclear attack by the Americans, which was not a far-fetched fantasy since General Douglas MacArthur in 1951 recommended just that. After the Sino-Soviet split in 1958, Mao also feared nuclear attack from the Soviets. He concluded that China's best defence lay in raising its population so that it could better withstand nuclear war. For Mao, a large population was China's way to combat technologically more advanced enemies. He surprised Nikita Khrushchev in 1957 with his views:

> We shouldn't be afraid of atomic missiles. No matter what kind of war breaks out – conventional or thermonuclear – we'll win. As for China, if the imperialists unleash war on us, we may lose more than 300 million people. So what? War is war. The years will pass and we'll get to work producing more babies than ever before (Khrushchev 1974: 255 quoted in Shapiro 2001: 32).

Mao's successors were horrified by the rapid population growth Mao encouraged, and in 1976 turned to the most restrictive birth control programme ever implemented. The 20th century witnessed many other cases of military pro-natalism, a policy which, when successful, could lead to imbalance between population and environment, over-intensive resource exploitation, environmental degradation, and perhaps a higher probability of war.

2.4.7 Military Industrialization

Most states, however, recognized early in the 20th century that military power rested on industrial might more than upon massive population. Several shuffled their priorities accordingly, building military-industrial complexes. The British and Germans began this policy in the 19th century, and were soon imitated by the Japanese. The lessons of WWI, in which the Russian army lacked the necessary armament to fight the Germans effectively, drove home the importance of having one's own heavy industry. So from WWI onwards all great powers, and some not-so-great, encouraged the emergence of metallurgical and armaments industries within their national territories, and their empires. These industries, inevitably, involved heightened levels of air and water pollution. Further, they intensified resource use, especially of coal and iron, with attendant environmental effects from mining.

The most dramatic examples came where the state enjoyed maximal latitude to direct economic development, as in Stalin's USSR and Mao's China. In both cases security anxiety helped to motivate heroic, overnight industrialization campaigns (which in both cases had other motives as well). The dirty industrialization of the USSR beginning in 1929 reflected Stalin's fear that his country would be crushed by its enemies if it did not become an industrial power within ten years. He was correct in this assessment, although it is certain that sufficient industrialization to resist Hitler could have been achieved at lower environmental (and human) cost than Stalin was prepared to exact.

After the defeat of the Germans in 1945 the Soviets embarked on grand plans for the harnessing of nature in the service of the state, formalized in the 1948 "Plan for the Transformation of Nature" (Josephson 2002: 28). The deepening Cold War made it seem necessary that no drop of water should flow to the sea unused; no forest should be left unharvested. Giant hydroelectric dams served as the centrepiece of this plan, but it involved a comprehensive restructuring of the USSR's ecology. Cost constraints prevented Stalin and his successors from realizing their most grandiose ambitions: The Soviets never managed to divert the Siberian Rivers to Central Asia, or reroute the Pacific Ocean's Japan Cold Current. But they built a sprawling military-industrial complex with very few checks on pollution, and kept secret the environmental and health consequences of their efforts (Josephson 2002; Weiner 1999; Feshbach/Friendly 1992).

In 1958 the Chinese embarked on an industrialization that was even dirtier than the Soviet effort. Mao had become fixated on the idea of surpassing British steel production, and encouraged Chinese peasants to make steel in their backyards. They made plenty of steel, most of it useless, and in the process acceler-

ated the deforestation of China in their quest for fuel for their tiny smelters (Shapiro 2001). After Mao's death in 1976, China continued its industrialization programme, although in more conventional forms.

Meanwhile, South Korea and Taiwan proceeded apace with their own pollution-intensive industrializations, nurtured by the Americans, whose interest in economic development in East Asia was mainly geopolitical. The American security agenda required the rapid industrialization of its East Asian allies to counter the emergence of China. All of these efforts, capitalist or communist, were notably successful except for Mao's Great Leap Forward. In every case, pollution levels and other environmental concerns carried a very low priority until about 1990. And in every case, especially the Great Leap Forward, the environmental consequences proved unfortunate.

In the United States a military-industrial complex emerged in the 20th century too, although there top-down state planning played a much smaller role. And domestic, non-military demand was so strong that the steel mills of Pittsburgh and Gary, along with the coalmines of West Virginia and Wyoming would have thrived even without security anxiety. Nonetheless, tentatively and temporarily in WWI, and exuberantly from 1942 onward, the American state subsidised and otherwise encouraged military industry, adding a fillip to the demand for steel, coal, bauxite, nickel, electricity and other enterprises, all of which carried profound ecological consequences.

2.4.8 Militarily Useful Transportation Infrastructure

Beyond the more or less direct environmental impacts of industrialization and weapons programmes, there are indirect environmental consequences of state actions driven, at least in part, by security anxiety. Consider transport infrastructure. German railroads, the trans-Siberian railroad, Brazilian Amazonian highways, the Karakoram Highway connecting Pakistan and China, and even the U.S. Interstate system were built partly or entirely for military reasons.[9] Each investment in rails or roads led to rapid economic change (generally regarded as beneficial), rapid social change (often controversial), and unanticipated environmental change (normally ignored). People and businesses flocked to the new roads and railroads, almost like iron filings to a magnet. The U.S. Interstate system strongly affected land use, population distribution and densities, and, through promoting trucking and automobile travel at the expense of rail transport, air quality and energy use. It is true, of course, that highways and railroads also exist in places where military motives played no role in their construction. In light of this it is fair to say that, in contrast to nuclear weapons, the world's networks of roads and railroads would exist approximately as it is even absent security anxiety. The point here is a limited one: the extent, location, and timing (of construction) of much of the 20th century's transport infrastructure had military motives, and that in myriad ways transport infrastructure affects the environment.

2.4.9 Nuclear Weapons Industry

The starkest illustration of how security anxiety propelled the great powers to indulge in reckless environmental change comes from the nuclear weapons programmes of the U.S. and USSR. No component of the world's military-industrial complexes could rival nuclear weapons for state support, for freedom of action with respect to environmental consequences, and for protection from public and press scrutiny.

The American nuclear weapons complex was born in 1942 and by 1990 involved some 3,000 sites in all. The U.S. built some 70,000 nuclear warheads, and tested more than a thousand of them, mainly in Nevada and on small Pacific atolls.[10] The jewel in the nuclear weapons crown was the Hanford Engineering Works, a sprawling bomb factory on the Columbia River in the bone-dry steppe of south-central Washington State. It built the bomb that flattened Nagasaki in 1945. Over the next 50 years, Hanford engineers intentionally released billions of gallons of low-level radioactive wastes into the Columbia River, and accidentally leaked some more into groundwater. In 1949, shortly after the Soviets had exploded their first atomic bomb, the Americans conducted a secret experiment at Hanford. The fallout detected from the Soviet test prompted questions about how quickly the Soviets were able to process plutonium. In response, American officials decided to use 'green' uranium, less than 20 days out of the reactor, to test their hy-

9 See: The Economist, 10 October 1992, recounts the story of Eisenhower's 1919 cross-country convoy drive and his role in establishing the federal interstate highway programme in 1956. He also admired the military potential of Germany's autobahns in the campaigns of 1945.

10 Figures from: Brookings Institution, see at: <http://www.brook.edu/FP/PROJECTS/NUCWCOST/50. HTM>.

potheses about Soviet activities. The 'Green Run', as it was known to those in on the secret, released nearly 8,000 curies of iodine-131, dousing the downwind region with radiation at levels varying between 80 and 1,000 times the limit then thought tolerable. The officially tolerable limit has been lowered since then. The local populace learned of these events in 1986, when Hanford became the first of the US nuclear weapons complexes to release documents concerning the environmental effects of weapons production. The 'Green Run' shows the environmental liberties the Americans took under the influence of Cold War security anxiety.[11]

That was the tip of the iceberg. More environmentally serious were the wastes, which in the heat of the Cold War were left for the future to worry about. A half century of weapons production around the U.S. left an archipelago of contamination, including tens of millions of cubic meters of long-lived nuclear waste. More than half a ton of plutonium is buried around Hanford alone. No one has yet devised a technically feasible and politically acceptable solution to the environmental problems posed by the American nuclear weapons industry (Fioravanti/Makhijani 1997; US Department of Energy 1995).

The Soviet nuclear program began with Stalin, who wanted atomic weapons as fast as possible, whatever the human and environmental cost. The Soviet command economy was good at such things: a large nuclear weapons complex arose from nothing in only a few years. Soviet engineers built about 45,000 warheads and exploded about 715 between 1949 and 1991, mostly at Semipalatinsk (in Kazakhstan) and on the Arctic island of Novaya Zemlya. They also used nuclear explosions to create reservoirs and canals, and to open mine shafts. In 1972 and 1984 they detonated nuclear bombs to try to loosen ores from which phosphate (for fertilizer) was derived. They experimented with nuclear explosions as a means of salt mining. They dumped much of their nuclear wastes at sea, mostly in the Arctic Ocean, some of it in shallow water. They scuttled defunct nuclear submarines at sea. Most of the world's known reactor accidents befell the USSR's Northern Fleet, based at Archangel.

The Soviets had only one centre for reprocessing used nuclear fuel, at Mayak in the upper Ob basin of south-western Siberia, now easily the most radioactive place on earth. It accumulated 26 metric tons of plutonium, 50 times Hanford's total. From 1948 to 1956 the Mayak complex dumped liquid radioactive waste into the Techa River, an Ob tributary, and the sole source of drinking water for 10,000–20,000 people. Some 124,000 people in all were exposed to heightened radiation in this way. After 1952, storage tanks held some of Mayak's most dangerous wastes, but in 1957 one exploded, raining 20 million curies down onto the neighbourhood – equivalent to about 40 per cent of the radiation released at Chernobyl. About 270,000 people lived in the contaminated territory. After 1958 liquid wastes were stored in Lake Karachay, a shallow pond some 45 hectares in area. In 1967 a drought exposed the lakebed's radioactive sediments to the steppe winds, sprinkling dangerous dust, with 3,000 times the radioactivity released in the 1945 bombing of Hiroshima, over an area the size of Belgium and onto a half million unsuspecting people. By the 1980's, anyone standing at the lakeshore for an hour received a lethal dose of radiation (600 roentgens/hour). A former chairman of the USSR's Supreme Soviet's Subcommittee on Nuclear Safety, Alexander Penyagin, likened the situation at Mayak to 100 Chernobyls. No one knows the extent of contamination in the former USSR because the nuclear complex was so large and so secret. Much of the complex was shut down in the last years of the USSR, but the mess remained and post-Soviet Russia and Kazakhstan could not afford to clean it up even if the technical and political obstacles to doing so were overcome (Egorov/Novikov/Parker/Popov 2000; Yablokov 1995; Bradley 1997; Josephson 2000; Cochran/Norris/Suokko 1993).[12] The lethal residues of the British, French, Chinese, Indian, Pakistani, Israeli, South African (and perhaps a few other) nuclear weapons programmes were, mercifully, not on the superpower scale (Danielsson/Danielsson 1986; Makhijani/Hu/Yih 1995).

Taken as a whole, the nuclear programmes of the great powers left a remarkable legacy. They burdened

11 Details of this episode are in Caufield (1990) and Gerber (2002). In arguing that the U.S. ought not to adhere to radiation guidelines approved by the International Commission on Radiological Protection, one American nuclear mandarin in 1958 said, "the nation's security may demand the exposure of people to higher levels of radiation than those just established by the International Commission" (Caufield 1990: 130). See also Gephart (2003) for a detailed discussion of Hanford.

12 A useful general study of the Soviet nuclear weapons program to 1956 is Holloway (1994). The latest general report on Russian nuclear issues is Kurdrik, Digges, Nikitin, Bohmer, Kuznetsov and Larin (2004)

posterity with an apparently intractable long-term waste-management obligation. They exploded about 400 atomic devices above ground after 1945, sprinkling some 200 million tons of radioactive material around the earth. Underground testing irradiated chambers in the earth's crust. Moreover, undersea testing, practiced by the French in Polynesia, leaked plutonium into the Pacific (Danielsson/Danielsson 1986). The magnitude of these leaks remains secret, but their durability is well-known: plutonium's half-life is 24,000 years. Nuclear weapons programmes also gobbled up nearly a tenth of the commercial energy deployed worldwide after 1940 (Smil 1994: 185). The environmental changes resulting from nuclear weapons production and testing, which will persist long after the wars and tensions of the 20th century are forgotten, were driven exclusively by international security concerns.

2.5 Conclusion

In most societies, politics, institutions, and mentalities have evolved so as to provide security as their foremost goal. This has been truer since about 1910 than at most times in the deeper past. Hence, our politics and institutions are ill-adapted to the complex demands of ecological prudence, in which everything is connected to everything, and everything is always in flux. In Darwinian terms, the international security anxiety of the 20th century selected for states and societies that emphasized military power and industrial strength over all else: survival of the dirtiest.

When the ecology movement gathered force, in the 1970's, it did so in a moment of detente, which provided an opening for other items on political agendas. Since then it has flourished best in societies with minimal risks of war. Ecological concern on the part of states remained hostage to fortune.[13]

In 1990 when the war clouds were gathering over the Persian Gulf, President George Bush asked the American Congress to exempt the military from all environmental laws, and Congress complied. After 2001, his son asked that oil companies be allowed to drill for oil in the Arctic National Wildlife Refuge in Alaska, on the grounds that in time of war Americans cannot let caribou get in the way of strategic requirements. And in March 2003, as the U.S. prepared to attack Iraq, the President and Secretary of Defense pressed Congress for a permanent, blanket exemption from environmental regulations for the American military. The 20th century's pattern, in which great power security anxiety put a ceiling on environmental preservation and actively fomented ecological change, bids fair to hold in the 21st as well.

13 Britain relaxed its air and water pollution regulations during WWII in hopes of spurring industry to greater production levels; indeed coal smoke over cities served military purposes because it made it harder for German bombers to see their targets.