"The grand social and ideological systems that people construct for themselves invariably carry large consequences, for the environment no less than for more strictly human affairs. Among the swirl of ideas, policies, and political structures of the twentieth century, the most ecologically influential were the growth imperative and the (not unrelated) security anxiety that together dominated policy around the world. . . . By 1970, however, something new was afoot."

Ideas Matter: A Political History of the Twentieth-Century Environment

J. R. McNeill

The twentieth century has no rivals when it comes to human impact on the environment. Why this is so has much to do with the interconnected histories of technology, energy, population, and economic growth. But their trajectories, and the fate of the environment, have also been bound to the realms of ideas and politics, in ways both obvious and subtle.

What people think has affected the environment because to some extent it has shaped their behavior. And of course, the changing environment has played a part in affecting what people have thought. Here there are two related points. First, what people thought specifically about the environment, nature, and life mattered only marginally before 1970. Second, at all times, but more so before 1970, other kinds of ideas governed the human behavior that most affected the environment.

Ideological lock-in

Big ideas somehow succeed in molding the behavior of millions. They are usually about economics and politics. Ideas, like genetic mutations and technologies, are hatched all the time, but most quickly disappear for want of followers. Ruthless selection is always at work, but, again like mutations and technologies, the notion of increasing returns to scale often applies. When an idea becomes successful, it easily becomes even more successful: it gets entrenched in social and political systems, which assist in its further spread. It then prevails even beyond the times and places where it is advantageous to its followers. Technology historians refer to analogous situations as "technological lock-in." For example, the narrow-gauge railway track adopted in the nineteenth century, once it became the standard, could not be replaced even after it prevented improvements that would allow for faster trains. Too much was already invested in the old ways. Ideological lock-in, the staying power of orthodox ideas, works the same way. Big ideas all became orthodoxies, enmeshed in social and political systems, and difficult to dislodge even if they became costly.

At the outset of the century the ideas with mass followings remained the great religions. Their doctrines include various injunctions about nature. The God of the ancient Hebrews enjoins believers to "Be fruitful and multiply, and fill the earth and subdue it" (Genesis l:26–29). This and other biblical passages inspired an argument to the effect that Christianity, or the Judeo-Christian tradition, uniquely encouraged environmental despoliation. But the record of environmental ruin around the world, even among followers of Buddhism, Taoism, and Hinduism (seen in this argument as creeds more reverent of nature), suggests this is not so: either other religious traditions similarly encouraged predatory conduct, or religions did not notably constrain behavior with respect to the natural world.

A variation on the Judeo-Christian theme is the notion that Western humanism, rationalism, or the Scientific Revolution uniquely licensed environ-

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mental mayhem by depriving nature of its sacred character. While the lucubrations of Erasmus, Descartes, and Francis Bacon probably did not filter into the calculations of peasants, fishermen, or most landowners in the twentieth century or before, something can be said for this proposition. Western science helped recast environments everywhere indirectly, by fomenting technological change. Sir Isaac Newton said that if he had seen further than others it was because he stood on the shoulders of giants. Scientists of the twentieth century, such as Haber and Midgley, whose work proved enormously consequential in ecological terms, stood on the shoulders of giants of scientific method who held the notion that science's job was to unlock the secrets of nature and to deploy scientific knowledge in the service of human health and wealth.

This persuasive and pervasive idea legitimated all manner of environmental manipulation wherever modern science took hold. Applied science brought, for example, the chemical industry, which came of age in the mid- to late nineteenth century. By 1990 it had generated some 80,000 new compounds that found routine use, and inevitably also found their way into ecosystems un- adapted to them. A small proportion of these, even at tiny concentrations, proved disruptive, poisoning birds and fish, damaging genes, and causing other usually unwelcome effects. Some entered ecosystems at high concentrations; while the world's chemical industry in 1930 produced only a million tons of organic chemicals, by 1999 the total had grown a thousandfold. Slowly but surely the chemical industry came to play a part in ecology, introducing new selective criteria in biological evolution, namely compatibility with existing chemicals present in the environment. This development and others like it were an accidental result of rigorous scientific work over a century or more. In science more than religion, ideas from earlier eras exerted an impact on environmental history in the twentieth century.

NATIONALISM AND NATURE

Modern political ideas also shaped environmental history. Nationalism, born of the French Revolution, proved an enormously successful idea in the twentieth century. It traveled across cultures and continents better than any other European idea, appearing in several guises. It powerfully affected environmental change, although in no single consistent direction.

In some contexts, nationalism served as a spur to landscape preservation. As Europe industrialized quickly after 1880, nostalgic notions of German, Swiss, or English countryside acquired special patriotic overtones. In 1926 British architect Patrick Abercrombie could write that "the greatest historical monument that we possess, the most essential thing that is England, is the countryside, the market town, the village, the hedgerow, the lanes, the copses, the streams and farmsteads." The Swiss waxed sentimental and patriotic about their mountains and farms, resisting railroads near the Matterhorn and other threatening manifestations of "Americanism." Germans honed such forms of nationalism to a fine edge, alloyed them with idyllic romanticism, and organized countless countryside-preservation societies. Such ideas added a current to Nazism. Himmler's SS (the Nazi special forces) dreamed of converting Poland into a landscape redolent of German tribal origins, with plenty of primeval forest to reflect the peculiarly German love of nature.

Nationalism's preservationist, arcadian component lost out to a rival one that emphasized power and wealth.

Similar equations of national identity with rural righteousness, the sanctity of (our) land, and nature preservation cropped up wherever cities and industrialization spread. Russian populism before 1917; Russian (not Soviet) nationalism after 1917; western Canada's Social Credit movement; D. H. Lawrence's nature worship; the back-to-nature romanticism of best-selling and Nobel prize–winning Norwegian novelist Knut Hamsun; the intellectual hodgepodge underlying Mediterranean fascism and Japanese militarism; Mao's peasant populism; and all manner of back-to-the-land, antimodern currents—all these reflected political and cultural revulsion at urban and industrial transformations. In the Mediterranean, they provoked some small-scale reforestation schemes, including projects that won Mussolini's favor because he thought they would make Italy colder and thereby make Italians more warlike.

The SS did not carry out its plans for Poland; in general, nationalism's preservationist, arcadian component lost out to a rival one that emphasized power and wealth, and therefore favored industrialization and frontier settlement, regardless of ecological implications. The nationalism unleashed in

the Mexican Revolution (1910–1920), for instance, quickly abandoned peasant causes in favor of accelerated industrialization. Argentina and Brazil pursued the same vision, without the revolutions, after 1930. In Japan, nationalism and industrialization were yoked together from the Meiji restoration to World War II (1868–1945), and in a more subdued and less militaristic way, after 1945 as well. The vast changes in land use and pollution patterns brought on by industrialization were in part a consequence of nationalisms.

So were the changes provoked by efforts to populate "empty" frontiers. States earned popular support for steps to settle (and establish firm sovereignty over) the Canadian Arctic, Soviet Siberia, the Australian Outback, Brazilian (not to mention Peruvian and Ecuadorian) Amazonia, and the outer islands of Indonesia. Settling and defending such areas involved considerable environmental change: deforestation in some cases, oil infrastructure in others, and road building in nearly all. It is also often involved displacing, resettling, or even killing off unassimilated indigenous populations whose loyalty to the states within whose borders they lived was doubtful.

Nationalism lurked behind other population policies too, notably pronatalism. Many twentieth-century states sought security in numbers, especially in Europe, where birth rates were sagging. Hypernationalist regimes in particular tried to boost birth rates, in France after the humiliation at the hands of Prussia in 1871, in fascist Italy, and in Nazi Germany. The most successful was Romania, under Nicolae Ceausescu (1918–1989). In 1965 he set a growth target of 30 million Romanians by the year 2000, banned all forms of birth control including abortion, and subjected women of childbearing age to police surveillance to make sure they were not shirking their reproductive duties. At the time, abortions outnumbered live births 4 to 1 in Romania. After 1966, Romanian maternity wards were deluged, sometimes obliged to wedge two delivering mothers into a single bed. Ceausescu temporarily reversed the demographic transition and doubled the birth rate, all for the greater glory of Romania. Other embattled societies, such as Stalin's Soviet Union and Iran after the 1979 revolution also sought to maximize population to safeguard the nation. Nationalism, in its myriad forms and through the multiple policies it inspired, was a crucially important idea because of its effects on the environment—especially when its adherents gave this connection no thought.

Communism, another European idea that traveled well, was in some respects the highest form of nationalism. Its political success in Russia and China, in Cuba and Vietnam, depended as much on its promise of independence from foreign domination as on its promise of social justice. The same ambitions—economic development and state power—that inspired state-sponsored industrialization elsewhere drove the heroic sprints of communist five-year plans.

Correcting Nature's "Mistakes"

But communism had other components too. Deep in Marxism is the belief that nature exists to be harnessed by labor. Friedrich Engels believed, like today's most cheerful optimists, that "the productivity of the land can be infinitely increased by the application of capital, labour and science." Karl Marx endorsed the French socialists who urged that the "exploitation of man by man" give way to the "exploitation of nature by man." Explicitly linking communist progress with environmental transformation, the wordsmith V. Zazurbin in 1926 addressed the Soviet Writers Congress: "Let the fragile green breast of Siberia be dressed in the cement armor of cities, armed with the stone muzzle of factory chimneys, and girded with iron belts of railroads. Let the taiga be burned and felled, let the steppes be trampled. Let this be, and so it will be inevitably. Only in cement and iron can the fraternal union of all peoples, the iron brotherhood of all mankind, be forged."

Communists, especially in the Soviet Union and Eastern Europe, liked things big. Ostensibly this was to realize economies of scale, but it became an ideology, a propaganda tactic, and eventually an end in itself. Gigantism most famously affected architecture and statuary but also industry, forestry, and agriculture. The Soviets typically built huge industrial complexes, like Norilsk and Magnitogorsk, concentrating pollution. When the Soviet Union faced a timber shortage during the course of its first five-year plan in 1929–1933, millions of prisoners and collective farmworkers were sent to the forests to cut trees as quickly as possible. The resulting deforestation and erosion put sandbars in the Volga, inhibiting traffic on the country's chief waterway. In collectivizing agriculture, the Soviet government created not merely huge farms but huge fields, stretching as far as the eye could see, far larger than necessary to realize efficiencies from mechanization. This maximized wind and water erosion. Gigantism, together with the Marxist enthusiasm for con-

quering nature, led to the slow death of the Aral Sea, the creation of the world's biggest artificial lake and the world's biggest dam, and countless efforts "to correct nature's mistakes" on the heroic scale.

Communism, at least after its initial consolidation in power, also resisted technological innovation. With fixed production quotas pegged to five-year plans, Soviet and Eastern European factory bosses could ill afford to experiment with new technologies. Subsidized energy prices helped ossify industry in the Soviet Union and Eastern Europe so that, for example, most steel mills in 1990 still used the open-hearth process, an obsolete nineteenth-century invention long since replaced in Japan, South Korea, and the West. The political system stymied decarbonization and dematerialization, leaving the communist world with an energy-guzzling pollution-intensive coketown economy to the end—a fact that helped bring on that end in the Soviet sphere.

THE GROWTH FETISH

Communism aspired to become the universal creed of the twentieth century, but a more flexible and seductive religion succeeded where communism failed: the quest for economic growth. Capitalists, nationalists—indeed almost everyone, communists included—worshipped at this same altar because economic growth disguised a multitude of sins. Indonesians and Japanese tolerated endless corruption as long as economic growth lasted. Russians and Eastern Europeans put up with clumsy surveillance states. Americans and Brazilians accepted vast social inequalities. Social, moral, and ecological ills were sustained in the interest of economic growth; indeed, adherents to the faith proposed that only more growth could resolve such ills. Economic growth became the indispensable ideology of the state nearly everywhere. How?

This state religion had deep roots in earlier centuries, at least in imperial China and mercantilist Europe. But it succeeded only after the Great Depression of the 1930s. Like an exotic intruder invading disturbed ecosystems, the growth fetish colonized ideological fields around the world after the dislocations of the Depression: it was the intellectual equivalent of the European rabbit. After the Depression, economic rationality trumped all other concerns except security. Those who promised to deliver the holy grail became high priests.

These were economists, mostly Anglo-American economists. They helped win World War II by reflating and managing the American and British economies. The international dominance of the United States after 1945 assured wide acceptance of American ideas, especially in economics, where American success was most conspicuous. Meanwhile the Soviet Union proselytized within its geopolitical sphere, offering a version of the growth fetish administered by engineers more than by economists.

American economists cheerfully accepted credit for ending the Depression and managing the war economies. Between 1935 and 1970 they acquired enormous prestige and power because—or so it seemed—they could manipulate demand through minor adjustments in fiscal and monetary policy so as to minimize unemployment, avoid slumps, and assure perpetual economic growth. They seized every chance to spread the gospel: infiltrating the corridors of power and the groves of academe, providing expert advice at home and abroad, training legions of acolytes from around the world, and writing columns for popular magazines. Their priesthood tolerated many sects, but agreed on fundamentals. Their ideas fit so well with contemporary social and political conditions that in many societies they locked in as orthodoxy. All this mattered because economists thought, wrote, and prescribed as if nature did not.

This was peculiar. Earlier economists, most notably the Reverend Thomas Malthus (1766–1834) and W. S. Jevons (1835–1882), tried hard to take nature into account. But with industrialization, urbanization, and the rise of the service sector, economic theory by 1935 to 1960 became a bloodless abstraction in which nature figured, if at all, as a storehouse of resources waiting to be used. Nature did not evolve, nor did it adjust when tweaked. Economics, once the dismal science, became the jolly science. One American economist in 1984 cheerfully forecast 7 billion years of economic growth—only the extinction of the sun could cloud the horizon. Nobel Prize winners such as Robert Solow could claim, without risk to their reputations, that "the world can, in effect, get along without natural resources." These were extreme statements but essentially canonical views. If Judeo-Christian monotheism took nature out of religion, Anglo-American economists (after about 1880) took nature out of economics.

The growth fetish, while on balance quite useful in a world with empty land, shoals of undisturbed fish, vast forests, and a robust ozone shield, helped create a more crowded and stressed one. Despite the disappearance of ecological buffers and mounting real costs, ideological lock-in reigned in both capi-

talist and communist circles. No reputable sect among economists could account for depreciating natural assets. The true heretics, economists who challenged the fundamental goal of growth and sought to recognize value in ecosystem services, remained beyond the pale to the end of the century. Economic thought did not adjust to the changed conditions it helped create; it thereby continued to legitimate, and indeed indirectly to cause, massive and rapid ecological change. The overarching priority of economic growth was easily the most important idea of the twentieth century.

From about 1880 to 1970, the intellectual world was aligned so as to deny the massive environmental changes afoot. While economists ignored nature, ecologists pretended humankind did not exist. Rather than sully their science with the uncertainties of human affairs, they sought out pristine patches in which to monitor energy flows and population dynamics. Consequently they had no political, economic—or ecological—impact.

Thinking Environmentally

In contrast to the big ideas of the twentieth century, explicitly environmental thought mattered little before 1970. Acute observers, such as Aldo Leopold (1887–1948) in the United States, remarked on changes to forests, wildlife, soils, and biogeochemical flows. Fears of global resource exhaustion, although almost always mistaken, provoked laments and warnings. But the audience was small and the practical results few. Environmental thinking appealed only to a narrow slice of society. Small nature conservation societies arose almost everywhere in the Western world by 1910. Nature preserves and national parks, mostly isolated from economic use, emerged after 1870, first in Australia and North America, where plenty of open space was available after the near elimination of aboriginal and Amerindian peoples. These efforts inspired widespread imitation, but in most countries preserves and parks had to be small and had to accommodate existing economic activity. These developments scarcely slowed the momentum of environmental change. The ideas, however sound and elegantly put, did not mesh with the times. That began to change in the 1960s.

The 1960s were turbulent times. From Mexico to Indonesia and from China to the United States, received wisdom and constituted authority came under fierce attack. Of the many ideas and movements nurtured in these heated conditions, two continue to have an important impact: women's equality and environmentalism. The success of environmentalism (loosely defined as the view that humankind ought to seek peaceful coexistence with, rather than mastery of, nature) depended on many things. In the industrial world, pollution loads and dangerous chemicals had built up quickly in the preceding decades. Wealth had accumulated (and diffused through Fordism) to the point where most citizens could afford to worry about matters beyond money. In a sense, the economic growth of the industrial countries from 1945 to 1973 provoked its own antithesis in environmentalism.

Successful ideas require great communicators to bring about wide conversion. The single most effective catalyst for environmentalism was an American aquatic zoologist with a sharp pen, Rachel Carson (1907–1964). In 1962 her salvo against indiscriminate use of pesticides, *Silent Spring,* appeared. She compared the agrochemical companies to the Renaissance Borgias with their penchant for poisoning. This earned her denunciations from chemical manufacturers and the Department of Agriculture as a hysterical and unscientific woman. The resulting hue and cry brought her, and her detractors, onto national television in 1963. But her scientific information, mainly concerning the deleterious effects of DDT and other insecticides on bird life, was mostly sound and her message successful. After serialization in *The New Yorker,* her book became a bestseller in several languages. President John F. Kennedy, against the wishes of the Department of Agriculture, convened a government panel to look into pesticide problems, and its findings harmonized with Carson's. Eventually she had elementary schools named for her and her face graced postage stamps.

Karl Marx endorsed the French socialists who urged that the "exploitation of man by man" give way to the "exploitation of nature by man."

In another age Rachel Carson's ideas might have been ignored. Instead she, and hundreds like her, inspired followers and imitators. Millions now found the pollution they had known most of their lives to be unnecessary and intolerable. Earth Day in 1970 mobilized some 20 million Americans in demonstrations against assaults on nature. By the 1980s, anxieties about tropical deforestation, climate change, and the thinning ozone shield added a fillip

(and a new focus) to environmentalism. Earth Day in 1990 attracted 200 million participants in 140 countries. American popular music—a global influence—added the environment to its repertoire of subjects. Mainstream religious leaders, from the Dalai Lama to the Greek Orthodox patriarch (of Istanbul), embraced aspects of environmentalism, as did some fundamentalist religions groups. Big science and its government funders converted too. The United Nations launched its Man and the Biosphere research program in 1971, and by 1990 most rich countries had global-change science programs. Taken together, by 1998 these amounted to the largest research program in world history.

Between 1960 and 1990 a remarkable and potentially earth-shattering (earth-healing?) shift took place. For millions of people, swamps long suited only for draining had become wetlands worth conserving. Wolves graduated from varmints to noble savages. Nuclear energy, once expected to fuel a cornucopian future, became politically unacceptable. Pollution no longer signified industrial wealth but became a crime against nature and society. People held such views with varying emphases and degrees of commitment. Movements based on them became schismatic in the extreme, but all shared a common perceptual shift. The package of ideas proved highly successful, to the point where by the late 1980s, oil companies and chemical firms caved in and instructed their public relations staff to construct new "green" identities. While the sincerity of their conversions remained open to doubt, their fig leaves showed that in the realm of ideology, environmentalism had arrived.

This extraordinary intellectual and cultural shift started in the rich countries but emerged almost everywhere. Environmentalism had many faces, each with its own issues and agendas. Where it was once systematically repressed—in some countries of the Soviet bloc ecological data were state secrets—environmentalism soon helped topple regimes. In countries as poor as India, vigorous environmental groups emerged by 1973 and coalesced by the 1980s. In poor countries environmentalism normally was entwined in social struggles over water, fish, or wood and had little to do with nature for nature's sake. The full meaning of this new current will take decades, conceivably centuries, to reveal itself.

If Judeo-Christian monotheism took nature out of religion, Anglo-American economists (after about 1880) took nature out of economics.

Security anxiety. . .

By far the most important political forces for environmental change were inadvertent and unwitting. Explicit, conscious environmental politics, while growing in impact after 1970, still operated in the shadow cast by conventional politics. This was true on both the international and national scales.

At the international level, the dominant characteristic of the twentieth-century system was its highly agitated state. By the standards of prior centuries, the big economies and populous countries conducted their business with war very much on their minds, especially from about 1910 to 1991. War efforts in the two world wars were all-consuming. Security anxiety between the wars, especially during the long cold war, was high given the perceived costs of unpreparedness; states and societies had strong incentives to maximize their military strength, to industrialize (and militarize) their economies, and after 1945, to develop nuclear weapons. The international system, in Darwinian language, selected rigorously against ecological prudence in favor of policies dictated by short-term security considerations.

Security anxiety had countless environmental ramifications. In France after the defeat of 1870, the army won the power to preserve public and private forests in northeastern France, using them in a reorganized frontier defense system designed to channel German invaders along narrow, well-fortified corridors. (The next German invasion, in 1914, came through Belgium.) Many tense borders became de facto nature preserves because ordinary human activities were prohibited (for example, the border between Bulgaria and Greece, the demilitarized zone between North and South Korea, and the border between Iran and the Soviet Union). But other border regions became targets for intensive settlement intended, among other goals, to secure sovereignty, and consequently witnessed wide deforestation, as in Brazilian and Ecuadorian Amazonia. Many states built road and rail systems with geopolitical priorities in mind, such as imperial Russia's Trans-Siberian Railroad, Hitler's autobahns, America's interstate system, and the Karakoram Highway between Pakistan and China. Such major transport systems inevitably affected land-use patterns.

The largest environmental effect of security anxiety occurred with the construction of military-industrial complexes. After World War I, aside from

plenty of young men, clearly the main ingredient of military power was heavy industry. Horses and heroism were obsolete. All the great twentieth-century powers adopted policies to encourage the production of munitions, ships, trucks, aircraft—and nuclear weapons.

. . .AND ENVIRONMENTAL LIBERTIES

No component of military-industrial complexes enjoyed greater subsidy, protection from public scrutiny, and latitude in its environmental impact than the nuclear weapons business. At least nine countries built nuclear weapons, although only seven admitted doing so (the United States, Britain, France, the Soviet Union, China, India, and Pakistan). Israel and South Africa developed nuclear weapons while pretending they had not (a pretense South Africa abandoned by publicly dismantling its nuclear weapons program after 1994).

The American weapons complex involved some 3,000 sites. The United States built tens of thousands of nuclear warheads and tested more than a thousand of them. The jewel in this crown was the Hanford Engineering Works, a sprawling bomb factory on the Columbia River in the bone-dry expanse of south-central Washington state. It opened during World War II and built the bomb that destroyed Nagasaki. Over the next 50 years, Hanford released billions of gallons of radioactive wastes into the Columbia and accidentally leaked some more into groundwater. In 1949, shortly after the Soviet Union had exploded its first atomic bomb, the Americans conducted a secret experiment at Hanford. The fallout detected from the Soviet test had prompted questions about how quickly the Soviet Union could process plutonium. In response, American officials decided to use "green" uranium, less than 20 days out of the reactor, to test their hypotheses 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 levels between 80 and 1,000 times the limit then thought tolerable. The local populace learned of these events in 1986, when Hanford became the first of the American 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.

But that was just 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 United States left a big mess, including tens of millions of cubic meters of long-lived nuclear waste. Partial cleanup is projected to take 75 years and cost $100 billion to $1 trillion, the largest environmental remediation project in history. Full cleanup is impossible. More than half a ton of plutonium is buried around Hanford alone.

The Soviet government was more cavalier. Its nuclear program began with Stalin, who wanted atomic weapons as fast as possible, whatever the human and environmental cost. As it happened, the Soviet command economy was rather good at such things: a large nuclear weapons complex arose from nothing in only a few years. The Soviet Union built approximately 45,000 warheads and carried out about 715 nuclear tests between 1949 and 1991, mostly at Semipalatinsk (in what is now Kazakhstan) and on the Arctic island of Novaya Zemlya. The government used nuclear explosions to create reservoirs and canals and to open mine shafts. In 1972 and 1984 it detonated three nuclear weapons in an attempt to loosen ores from which phosphate (for fertilizer) was derived. The Soviet government dumped much of its nuclear wastes at sea, mostly in the Arctic Ocean, some of it in shallow water. It also scuttled defunct nuclear submarines at sea.

The Soviet Union had only one center for reprocessing used nuclear fuel: the Mayak complex in the upper Ob River basin in western Siberia, now 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 radioactive waste into the Techa River, an Ob tributary and the sole source of drinking water for 10,000 to 20,000 people. After 1952, storage tanks held some of Mayak's most dangerous wastes, but in 1957 one exploded, raining 20 million curies down onto the neighborhood—about 40 percent of the level of radiation released by the 1986 nuclear reactor accident at Chernobyl. After 1958, liquid wastes were stored in Lake Karachay. In 1967 a drought exposed the lakebed's radioactive sediments to the steppe winds, sprinkling dangerous dust with 3,000 times the radioactivity released at Hiroshima over an area the size of Belgium and onto a half million unsuspecting people. By the 1980s, anyone standing at the lakeshore for an hour received a lethal dose of radiation (600 roentgens/hr). A former chairman of the Soviet Union's Supreme Soviet's Subcommittee on Nuclear Safety, Alexander Penyagin, likened the situation at Mayak to 100 Chernobyls. No one knew the extent of contamination in the former Soviet Union

because the nuclear complex was so large and so secret. Much of the complex was shut down in the last years of the Soviet Union, but the radioactive waste remains and Russia cannot afford much in the way of cleanup.

WAR'S OTHER COLLATERAL DAMAGE

Much less has been done in war than in the name of war. The twentieth century did not lack for prolonged combat, but most of the environmental changes wrought in combat proved fleeting. Bombers flattened most of Berlin and Tokyo near the end of World War II, but both cities sprang up again within a decade or two. American bombers put some 20 million craters in Vietnam, but vegetation covered most of these wounds, while some eventually served as fishponds. In the war between Japan and China (1937–1945), Chinese Nationalists, hoping to forestall a Japanese advance, destroyed the dikes holding the Huanghe (Yellow River) in 1938. Probably the single most environmentally damaging act of war, it drowned several hundred thousand Chinese (and many thousand Japanese), destroyed millions of hectares of cropland in three provinces, and flooded 11 cities and 4,000 villages. But the labor of surviving Chinese made good the devastation in a few years. The intense combat on the Western front and at Gallipoli during World War I and the scorched-earth policies of the German-Soviet struggle during World War II brought correspondingly intense environmental devastation. But patient labor and the processes of nature have hidden these scars and assimilated into the surrounding countryside the sites of even the most ferocious battles—except where a conscious effort has been made to preserve the battlefields as memorials. In the 1991 Persian Gulf War, Iraqi forces ignited huge oil fires that darkened the skies, and spilled further oil into the shallow and biologically rich Persian Gulf. The atmospheric pall dissipated in a few months when the burning wells were capped, but marine life took (and will take) years to recover. The Gulf War may prove an exception to the rule about the fleeting nature of environmental damage from combat.

While environments governed by irrigation works such as China's were the most vulnerable to war's destruction, deforestation took (and will take) longer to heal. Dryland agriculture recovered quickly from war, on average in about three years. Pasture and grassland often took a little longer, perhaps 10 years. But forests would take a century or three. For centuries warfare had featured forest destruction as policy. Caesar burned Gallic woods. In the twentieth century the prominence of guerrilla tactics meant that war played an unusually large role in deforestation. Many wars of colonial resistance in Africa and Southeast Asia involved guerrilla campaigns. During the cold war, many of the proxy wars fought in Africa, Asia, and Central America did too. Guerrillas had to hide, and forests provided ideal cover; hence antiguerrilla forces destroyed forest. At times guerrillas did too, often as acts of arson aimed at occupying powers or forces of constituted order.

Twentieth-century technology made forest destruction much easier than in Caesar's (or William Tecumseh Sherman's) day. The French pioneered incendiary bombing of forests in the Rif War, an uprising of Moroccan Berbers against Spanish and French colonial power in the 1920s. Napalm debuted in World War II in flamethrowers and proved its effectiveness against forest cover in the Greek Civil War before becoming a major weapon in the American arsenal in Vietnam. The British inaugurated the use of chemical defoliants in the Malaya insurgency in the 1950s. The Americans used them on a large scale (for example, Agent Orange) in Vietnam. The Soviet-Afghan War begun in 1979 witnessed the use of a variety of high-tech defoliants. These and a hundred cases like them constitute some of the more durable ecological effects of combat.

By far the most important political forces for environmental change were inadvertent and unwitting.

Outside of combat, war efforts had other ecological impacts. European wheat demand in World War I led to the plowing up of about 6 million hectares of grasslands on the American High Plains and in Canada's prairie provinces. This helped prepare the way for the dust bowl of the 1930s. The British war effort in World War II consumed about half of Britain's forests. To build Liberty Ships in 11 days, as Americans did in Portland, Oregon, during that war, took a lot of electricity, justifying additional hydroelectric dams on the Columbia River, where two large dams had already been built in the late 1930s. Frantic drives to raise production of food, fuel, minerals, and other resources surely led to sharp ecological disruptions in every combatant nation, as did crash road- and railroad-building efforts. More recently, belligerents in the

civil wars that raged in Cambodia and eastern Burma financed their campaigns by contracting with Thai logging companies to strip forest areas under their control.

By suppressing normal economic activity, war temporarily reduced some ordinary environmental pressures. Despite depth charges and oil spills in the U-boat campaigns, World War II brought back halcyon days for North Atlantic fish populations, because fishing fleets sat out the war. Industrial emissions slackened because of coal shortages and factory destruction, at least in Europe and Japan. Iraqi land mines in the Kuwaiti desert kept people out and allowed a resurgence of animal and plant life in the 1990s. Combat had its impacts on the environment, occasionally acute but usually fleeting. More serious changes arose from the desperate business of preparing and mobilizing for industrial warfare.

The impact of political change

Although war was the most dramatic, some of the twentieth century's other major political forces—imperialism, decolonization, and democratization—also had a lasting impact on the earth's environment.

As the twentieth century began, Russia, Japan, the United States, and especially the Western European powers had embarked on imperial expansions. This often involved the displacement of existing populations, as in South Africa and Algeria. Colonial powers reoriented local economies toward mining and logging, and toward export monocultures of cotton, tea, peanuts, or sisal. Normally these changes were imposed with no thought to environmental consequences: the only goals were to make money for the state and for entrepreneurs, and to assure the mother country ready access to strategic materials. By the 1940s the French and British at least claimed to have local interests at heart when converting as much as possible of Mali to cotton or of Tanganyika to peanut production. But through ecological ignorance they nonetheless brought salinization in the Niger bend region of Mali and turned marginal land into useless hardpan in central Tanganyika.

Decolonization surprisingly changed little of this. Newly independent regimes often continued the economic policies of their predecessors. Big prestige projects carried on the tradition of colonial environmental manipulation in places such as Ghana, Sudan, and India. Financially weak regimes in Indonesia, Papua New Guinea, and Ivory Coast often sold off timber and minerals as fast as possible, regardless of environmental impacts. Many rulers arrived in office by way of a coup and saw fit to cash in before the next colonel or sergeant followed suit. The decolonization of Soviet Central Asia brought no changes in the water regime that was strangling the Aral Sea. In environmental matters, as in so many respects, independence often proved no more than a change in flags.

Democratization was another matter. A global wind of democratization blew across Greece and Iberia in the 1970s, much of Latin America and East Asia in the 1980s, and parts of Eastern Europe and Africa in the 1990s. In some cases, environmental protests helped in modest ways to undermine the legitimacy of authoritarian (for example, Chile) and communist (Poland) regimes. Such regimes had encouraged pollution-intensive economies and ecologically heedless resource extraction in their quests to build state power and maximize economic growth. They normally had kept ecological information under tight control. Democratization broke the hold these regimes enjoyed over information, and brought to light many environmental problems. Those caused by foreigners, the military, or specific factories were often addressed and sometimes resolved. Those brought about by the consumption patterns of ordinary citizens often grew worse under democracy, when, for instance, Eastern Europe and Russia dropped subsidized public transport in favor of private cars. Moreover the media spotlight shone only on certain kinds of environmental problems, usually those inspiring maximum dread such as industrial accidents and nuclear issues. Slow-moving crises such as soil erosion or biodiversity loss remained hidden in the shadows, uncompelling to the media and the public and entirely irrelevant to politicians attuned to the next election. Thus democracy tended to generate its own characteristic environment.

The turn to environmentalism

Almost all the environmental changes generated by imperialism, decolonization, democratization, and to a lesser degree, war were inadvertent effects of politics and policies designed for other ends. In contrast, the politics and policies in which environmental considerations formed a conscious element had modest effects.

Environmental politics and policies, as such, began only in the 1960s. Before that, local, national, and (on a very limited scale) international laws and treaties regulated some aspects of pollution, land use, fishing, and other issues. Smoke nuisance ordinances go back at least 700 years. Britain established a regulatory agency for a specific source of pollution,

the Alkali Inspectorate, in 1865. But all this was uncoordinated—specific policies and laws for very specific instances. On the international scale, neighboring countries occasionally had agreed to restrain fishing or water use. A multilateral agreement in 1911 checked the exploitation, in the Bering Sea's Pribilof Islands, of fur seals that Russian, Japanese, Canadian, and American sealers had hunted nearly to extinction between 1865 and 1900. In the aftermath of World War II, international institutions sprang up, including some concerned with the environment such as the International Union for the Conservation of Nature. Others regulated the environment without making it their explicit focus, such as the World Health Organization. But no coordinated policies or political currents dealt with the environment as such. This changed in the 1960s, a direct result of the tumult in the world of ideas.

Two general phases are discernible in the environmental politics and policies of the late twentieth century. The first began in the mid-1960s and lasted until the late 1970s. In this phase, environmental movements and, in some cases, political parties, sprang up in the rich countries. New Zealand's Values Party, born in the late 1960s, was the first explicitly green party but far from the most successful: it splintered after some 15 years on the edges of New Zealand politics. Environmental movements focused mainly on pollution issues but also on fears of resource exhaustion, spurred by the actions of the Organization of Petroleum Exporting Countries in 1973. Governments responded by creating new agencies charged with protecting the environment as a whole. Sweden (1967) and the United States (1970) led the way. International regimes of cooperation remained very weak, despite the efforts made after the first international conference on the environment in Stockholm (1972). That led to the United Nations Environment Program, headquartered in Nairobi.

In the second phase, beginning around 1980, poorer countries established their own environmental protection agencies, often given the status of ministry. In many cases, such as Nigeria or Russia, environmental laws and policy existed only on paper. In some cases, for example, Angola or Afghanistan, ongoing wars meant no environmental politics or policy existed even on paper. But in India, Brazil, Kenya, and elsewhere, grassroots environmental movements germinated and, whether through civil disobedience or official channels, began to affect national politics. India boasted hundreds of environmental organizations by the 1980s, ranging from scientific research institutes that served as watchdogs—such as New Delhi's Center for Science and Environment—to coalitions composed mainly of peasant women, such as the Chipko movement that sought to check logging in the Himalaya. These movements were often led by women whose lives were most affected by fuelwood shortage (because fuelwood gathering almost everywhere was women's and children's work), soil erosion (where women worked the land, as in much of Africa and the Indian Himalaya), and water pollution (because women fetched water and were responsible for children's health). Ordinarily these grassroots environmental movements were embedded in peasant protest or some other social struggle. When strong enough, they won some concessions from governments; when not, they solidified anti-environmental attitudes in the corridors of power, inadvertently inviting elites to equate environmentalism with subversion and treason.

In the rich countries in this second phase, new concerns added new dimensions to environmental politics: tropical forests, climate change, ozone depletion. In the United States an ideological crusade to roll back environmental regulation boomeranged, as provocative statements by President Ronald Reagan's officials served as recruiting devices for environmental pressure groups. Leadership in terms of innovative institutions and planning passed to northern European countries, notably the Netherlands, and to Japan. Green parties entered politics, and in some cases (such as Germany in 1983) parliaments as well. In 1998 the German Green Party took part in a coalition government, and its members held some important ministries. The Europeans pioneered a consensual politics of environmental moderation, based on corporatist traditions in which government, business, and organized labor hammered out agreements after prolonged bargaining. The Dutch in particular, beginning in 1989, arrived at an integrated national environmental plan, designed to harness the power of the influential ministries and special interests resistant to ecological prudence, such as agribusiness.

Cooperation and Confrontation

The second phase featured unprecedented efforts at international cooperation. Regional and global problems, such as acid rain or ozone depletion, required new institutions, agreements, and regimes of restraint. In 1987 the United States Congress helped browbeat the World Bank into environmental awareness. That same year also saw the

Brundtland Report. The fruit of four years of UN-sponsored inquiry into the relationship between environment and economic development, the report offered intellectual underpinnings for environmental planning, for regimes of restraint, and for the ambition of ecologically sustainable development. Also in 1987, the Montreal Protocol to protect the ozone layer and subsequent accords showed what good science and diplomacy could do. Thousands of international environmental agreements were reached from the mid-1960s onward and many had real effects. Optimistic observers saw in this a nascent "global governance regime" that could address the world's cross-border environmental problems.

The impact of all this, from 1967 on, was considerable in the rich countries. The technically and politically easiest environmental problems were in fact significantly reduced. Industrial wastewater was cleaned up, with benefits to the Rhine, the North American Great Lakes, and elsewhere. Sulfur dioxide emissions waned. Leaded gasoline vanished into history. Municipal sewage treatment improved. In general, problems that arose from a single institution or point source were addressed with some success. Initially at least, local solutions such as taller smokestacks merely shunted ill effects elsewhere. Sometimes more systematic solutions succeeded in their specific task but at the same time deepened other problems. Scrubbers used to control particulate emissions from smokestacks worsened acid rain. Most truculent of all were those problems that derived from citizen behavior or from diffuse sources. Nitrous oxides from vehicle exhausts and toxic farm runoff, for instance, continued to mount in North America and Europe.

Moreover, in most rich countries some powerful industries resisted environmental regulation by launching endless lawsuits or controlling the decisive ministries. This helped prevent serious reform in transport, energy, and agribusiness, the myriad environmental impacts of which scarcely abated. The United States automobile industry fought successfully to hamstring fuel-efficiency standards. California agribusiness kept getting water at dirt-cheap prices. The coal industry in Germany retained its giant subsidies. More often than not, major decisions affecting the environment remained the province of powerful ministries—trade, finance, industry, agriculture—rather than of environmental agencies.

Environmental politics ran up against the limits of the possible at the international level too. Although the United States became more amenable to international agreements after the late 1980s, it still made clear at the 1992 UN Conference on Environment and Development in Rio de Janeiro that American "lifestyles" were not negotiable. Other countries matched this stance. Japan proved recalcitrant on whaling prohibitions (as did Norway) and the trade in elephant ivory. Saudi Arabia and other oil producers fought against agreements on carbon emissions. Brazil insisted on its right to develop Amazonia as it wished, regardless of the implications of burning the world's largest rainforest. India and China declined to join the Montreal Protocol and subsequent accords on ozone-destroying chlorofluorocarbons, and in general adamantly refused to compromise their industrial ambitions in the interest of their, or the global, environment. Mexico and many other countries resisted pressures to harmonize environmental laws with those of richer nations: countries with more relaxed laws (or enforcement) found multinational firms more eager to invest in new steel mills and chemical plants. While many fault lines and alliances existed in this late-century world of international environmental politics, the main one divided rich from poor. Called, with dubious geography, a North–South confrontation, it crystallized at Rio in 1992 and particularly bedeviled climate-change negotiations, which had achieved only toothless accords up to 1999.

In short, both before and after 1970, for good and for ill, real environmental policy, both on the international and national levels, was made inadvertently, as side effects of conventional politics and policies. Britain managed to reduce its sulfur emissions after 1985 because Prime Minister Margaret Thatcher scuttled the coal industry in her quest to break the political power of trade unionism. Farm subsidies, especially in Japan and Europe, helped

create and maintain a chemical-intensive agriculture and dense populations of pigs and cattle, with deleterious consequences. Soviet and Chinese policies reduced the mobility of Central Asian nomads, aggravating overgrazing and desertification. China's collectivization and Cultural Revolution in the 1960s destroyed village-level constraints on marriage and fertility, provoking a gargantuan baby boom that lay behind many aspects of China's manifold environmental crisis in the 1980s and beyond. China's collectivization also helped inspire Tanzania's "villagization" scheme of the 1970s, the largest resettlement plan in African history, and one that led to deep environmental problems. Even in the age of environmental politics and overt environmental policy, real environmental policy almost always derived from other concerns, and traditional politics exercised stronger influence over environmental history.

HUMAN HISTORY AND UNINTENDED CONSEQUENCES

The grand social and ideological systems that people construct for themselves invariably carry large consequences, for the environment no less than for more strictly human affairs. Among the swirl of ideas, policies, and political structures of the twentieth century, the most ecologically influential were the growth imperative and the (not unrelated) security anxiety that together dominated policy around the world. Both were venerable features of the intellectual and political landscape, and both solidified their hold on imaginations and institutions in the twentieth century. Both, but particularly the growth imperative, meshed well with the simultaneous trends and trajectories in population, technology, energy, and economic integration. Indeed, successful ideas and policies had to mesh with these trends.

Domestic politics in open societies proved mildly more responsive to environmental problems that annoyed citizens than did more authoritarian societies, especially after 1970, but there were clear limits to the ecological prudence that citizens wanted. Regardless of political system, policymakers at all levels responded more readily to clear and present dangers (and opportunities) than to more subtle and gradual worries about the environment. The prospect of economic depression or military defeat commanded attention that pollution, deforestation, or climate change could not. More jobs, higher tax revenues, and stronger militaries all appealed, with an immediate lure that cleaner air or diversified ecosystems could not match.

By 1970, however, something new was afoot. The interlocked, mutually supporting (and co-evolving) social, ideological, political, economic, and technological systems that we conveniently call industrial society spawned movements that cast doubt on the propriety and prudence of business as usual. Some of these movements demanded the antithesis of industrial society, denouncing technology, wealth, and large-scale organization. Others called for yet more and better technology and organization, and more wealth for those who had least, as solutions to environmental problems. To date these new movements exercise only modest influence over the course of events, but they are still young. When Zhou Enlai, longtime prime minister of Mao's China, was asked about the significance of the French Revolution some 180 years after the event, he replied that it was still too early to tell. So it is, after only 35 years, with modern environmentalism.

Environmental change of the scale, intensity, and variety witnessed in the twentieth century required multiple, mutually reinforcing causes. The most important immediate cause was the enormous surge of economic activity. Behind that lay the long booms in energy use and population. Economic growth had the environmental implications that it had because of the technological, ideological, and political histories of the twentieth century. All these histories mutually affected one another; they also determined, and in some measure were themselves determined by, environmental history.

Few people paused to contemplate these complexities. In the struggles for survival and power, in the hurly-burly of getting and spending, few citizens and fewer rulers spared a thought for the ecological impacts of their behavior or ideas. Even after 1970, when environmental awareness had hurriedly dawned, easy fables of good and evil dominated public and political discourse. In this context, environmental outcomes continued, as before, to derive primarily from unintended consequences. Many specific outcomes were in a sense accidental. But the general trend of increasing human impact and influence was no accident. It was, while unintended, strongly determined by the trajectories of human history. ■