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Malthusianism, Eugenics, and Carrying Capacity in the Interwar Period

> "Forty-knot vessels, 60-mile trains, aeroplanes, wireless, and other devourers of distance, have made neighbors of us all, whether we wish to be neighborly or not."
>
> –Edward Murray East, *Mankind at the Crossroads*, 1923

After World War I, Malthusian prophets of despair and gloom appeared in large numbers. "There is at the present moment," the biologist Raymond Pearl wrote in 1925, "a great recrudescence of public interest in the problem of population. Books and articles on population growth have been appearing in the last five years with an abandon which could fairly be called reckless if the protagonists were not so obviously in deadly earnest."[1]

Several factors drove this "great recrudescence." First was a sense that the world had grown smaller because of global integration. "The world has changed," fellow biologist Edward Murray East wrote at the opening of *Mankind at the Crossroads* (1923), one of the prominent Malthusian books of the decade. "The present age is totally unlike any previous age. There is no longer isolation; space has been annihilated. . . . Thanks to steam and electricity the world as a whole is more of a single entity than were some of the smaller kingdoms of Europe in the fifteenth century." More than ever before, East pointed out, people and resources moved around the globe.[2]

East pointed to a second factor: a new abundance of population statistics. "We are just coming to be able to judge population matters," he wrote, "by knowledge rather than by guess, owing to a more plentiful supply of facts." When Malthus wrote his classic essays over a century earlier, such data did not exist. These data enabled people, especially state actors, to make sense of the accelerating changes in the world. In the late nineteenth century, states began registering citizens, issuing passports, and in some cases, restricting immigration. "Bookkeeping on a national scale," East pointed out, "is rather a new thing to the world."[3]

FIGURE 2 "The Most Critical Race in History," 1917, by Jay N. "Ding" Darling, shows the connection between World War I–related famine and American agriculture. Darling, an avid conservationist, later expressed worry about the toll of American foreign policy programs on U.S. soil and streams.

Courtesy of the Jay N. 'Ding' Darling Wildlife Society.

World War I also drove the surge of interest in population growth. Nothing showed that the world was interconnected, or the importance of statistics and planning, more than the war. And for Malthusians, nothing so dramatized the consequences of overpopulation. Fear of renewed war loomed over this generation of Malthusians much as it would for Malthusians of the late 1940s and early 1950s.

In retrospect, the Malthusian arguments of the interwar period can be clustered into at least three groups. One group stressed the political-economic aspects of population growth. In his influential *The Economic Consequences of the Peace* (1919), British political economist John Maynard Keynes saw the origins

of World War I in the population explosions of turn-of-the-century Germany, Austria-Hungary, and Russia. A second group emphasized the ethnic and racial consequences of population growth. In *The Rising Tide of Color against White Supremacy* (1920), Lothrop Stoddard warned that nonwhite peoples were winning demographic superiority around the world. A third strand, best represented by American birth-control activist Margaret Sanger, stressed the consequences for women and family. These three strands often overlapped. Sanger, for instance, wrapped together her concern for war, growing numbers of the unfit, and women's health.[4]

To varied extents, the environmental Malthusians of the late 1940s and 1950s—the generation including William Vogt and Fairfield Osborn, who would lay the groundwork for 1960s environmental Malthusians such as Paul Ehrlich and Garrett Hardin—drew from these political, racial, and family concerns. But even more they borrowed from an often overlapping but ultimately distinguishable set of concerns that a group of biologists, ecologists, and scholars developed in the interwar years: concerns about consumption, soil fertility, and environmental degradation. It was this emphasis on degradation and limited carrying capacity that most separated environmental Malthusians from other sorts of Malthusians.[5]

Some of those who pioneered these ideas focused on human beings, others on animals. The best known of the first group included biologists Pearl and East. Most Malthusian arguments, East noted at the beginning of *Mankind*, had overlooked the most central issue: they "concern only birth-rates and death-rates, and . . . neglect the importance of agriculture." Studying not just food supply but also agriculture was crucial, East insisted, because the planet's capacity was declining. Historians of population have noted the prominence of Pearl and East in debates about population, mostly to point out their race and class fears, but have rarely stressed their emphasis on environmental limits.[6]

A second group of theorizers about carrying capacity and environmental limits were ecologists who studied animals. Best known was Aldo Leopold, whose influence on the postwar environmental movement ranks with that of Rachel Carson. Investigating population dynamics—especially of deer—led Leopold to some of his most influential breakthroughs and one of his most memorable essays, "Thinking Like a Mountain." Even more than the ideas of Pearl and East, Leopold's ideas about population, consumption, limits, and environmental quality influenced postwar environmental Malthusians such as Vogt and Osborn and their 1960s successors. Leopold's ideas created a framework that later environmentalists used to critique the economic order that dominated the second half of the twentieth century—a Keynesian emphasis on economic growth that, not coincidentally, emerged in the 1930s and early 1940s, exactly when Leopold was unraveling the mysteries of deer population dynamics. Like Pearl and East, Leopold helps show that concerns about population

growth grew less from eugenics concerns than from new ideas about consumption, resource degradation, and carrying capacity in a time of war.

Raymond Pearl: Eugenics, Carrying Capacity, and Population Planning

Raymond Pearl (1879–1940) was one of the best known biologists of the early twentieth century. Conducting research at the Maine Agricultural Experiment Station from 1907 to 1918, and at Johns Hopkins University during the 1920s and 1930s, he pioneered breakthroughs that have shaped modern biology. He was also, according to one scholar, "unquestionably the most vocal exponent of population control ideology within the scientific community at the time." During the 1920s, Pearl wrote several articles about population problems as well as *The Biology of Population Growth* (1925). In 1928, he helped found the International Union for the Scientific Investigation of Population Problems. His thinking helps show the social politics wrapped up in early concern about population growth but also the emergence of the idea of carrying capacity.[7]

A key influence on Pearl's career was the British scholar Karl Pearson, with whom Pearl studied in London in 1905, not long after he earned a Ph.D. in zoology from the University of Michigan. From Pearson, Pearl learned two key things. First was biometrics, the statistical analysis of biological phenomena. As Pearl later wrote, Pearson made scientists "for the first time truly conscious that some sort of a logically coherent statistical calculus was indispensable." Pearl also learned about eugenics from Pearson, who was, according to one historian, a "chief disciple" of its founder, Francis Galton. Eugenics was a Progressive-era movement that hoped to spread genes seen as desirable and contain those thought to be destructive by encouraging those of the "right stock" to have lots of children and discouraging the "unfit" from doing so. Combining new discoveries about genetics with older ideas of racial and ethnic hierarchy, eugenicists believed that human reproduction could be monitored and shaped in order to prevent social problems like poverty, crime, and prostitution.[8]

After returning from Europe, Pearl made his reputation investigating the genetics of chicken populations. As a researcher in Maine, he studied how to increase egg output by hens. Drawing from the work of Danish botanist Wilhelm Johannsen, he helped discover the difference between the phenotype of an individual, its outward appearance, and its genotype, its internal genetic composition. Because of this difference, offspring did not always appear exactly like their parents. This realization was important in its own right, but also pushed Pearl toward the study of populations. He realized that studying the fertility patterns across an entire population could reveal as much as studying individual pairs. He began to focus on gathering population-wide data—a focus on groups, not individuals, that was a prerequisite for adopting a Malthusian view.[9]

While conducting this research, Pearl also started publishing articles about eugenics, quickly becoming a leading voice in the movement. "It is of prime importance," he wrote in 1908, "for the welfare of state or nation that those stocks which are on the whole endowed with the best traits should contribute more, many more, individuals to the next generation than should those stocks whose characteristics are on the whole bad." Eugenics historian Daniel Kevles writes that Pearl was part of the "eugenic priesthood," along with Charles Davenport, Herbert S. Jennings, Clarence C. Little, William E. Castle, and Edward Murray East.[10]

World War I helped Pearl see the importance of using population analysis as a tool for understanding human society. Due to his background in biometrics, he was selected to head the statistical division of the U.S. Food Administration under Herbert Hoover from 1917 to 1919. He drew two major conclusions from the war: overpopulation played a key role in causing international conflict, and good population-wide statistics were needed for postwar assistance. Numbers helped him see how close Europe had come to famine.[11]

These insights—combined with a 1919 fire that destroyed his lab and almost twenty years of records—pushed Pearl to begin to study the population dynamics of not just animals but also human beings. In what became a famous article, Pearl and fellow Hopkins researcher Lowell J. Reed claimed in 1920 to have found a "law" of population growth that applied equally to human beings and animals. All populations, they argued, followed a similar pattern of slow growth at first, followed by rapid growth, and then a plateauing. "The half-pint universe of the laboratory Drosophila," Pearl wrote in *The Biology of Population Growth*, "is without doubt a simpler world than that in which we carry on, but in both the great realities of birth and death are much the same. And it is these that count." On a graph, this traced a flattened, elongated "S." This "law" was criticized roundly, but has become a useful starting point for many population biologists.[12]

Over the next decade, in addition to promoting his idea of the logistical curve, Pearl warned frequently of unsustainable human population growth. In particular, two issues worried Pearl, the first being that the unfit of the world, both individuals and races, would take over the planet. "What kind of people are they to be," Pearl asked in 1923, "who will then inherit the earth?" Eugenics was the answer: "Man, in theory at least, has it now completely in his power to determine what kind of people will make up the earth's population." Most historians have focused on this aspect of Pearl's thinking. "It was not population growth of all people which worried Pearl," Garland Allen writes, "it was the growth of that segment of the population that he thought was defective."[13]

This may be so, but Pearl was no simple eugenicist. As he was developing his ideas about population in the mid-1920s, he was also rethinking—in fact narrowing—whom he thought of as defective, and in the process reforming the eugenics movement. His genetic research over the previous decade had indicated

that offspring would not necessarily be identical to their parents, and he moved away from some of his more crudely formulated eugenics positions, criticizing eugenicists such as Madison Grant for using flawed science to attack poor people. "It has yet to be demonstrated," Pearl wrote in a 1927 article, "that either poverty or lack of membership in a social aristocracy are biologically inherited traits, though the inference is too often drawn that they are." In *American Mercury* the same year, he attacked the "biology of superiority," arguing that eugenics had "largely become a mingled mess of ill-grounded and uncritical sociology, economics, anthropology, and politics, full of emotional appeals to class and race prejudices, solemnly put forth as science."[14]

Nonetheless, Pearl did not completely renounce eugenics. He still claimed to adhere to "Galton's view that heredity plays the principal role." His point was to expose the flawed genetic thinking of mainstream eugenicists, especially the idea that an individual's intelligence and character could be predicted on the basis of his parents' traits. Genetics worked in more complicated ways. "The almost infinite manifoldness of germ-plasmic combinations can be relied on to produce in the future, as it has in the past, Shakespeares, Lincolns, and Pasteurs, from socially and economically humble origins," he wrote. Pearl himself had come from humble origins: his father worked as a grocery clerk and foreman in a shoe factory.[15]

Pearl's concern about global resource limits also drove his approach to population growth. Whereas some Malthusians spoke of resource shortages and imbalances, Pearl stressed limits. In a 1922 essay examining population growth side by side with rates of resource consumption, he asked, "Where Are We Going?" With this question, Pearl was noting and criticizing the revolution in American patterns of consumption that that had developed in the early decades of the twentieth century and intensified in the 1920s. As many historians have described since, during these years more and more Americans became consumers, purchasing the goods they relied upon for daily needs, especially food and clothing. The 1920s also saw the spread of urbanization, cars, and electricity. The increased consumption that came with increased population focused Pearl's mind on the limits of the earth. "The volume and the surface of the planet on which we live are strictly fixed quantities," Pearl stressed. "This fact sets a limit." He often spoke of "closed universes." Pearl was using the concept of carrying capacity, if not the actual term, applying it to the world as a whole and its human inhabitants. Carrying capacity refers to the number of animals that a given landscape can support without deterioration. In the late nineteenth century, ranchers and rangeland managers began applying this concept to cattle and land, but only in crude fashion. Pearl was now giving the concept wider application.[16]

Scholars often ignore Pearl's emphasis on carrying capacity, or suggest that it was merely a more politically acceptable package for his main concern, eugenics. But the two concerns were not identical and deserve to be distinguished. "It is not only desirable in the eugenic interest of the race to cut down, indeed

completely extinguish, the high birth rate of the unfit and defective portions of mankind," Pearl wrote in *The Biology of Population Growth* (1925), his major work on the subject. "But it is also equally desirable because of the menacing pressure of world population, to reduce the birth rate of the poor, even though that unfortunate moiety of humanity be in every way biological sound and fit." The first point addressed proliferation of the unfit and the population composition. The second regarded not the "quality" of the population but rather its quantity, which Pearl worried about despite the lower classes being biologically sound and fit. He wanted to reduce their birth rate because he wanted to decrease the overall population, not because the poor were genetically inferior.[17]

In a 1927 essay, Pearl again distinguished his views of population composition from those about carrying capacity. After critiquing the flawed science of eugenicists in favor of a reformed vision of eugenics based less on group and more on individual deficiencies, he moved on to discuss carrying capacity: "It should be emphasized that what has been said in this paper related entirely and solely to the *relative* or *differential* aspect of fertility . . . and *not* to the absolute fertility of the population as a whole." For Pearl, the sustainability of continued aggregate population growth differed from the relative population size of different groups. "That the population of the United States," he wrote, "as a whole cannot go on increasing at its present rate per unit of time, and its component elements continue to enjoy the standards of living which they have in the past and do now, would seem to be obvious." Pearl's eugenic concerns and his concern about limits to growth, which he connected to increased consumption rates, may have overlapped, but they were not the same.[18]

In 1928, the population biologist Royal Chapman, one of Pearl's chief competitors, worked this concept of carrying capacity into an influential paper. "We have in nature a system," he wrote, "in which the potential rate of reproduction of the animal is pitted against the resistance of the environment, and that the quantity of organisms which may be found is a result of the balance between the biotic potential, or the potential rate of reproduction, and the environmental resistance." Chapman did not apply the concept to human populations, but later ecologists who did, including William Vogt and ecologist Eugene Odum, cited his works.[19]

In the 1920s, in the context of a recent global war, resource competition, growing populations, growing consumption, and the spread of new technologies of agriculture and new agricultural sciences, ideas of carrying capacity seemed a useful tool for understanding the changing world.

Edward East: Malthus and Soil Conservation

When Edward East (1879–1938) sat down to write *Mankind at the Crossroads* (1923), he originally had in mind a study of immigration, population composition, and

eugenics. Far more than population growth, these questions dominated demographic discourse in the first half of the twentieth century. Like Pearl, East was a eugenicist; *Mankind* includes many racist, elitist remarks. But it is not primarily a book about eugenics. East came to believe the problem of population growth to be separate and far more pressing. "The broader aspects" of the problem, he wrote, "continually asserted themselves." The population of the world "is advancing in a tidal wave the like of which has never before been seen."[20]

Like Pearl, East saw humanity filling all available spaces and reaching limits. But East went beyond Pearl. He warned not just of limits being reached but also of environmental degradation that would severely reduce carrying capacity—the argument that most defined environmental Malthusians. Moreover, even more clearly than Pearl, East showed the gap between eugenics and Malthusian population concerns.

East made his name as an expert in corn genetics, just after the rediscovery of Gregor Mendel's pea experiments had kicked off a genetic revolution in biology. He grew up and studied in Illinois, and worked at agricultural extension stations there and in Connecticut before joining Harvard's faculty in 1909. He made two discoveries that sealed his place in the history of modern biology. First, while researching inbreeding and outbreeding in corn, he showed that blended inheritance could be explained by genetics, thus removing one of the key doubts about Mendelian theories. He also discovered that sexual reproduction leads to a recombination of genes and thus to more variations—what has become a bedrock idea in genetic theories of evolution. Ironically, given his pessimism about population growth and food supply, East's experiments and writings helped lay the foundation for hybrid corn and a revolution in food production in the United States and eventually around the world.[21]

As with many of the Malthusians in the 1920s, East's concern about population grew out of World War I. Like Pearl, East held administrative posts during the war that offered him a bird's-eye view of the world food situation: chief of statistics for Food Administration and chairman of the Botanical Raw Products Administration. His work in the food administration showed him, according to one colleague, "how narrow is the margin between the world's food supply and its ever increasing needs." During the war, East also read Thomas Malthus's essays on population.[22]

In *Mankind*, like Malthus and other Malthusians, East offered stern warnings: "If something is not done . . . the day of reckoning may arrive with astonishing suddenness in the shape of a breakdown . . . of the system." He prophesized that "If world saturation of population, which approaches speedily, is not prevented, in its train will come more wars, more famine, more disease." Too many people, he stressed, failed to realize "the gravity of this situation."[23]

Like Pearl, he saw the planet as a finite place: "The vessel is somewhat elastic, it is true, but it is a closed vessel nevertheless." Yet East took Malthus in a

different direction from other Malthusians, even Pearl. What most worried him most was not differential fertility, or even the filling the planet—but the diminishing returns of agriculture as populations grew. "Soil fertility," he wrote, "is being exploited with high speed and unnecessary wastefulness." In the 1890s, the United States reached the "era of diminishing returns in agriculture." The world, he wrote, could do so shortly.[24]

In many ways, East anticipated late twentieth-century concerns about sustainable agriculture. Devoting an entire chapter of *Mankind* to what he called "permanent agriculture," East highlighted soil fertility and called for putting agriculture on "a permanent scientific basis for all time." In particular, he wanted to remind people of agriculture's chemical foundation. Crops, he said, citing German chemist Justus von Liebig, drained the soil of various elements, especially nitrogen, phosphorus, and potassium. Without replenishing them, land would simply not produce. "In the last analysis," he noted, "the future food-supply of the world depends upon the conservation of soil fertility."[25]

Several factors led East to stress soil. He had grown up in the rural Midwest, surrounded by farms and farmers. He had trained and worked as a chemist, so he fully understood soil science, and knew that crops drained the soil of vital nutrients. And finally, as one of the inventors of hybrid corn, he could discern better than most the world's agricultural future. He was not optimistic; hybrids would increase yields but not dramatically. "There will be no revolution," he wrote. "There is no royal road to raising turnips." East doubted modern science's ability to improve agriculture, criticizing "those credulous day-dreamers who expect all future troubles to be straightened out by the genius of the test-tube shaker." Again and again, he returned to the basic issue of soil fertility: "All increase will be temporary, and even current production cannot be maintained, unless the essential elements of soil fertility are conserved by every method possible." Those who expect an agricultural revolution lacked real knowledge of agriculture. "The end of expansion," he stressed, "is in sight."[26]

East called for a new kind of conservation. Traditional conservationists focused too much on minerals: "Conservation[ists] . . . usually expend their energies solely upon this type of natural wealth. Forestry is the only agricultural specialty included in their exhortations." Instead, he pushed conservationists to focus more on agriculture: "It is agriculture rather than mechanical industry that is in need of these evangelists to-day."[27]

In addition to a new emphasis on conservation, East advocated several other measures that foreshadowed post–World War II environmentalism. He called for "rational birth control," which he said was "just as much a fundamental need of the nation as conservation of resources, equitable laws, and healthy social customs." He also wanted "a severe permanent restriction on immigration." Overseas, he called for "an agricultural foreign policy" that would have as its primary aim "the stabilization of prices and the conservation of soil wealth."

He also worried about exporting health measures to poor countries. He felt that the Rockefeller Foundation, a leading philanthropy working in Asia, had "gone naively into China bringing her the blessings of Western medical art and sanitation" without thinking through how "they are going to support the people they save."[28]

Like many biologists, East stressed that human beings were essentially animals, as genetics had proven. "Man is an animal," he wrote. "His life, growth, and death are subject to natural law." East underscored in particular the "imperious instinct" of reproduction. "The fundamental nature of the sex instinct," he wrote, "is no less apparent in man than in the lower animals." Like many in the later population planning movement, he felt that humans had no choice but to acknowledge and accept the sexual aspects of humanity. "Nature," he noted, "is not to be denied."[29]

Like Pearl, East often criticized eugenicists for bad science, but remained a racist, elitist, and ardent eugenicist, arguing that intermarriage between whites and blacks could undermine social progress. He wanted birth control distributed "at the lower end of the social scale" because, as he said, social problems came "disproportionately from the least desirable elements." "Parentage," he insisted, "must not be haphazard."[30]

And yet, like Pearl, East shows that the relationship between population planning and the racism and elitism of the eugenics movement was not straightforward. Although they often overlapped, his arguments about overpopulation were at times distinct from his racial and ethnic calculations. In *Mankind*, he did not fear a decline of the white population relative to others. Indeed, he believed that the white population was outgrowing the nonwhite population. Directly rejecting Lothrop Stoddard's argument that Asians, Africans, and other nonwhites were taking over the planet, he pointed out that whites tended to double their population every fifty-eight years, while Asiatics only in eighty-seven years. Moreover, unlike Asians, whites had more space in which to grow. In *Mankind* at least, East worried about the world filling up, not so much the world filling up with the wrong races. To him, the real problem with population growth was not differential fertility, but soil fertility.[31]

In one passage of the book, East crystallized the core problem. He saw "two great opposing forces" driving history. On one side were genes encouraging reproduction, high population growth, and, as for Pearl, increasing consumption: "the natural human desires to live an individual life of comfort and to exercise the instinct of reproduction." On the other side, he saw environmental degradation and "the immutable law of diminishing returns." This law "rules in agriculture more strictly than in other industries, pulling down and simplifying the standards of living, and requiring greater and greater efforts for mere existence as time goes on."[32]

Many of East's views and values—ideas of an interconnected, closed vessel of a planet with diminishing carrying capacity; of people as animals, especially reproductive animals, yet with the capacity to plan; of hopes for birth control technologies but overall technological skepticism; of concern about agriculture as well as new health measures overseas; of racism and calls for immigration restriction; and especially of increasing consumption—would reappear in the environmental Malthusians in later decades. But East also shows that concerns about carrying capacity, limits, and environmental degradation were not identical to concerns about differential fertility and weeding out the "unfit."

Aldo Leopold: Population, Consumption, and Wildlife Management

Aldo Leopold's thinking about population dynamics and consumption also shaped his ecological vision in profound and often overlooked ways. By studying wildlife population fluctuations, Leopold extended many of the ideas about carrying capacity and environmental degradation that Pearl and East had articulated, and these ideas, in turn, shaped his path-breaking ideas of ecological interconnection. Moreover, although later readers associate Leopold with wildlife ecology, his career helps show how Malthusian ideas of human society intertwined and overlapped with ideas of nature. He was greatly influenced by ecologists who gleaned ideas from Malthusian models of human society, and he himself often thought of human events—especially the Great Depression and World War II—in terms of the models of population and consumption that he was developing for animals.[33]

Leopold (1887–1948) is remembered as a transitional figure between Theodore Roosevelt's conservation movement and the 1960s environmental movement. He studied at Yale, the main training ground for Gifford Pinchot's U.S. Forest Service, the heart of the conservation movement. In 1909 he began fifteen years of work for the forest service in Arizona and New Mexico, which at the time were territories on the edge of the nation's growing empire. After moving back to his home state of Wisconsin and becoming the nation's first professor of game management, he became involved in many 1930s New Deal conservation projects. Interpreting these experiences through the lens of his specialty, wildlife conservation and ecology, Leopold pioneered ecological and ethical ideas that charted a path for environmentalists in subsequent decades. He synthesized his ideas in a famous collection of essays called *A Sand County Almanac* (1949).

Leopold's first exploration of population and carrying capacity came in the Southwest, where he worked in the U.S. Forest Service from 1909 until 1924. In 1913, after several years of work, Leopold experienced an epiphany: he realized that foresters fundamentally misunderstood their real task. They were, he wrote

in a Forest Service newsletter, confusing the means and ends of conservation. They had become so focused on the gospel of efficiency in managing land for production that they had lost sight of the true end of conservation—the long-term health of the forest and other resources under their protection. "The sole measure of our success," he wrote, should be "the *effect* . . . on *the Forest*." "My measure," he reiterated in capital letters, "is THE EFFECT ON THE FOREST."[34]

Leopold's thinking about human society, especially the tragic history of the Blue River Valley in Arizona, helped him refine his ideas. Settled by Anglo farmers and ranchers in the 1880s, the Blue River Valley had initially provided fertile bottomland soil, cottonwoods, and pines. But by the first decade of the twentieth century, when Leopold first visited, it routinely suffered flash floods and severe erosion. By the 1920s, settlements were literally washing away. The place, Leopold wrote, was "mostly boulders, with a few shelves of original bottom land left high and dry between rocky points." Only forty years after settlement, less than 8 percent of its arable land remained. In scores of other colonial settlements in the Southwest, Leopold encountered a similar pattern. He came to realize that, as one biographer put it, "the test of true civilization . . . was whether it could endure, whether its citizens could prosper for generations in a place."[35]

What he saw in these valleys—small islands of habitation whose limits had been reached—prompted Leopold to refine the idea of carrying capacity, which previously had mostly been applied in simplistic fashion. The settlers, and even the Forest Service, had overestimated the number of animals that could graze in a certain area. They had been looking at a single resource, the amount of available forage, but really needed to look at the health of the entire fabric of life in the area, especially the health of the soil. Summarizing his conclusions in 1923, Leopold stressed "the interdependent function of the elements"—what later would be called ecology. His conception of carrying capacity resembled Edward East's. Supply of food alone was not the best measure of carrying capacity; the condition of the environment had to be considered. There's no evidence that Leopold knew of the work of East and Pearl, but a decade later he would make a quick reference to Royal Chapman's 1928 article about carrying capacity in *Game Management*, his 1933 textbook on wildlife ecology.[36]

After moving back to his native Midwest in the mid-1920s, Leopold struggled for the next fifteen years with questions regarding wildlife populations and carrying capacity. During the 1920s, wildlife populations around the country but especially in the Midwest had declined alarmingly. The reigning explanation for this decline, most associated with the famous naturalist William Hornaday, was overhunting by humans. But using the ideas he had developed in the Southwest, Leopold stressed that habitat loss and degradation were just as important, if not more so. The main point here—that a population's size was dependent on the quality of its land and resource

base—would eventually become crucial to understanding human populations and sustainability.[37]

The problem was not just population declines but population explosions, as exemplified most dramatically on the Kaibab plateau in Arizona. The story of what happened there, later made famous by Leopold in his essay "Thinking Like a Mountain," would become a parable repeated by Rachel Carson and especially environmental Malthusians. The plateau, an "island" ecosystem bounded by the Grand Canyon on one side and by desert on all other sides, came under federal protection during the 1890s and became a wildlife refuge in 1906. In the 1920s, the deer population spiked then fell off dramatically. Having neither worked on the Kaibab nor visited it, Leopold relied upon others for information. At that time and later, scientists and wildlife officials disputed both the size and drop of the population and the dynamics involved. Estimates of the peak number of deer ranged from 20,000 to 100,000, and of the population crash from a few thousand to tens of thousands of animals. On the basis of the work of D. I. Rasmussen, Leopold eventually decided upon the higher range.[38]

Leopold struggled to understand the Kaibab and other population irruptions for most of the 1930s. He found a great source of insight, especially about the understudied role of consumption, from Charles Elton's *Animal Ecology*, an instant classic from 1927. Leopold and Elton met in 1931 and developed a good friendship. In his book, Elton established several core tenets of animal ecology, including "food chains" and the "pyramid of numbers"—concepts that, according to historian Thomas Dunlap, "put flesh on the skeleton of the 'balance of nature.'" Both concepts highlighted not just ecological interconnection but the mechanism for interconnection: animals were linked to each other through cycles of consumption. In a food chain, to put it simply, one species lived off of a second, which lived off of a third, which itself lived off of the first species. A species with fewer numbers sustained itself on—and was therefore limited by—those species with far greater numbers: thus, the pyramid of numbers. In Elton's wake, wildlife managers began to focus much more on consumption; wildlife research became, according to Dunlap, "studies of who ate whom." Management practices also moved toward concern with populations in a given environment, and toward quantification.[39]

Elton had developed many of his ideas thinking about human sociology and economics, especially in an imperial context (as had Leopold). In much the same way that Charles Darwin drew from Thomas Malthus's ideas, Elton drew from the British sociologist Alexander Carr-Saunders and his well-known 1922 book, *The Population Problem: A Study in Human Evolution*. Elton adapted ideas about food chains, cycles, and the pyramid of numbers directly from similar patterns in Carr-Saunders's analysis of human population history. In fact, Elton once described Carr-Saunders's work as the "sociology and economics" of human beings and his own work as the "sociology and economics of animals."

"Elton's achievement," historian Peder Anker has argued, "was to read by analogy Carr-Saunders's sociology into nature."[40]

During 1930s, as he continued to struggle with the question of population irruptions, Leopold began to use ideas of consumption and carrying capacity to criticize human society. "Man thinks of himself as not subject to any density limit," Leopold wrote in his pioneering 1933 textbook *Game Management*. "Industrialism, imperialism, and that whole array of population behaviors associated with the 'bigger and better' ideology are direct ramifications of the Mosaic injunction for the species to go to the limit of its potential, i.e., to go and replenish the earth. But slums, war, birth-controls, and depressions may be construed as ecological symptoms that our assumption about human density limits is unwarranted." Leopold took aim at modern civilization in general, not just capitalism. "As nearly as I can see," Leopold wrote in a 1933 essay, "all the new *isms*—Socialism, Communism, Fascism, and especially the late but not lamented Technocracy—outdo even Capitalism itself in their preoccupation with one thing: The distribution of more machine-made commodities to more people." He specifically warned about consumption. People in all these forms of society, he elaborated, "all proceed on the theory that if we can all keep warm and full, and all own a Ford and a radio, the good life will follow." The stakes, he stressed, couldn't be higher: "There are now wars and rumors of wars which foretell the impending saturation of the earth's best soils and climates."[41]

By the late 1930s, Leopold felt he had finally figured out the mysteries of population explosions. In an important 1939 essay called "A Biotic View of Land," he outlined an ecologically informed model of population explosion and carrying capacity. Nature, he wrote, should be understood as energy circulating in the form of nutrients through Elton's food chains and pyramids. Species should be defined by their consumption—not "where they came from, nor . . . what they look like, but rather . . . what they eat." Leopold connected these insights about consumption to his earlier insights about soil erosion, which had by this time become one of the most glaring conservation problems of 1930s because of the devastating Dust Bowl storms on the Great Plains. The health of land, he stressed, could not be separated from animal dynamics, especially animal consumption patterns. When the circulation of energy and nutrients from animals was healthy, plants and soils were healthy. But if these circulations were disturbed, soils suffered. "Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals. Food chains are the living channels which conduct energy upward; death and decay return it to the soil."[42]

"A Biotic View" displays a shift from the conservation focus on increasing productivity to the environmental focus on ecological interconnection and environmental quality. Conservationists, Leopold believed, had focused too much on cultivating species deemed useful and extirpating those deemed injurious, instead of on the health of the land and the overall system. In particular,

he stressed, removing predators was counterproductive because they helped maintain the circulation of nutrients within animal and plant communities, which in turn maintained the health of the soil. This was the problem on the Kaibab Plateau. All throughout the Southwest, federal officials, hoping to increase the yield of a desired species—in this case deer—had disrupted the ecological food chain and thereby degraded the entire ecology. He himself had killed many a wolf in such federal programs. "A Biotic View" warned of an "epidemic of new Kaibabs." The real goal of conservation, Leopold said, should be to achieve land health by maintaining ecological relationships. "Only wolves and lions," he concluded, "can insure the forest against destruction by deer and insure the deer against self-destruction."[43]

Here, too, the influence of larger events was visible. In the late 1930s, as Europe was falling into the chasm of war, a dark tone crept into Leopold's writings, a gloominess that appeared in "A Biotic View" as a deep concern with violence, especially human violence toward nature, a theme that drives the essay. "Man's invention of tools," Leopold wrote, "has enabled him to make changes of unprecedented violence, rapidity, and scope." The work of conservation should lead us "toward a nonviolent land use." Combining this idea with his understanding of population dynamics, he noted that human violence corresponded to population density. "Violence," he wrote, "would seem to vary with human population density: a dense population requires a more violent conversion of land." He criticized the "pioneering philosophy" in the United States, "which assumes that because a small increase in density enriched human life, that an indefinite increase will enrich it indefinitely."[44]

In subsequent years, Leopold spoke more explicitly about ecology, overpopulation, unsustainable consumption, and war. In a lecture to his University of Wisconsin students in 1941 called "Ecology and Politics," he stressed that when ultimate limits are reached, populations fall, sometimes dramatically. "One of the most emphatic lessons of ecology is that animal populations are usually self-limiting." For an example he pointed to "overpopulated" Europe: "Perhaps the present world-revolution is the sign that we have exceeded that limit, or that we have approached it too rapidly. If so . . . why not call a moratorium on human increase? . . . Why not bend science more toward new understandings, less toward new machines? . . . The technologists' cure for war is more technology." He then attacked ideas of unlimited production, consumption, and population growth: "We assume, I think naively, that increasing 'take' (i.e. more extraction, conversion, and consumption of resources) always raises standards of living. Sometimes it merely raises population levels. Perhaps this is a bear chasing his own tail."[45]

The mass patterns of human society, Leopold wrote in a 1943 essay, needed to be uncovered. Animals, he wrote, have behavior patterns of which an individual animal is unaware but which he nevertheless helps to execute. These

patterns were not visible by looking at just one animal, but only by "scrutiny of the mass through decades of history." This idea raised for Leopold a "disquieting" question: "Do human populations have behavior patterns of which we are unaware, but which we help to execute? Are mobs and wars, unrests and revolutions, cut of such cloth?" Historians and philosophers, he pointed out, persist in interpreting the "mass behaviors" of humans as the collective result of individual acts of volition. He recognized that humans have higher volitional content than animals, but thought that "it's important to look for analogues in higher animals." In future years, searching for such lessons would be one of the chief missions of ecologists. Doing so, he emphasized, might be "of potential importance to the whole human enterprise." With these questions, Leopold was broaching an old question with tremendous new consequences: In what ways were human beings similar to nonhuman animals and in what ways were they different?[46]

In April 1944, at the urging of one of his former students, Leopold sat down to summarize his intellectual journey from his early days in Pinchot's forest service to an ecological framework at odds with most 1930s conservation. The result was an essay about animal carrying capacity and overpopulation that became one of the most famous parts of *A Sand County Almanac*: "Thinking Like a Mountain." Leopold opened the essay by recounting shooting several wolves while crossing a river in the Southwest because, as he explained, "I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise." He then painted a vivid picture of how early federal wolf extirpation programs in the Southwest had backfired, creating a massive deer population explosion and die-off. "In the end," he wrote, "the starved bones of the hoped-for deer herd, dead of its own too-much, bleach with the bones of the dead sage, or molder under the high-lined junipers." Instead of focusing on one or two desirable species, Leopold stressed, land managers needed to think more "like a mountain"—to manage from the long-term perspective of the land and the entire system. In particular, Leopold indicted environmental manipulations that backfire because of a lack of ecological knowledge, such as predator controls that increase a population to where it ends up dying of "its own too much."[47]

By stressing interconnection, limits, and land health, Leopold's "Thinking Like a Mountain" departed from the single-species and utilitarian conservation values that he had implemented in the Southwest three decades earlier as one of Pinchot's foot soldiers and that, importantly, had come to dominate New Deal conservation, only now on a much larger scale. It was this new ecological model, with consumption patterns at its center, that became a textbook example of wildlife management—and for some, a way to think about human populations—for decades to come. "'The Kaibab,'" Thomas Dunlap has written, "became a classic conservation horror story, repeated in sportsmen's

magazines and game management and ecology texts for the next forty years." Later environmentalists would draw from Leopold's analysis of the Kaibab in textbooks, articles, and museum exhibits. Even activists on Earth Day in 1970 would borrow from it.[48]

That in other venues Leopold had blamed World War II on overpopulation adds an unusual layer of meaning to "Thinking Like a Mountain." In the context of the war, a story about misguided human actions and a population that dies of "its own too much" carried a darker warning about humanity's future. It is perhaps because of this subtext that the essay has moved so many people over the years. Indeed, *A Sand County Almanac* became popular during historical moments of war or threatening war that made it easy for readers to infer this meaning. The book appeared in 1949, just a year after Osborn's *Our Plundered Planet* and Vogt's *Road to Survival* blamed the recently ended global war on overpopulation and resource depletion. And it gained its greatest popularity in the 1960s and 1970s, the decades of another disturbing American war, and a moment in which overpopulation ranked as one of the environmentalism's top concerns.

Keynesian Growth Models and the Environment

During the Depression and World War II, American policy both at home and internationally was moving in exactly the direction that Pearl and East, and especially Leopold, were growing alarmed about: toward an economic system based on consumption-based growth that paid little regard to environmental limits. These programs grew out of the ideas of economist John Maynard Keynes, who, by the 1930s, had flipped his earlier Malthusian assumptions. Leopold and Keynes are rarely juxtaposed, and yet in the 1930s and early 1940s, they laid the foundation for rival philosophies about consumption and economic growth that would compete with each other the rest of the century both within the United States and around the world. They form the necessary context for understanding postwar environmental Malthusianism.

Few people have shaped the economic, political—and the environmental—history of the United States and the larger world, especially since the 1930s, as much as Keynes and his intellectual descendents. Hoping to revive economies around the world and improve the lot of the working class through government action, Keynes (1883–1946) more than anyone else invented the tools of an economic order based on planned consumption and economic growth, and advertised its advantages. Along with his allies, he was the main architect of not just the American economy that emerged after World War II but also the postwar international economy. Expanded by others into advocacy of a permanent consumption-driven growth machine, Keynes's insights would remake the policies of nations around the world, and also their forests, soils, rivers, and atmospheres. Many environmental Malthusians of the next half century—including

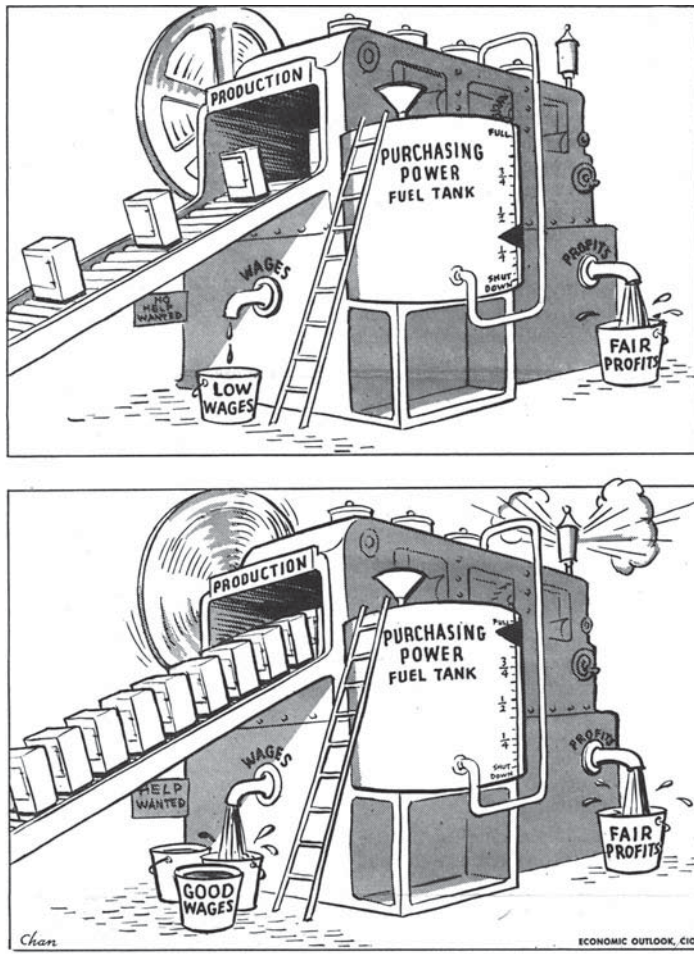

FIGURE 3 This image from the March 1946 issue of the Congress of Industrial Organization's *Economic Outlook* depicts a Keynesian economy. While most Americans and organizations like the CIO focused on the good wages and high purchasing power that greater consumption would bring, some conservationists began to focus on resources required and pollution emitted.

Courtesy of The George Meany Memorial Archives/SN70.

William Vogt, Fairfield Osborn, and Paul Ehrlich—reacted as much against this new obsession with growth as from concern about population per se.

Keynes's thinking, which he outlined in his best-remembered work, *The General Theory of Employment, Interest, and Money* (1936), emerged from his diagnosis of the Great Depression, which had stumped traditional economists and policymakers. By the early 1930s, unemployment rates had reached 25 percent for several consecutive years. To many observers, social turmoil threatened to

turn to upheaval and even revolution. The tools that economists of the period relied upon—the microeconomic analysis of how supply and demand played out—enabled them to suggest nothing better than to wait for the business cycle to finish its rotation. Keynes thought otherwise. Looking at the economy as a whole, he noticed that the supply of goods far exceeded the aggregate demand. While others saw this as a problem of *overproduction*, he instead emphasized *underconsumption*. The problem was not overstocked warehouses but shopperless stores. Eliminating overproduction, he acknowledged, could in fact realign supply with demand, stabilize prices, and end the rash of bankruptcies plaguing western economies. But doing so would do nothing for the millions of jobless Americans who relied on high production for employment. If, on the other hand, aggregate level of demand could be increased to meet the level of production, prices would stabilize and businesses would hire millions of workers to replace depleted inventories. Increased consumption could end the economy's freefall *and* create jobs.[49]

But how to increase consumption? Keynes's answer transformed the nation's economy and the world's environment for decades to come: government-sponsored consumption. Through his study of savings and the flow of money through the web of relations that constitute an economic system, Keynes realized that, in a stagnant economy, each new purchase had a "multiplier effect" on the economy—that is, that in an interconnected economic system, because each new purchase led to a series of additional purchases, each original purchase ultimately yielded an economic impact several times the original purchase amount. Thus, Keynes predicted that governments could jumpstart stagnant economies through carefully planned deficit spending. Because of the multiplier effect, each new governmental purchase could influence the economy far more than it might seem. Here was born the "growth fetish"—the obsession with government-fueled economic growth, which, according to environmental historian J. R. McNeill, has influenced the environment more than any other twentieth-century idea besides national security, to which it would soon become attached.[50]

Ironically, given the opposition that Keynes's growth economy would eventually receive from conservationists worried about population growth, Keynes owed many of his key insights to Thomas Malthus. Malthus, too, had studied economic "gluts" similar to the Great Depression, where supply seemed to vastly outpace demand, and, like Keynes, favored holistic approaches to understanding them. He even developed a notion akin to Keynes's idea of aggregate demand and recommended increased government spending in order to escape imbalances. Between October 1932 and January 1933, just before he started work on *The General Theory*, Keynes rewrote an essay on Malthus.[51]

Indeed, aggregate population analysis formed a key part of Keynes's diagnosis of the Depression. In a 1937 article, "Some Economic Consequences of a

Declining Population," Keynes argued that, by decreasing aggregate demand, the precipitous decline in birth rates during the 1930s had contributed to the Depression. "When [the] devil . . . of Population is chained up, we are free of one menace," Keynes wrote, "but we are more exposed to the . . . devil . . . of Unemployed Resources than we were before." Keynes eventually argued for pro-population-growth policies as a way to increase consumption and promote full employment and economic prosperity.[52]

A "gross national product war," World War II convinced policymakers of the efficacy of Keynes's prescriptions, and his ideas dominated early postwar economic thinking. As the end of the war drew near, planners worried about how to replace the government's wartime spending began to call for a dramatic expansion of consumption. "The volume of demand and production . . . will have to increase steadily," Harvard economist Alvin Hansen and Gerhard Colm of the Bureau of the Budget's Fiscal Division wrote. In *Mobilizing for Abundance* (1944), liberal economist Robert R. Nathan echoed this sentiment, "Only if we have large demands can we expect large production. Therefore . . . *ever-increasing consumption* on the part of our people [is] . . . one of the prime requisites for prosperity. *Mass consumption* is essential to the success of a system of mass production." Many Roosevelt advisors had bought into the Keynesian approach by the late 1930s, and in 1943, President Roosevelt himself spoke of the virtues of "an expanded economy." No doubt Roosevelt noticed how well Keynesian economics played politically, since it appealed to both big business and big labor.[53]

After the war, the U.S. government promoted Keynesian consumerism through several mechanisms: the G.I. Bill of Rights, which subsidized veterans' house purchasing; the Federal Housing Authority, which underwrote a massive expansion of homebuilding; and the Employment Act of 1946, which was designed "to promote maximum employment, production, and purchasing power." During the late 1940s, some powerful economic planners even went beyond Keynes's ideas of consumption-driven full employment to champion what historian Robert Collins has called "growthmanship." Whereas Keynes had pushed for increasing demand to help the economy reach full productive capacity and full employment, President Harry S. Truman's newly formed Council of Economic Advisors (CEA) hoped to use Keynesian tools to significantly *expand* productive capacity. By the end of 1947, the CEA had begun to call for not just full employment but "maximum production." In time, according to Collins, this "self-conscious emphasis on economic growth" became "the centerpiece of the postwar political economy."[54]

It's hard to exaggerate the environmental impact of growthmanship. Although other factors were involved, much of the material history of the 1950s—and indeed, the entire postwar period—owed no small debt to a consumption-based growth economy that saw few material limits. Government-sponsored highway building and home buying, for instance, ate up prodigious amounts of

farmland for new subdivisions, forests for balloon-frame houses, steel for appliances and cars, and oil for heating and transportation. Moreover, these economic policies did not fade after a year or two, but persisted over a half century. It was not for nothing that McNeill emphasized that next to national security, no idea reconfigured the environment more than the growth fetish.

Keynesian-based calls for planned consumption also played a crucial, yet often overlooked, role in the new international order at the end of the war. Remembering the Versailles Treaty and the Depression, and especially Keynes's prescient warnings in *The Economic Consequences of the Peace* (1920), many politicians and diplomats saw conscious development of an interconnected and growing international economy as a prerequisite for global prosperity and peace. Presenting this vision himself at the Bretton Woods conference in New Hampshire in 1944, Keynes articulated a vision of a rationally planned economy that connected societies instead of separating them. With the right tools, he believed, world leaders could do on a global level what the U.S. government was doing nationally: through calculated macroeconomic interventions, they could generate a ripple effect of economic activity around the world. The resulting growth would prevent the vast inequities between "haves" and "have-nots" that often fueled instability and war.[55]

Keynes found a great deal of support for his international program from Franklin Roosevelt, among others. In 1941, calling for "a wider and constantly rising standard of living," Roosevelt had declared "Freedom from Want" as a top war aim. After Bretton Woods, Roosevelt supported the creation of two organizations to oversee the world's economy: the International Monetary Fund (IMF) to coordinate currencies and market integration, and the World Bank to provide low-interest loans and grants around the world. Two American programs from the late 1940s—the massive Marshall Plan, initiated in 1948, and the Point Four foreign aid programs for the underdeveloped world, launched in 1949—also became foundations of international Keynesianism. "For roughly a quarter of a century after the Second World war," historian Robert Skidelsky notes, "Keynesian economics ruled triumphantly."[56]

By the late 1940s, most American policy makers believed that a mass consumption-oriented economy provided the best route for forestalling a return to economic depression and global war. Domestically, the United States was well on its way to becoming what historian Lizabeth Cohen has called a "consumers' republic." By this, Cohen meant not just a society of consumers but a society in which consumption had become something of a civic religion, or where, as she puts it, "the consumer satisfying personal material wants actually served the national interest, since economic recovery . . . depended on a dynamic mass consumption economy." It might also be claimed that because of the Keynesian influence on American foreign policy, the United States was well on its way to developing a "consumer world system" as well. By this time, Americans not only

consumed more than ever before but they also tried to convince others around the world to consume more than ever before. They also did so in a remarkably self-conscious fashion. In the postwar years, more than ever before, Americans talked and thought about the societal benefits of mass consumption.[57]

Consumption and Interconnection

Curiously, although Keynes and Leopold reached opposite views about consumption and limits, their worldviews emerged out of the same conditions and deployed many of the same analytical tools. Both took aim at the tendency to study things in isolation and emphasized how consumption created systems. Within economics, Keynes went beyond the traditional focus on individual transactions to focus on the "multiplier effect" and aggregate demand. In doing so, he helped invent the field of "macro" economics. Similarly, Leopold focused on aggregate analysis and the cycles of production and consumption within interconnected systems, only in his case to understand nature, not economic life. Previous conceptualizations of nature, which had focused on individual plants and animals in isolation from each other, were too descriptive. "The early attempts to apply biology," Leopold wrote in 1933, "soon disclosed the fact that science had accumulated more knowledge of how to distinguish one species from another than of the habits, requirements, and inter-relationships of living populations." Instead, in books like *Game Management* (1933), Leopold began stressing what he called "the fundamental behavior of all *aggregations* of living things."[58]

Ultimately, however, Keynes and Leopold understood interconnected systems differently. One stressed limits, the other did not. One saw consumption solving many of modernity's problems, the other saw it creating yet more problems. Like East and Pearl, Leopold worried about population growth and increased consumption undermining carrying capacity. All this came at a time when, because of Pearl Harbor and many new technologies, the United States was itself becoming less isolated from the rest of the world. In the age of interconnection that followed, the differences between Keynes and Leopold took on global importance.

For the most part, the two schools of thought that Keynes and Leopold developed did not clash directly in the 1930s and early 1940s. Occasionally, however, certain moments foreshadowed the disputes to come, to be carried out by their disciples. In 1944, writing in *Audubon* magazine, Leopold sketched what he saw as the chief conservation issue of the postwar years: the global spread of American-style industrialization. "The impending industrialization of the world, now foreseen by everyone," he wrote, "means that many conservation problems heretofore local will shortly become global." He warned of the consequences for rivers, forests, and air: "No one has yet asked whether the industrial

communities which we intend to plant in the new and naked lands are more valuable, or less valuable, than the indigenous fauna and flora which they, to a large extent, displace and disrupt." In the foreword to *A Sand County Almanac* (1949), Leopold attacked blind faith in a "higher standard of living": "our bigger-and-better society is now like a hypochondriac, so obsessed with its own economic health as to have lost the capacity to remain healthy. The whole world is so greedy for more bathtubs that it has lost the stability necessary to build them."[59]

Later decades would see more clashes between the viewpoints pioneered by Keynes and Leopold. Critics such as William Vogt and Fairfield Osborn would combine the insights about overconsumption and environmental degradation coming from Pearl, East, and Leopold into a distinct kind of environmental Malthusianism. The first of these clashes would come in the late 1940s, at a difficult moment of transition when the United States was beginning to reconstruct the domestic and global economy along consumption-based models of industrial growth.