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THE ANTHROPOCENE HYPOTHESIS

> The planet on which our civilization evolved no longer exits. The stability that produced that civilization has vanished; epic changes have begun. . . . We may, with commitment and luck, yet be able to maintain a planet that will sustain some kind of civilization, but it won't be the same planet, and hence it can't be the same civilization. The earth that we knew—the only earth that we ever knew—is gone.
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> —Bill McKibben, *Eaarth: Making a Life on a Tough New Planet*

The Idea of the Anthropocene

The idea of a new epoch in the history of planet Earth known as the Anthropocene—*anthropos* ("human") and *cene* ("new")—was proposed by the biologist Eugene F. Stoermer and the Nobel Prize–winning atmospheric chemist Paul Jozef Crutzen in 2000.[1] Our most recent epoch, the Holocene, began 11,700 years ago following the last Pleistocene Ice Age and inaugurated Earth's current interglacial period. In this time span—a brief event geologically—our species has become a global change agent equal to or greater than Earth's biophysical systems. A growing number of geologists, climatologists, biologists, and environmentalists are of the opinion that the human impact on Earth over the past two centuries has been so significant that identifying a new period in planetary history warrants examination. A group of geologists led by Jan Zalasiewicz has proposed to the International Commission on Stratigraphy, a body within the International Union of Geological Sciences, that the Anthropocene be recognized as a formal designation in the geologic time scale.[2]

Geologic periodization depends on how scientists interpret sedimentary rock layers and glacial ice and formally agree on a Global Stratotype Section and Point (GSSP) known as the "golden spike."[3] Stratigraphic significance is a factor of climate change and major shifts in evolutionary patterns. Evidence verifying the hypothesis that we have entered a new period of Earth's history

will come not from the remains of humanity's civilization but rather from its effects, from climate change, species extinction, and changes in oceanic biochemistry. All of these events are currently occurring and at ever-increasing rates. The Anthropocene remains a hypothesis, not a scientific theory. Yet for many, the real question is not geoscience consensus but whether our current global environmental transition will be moderate or catastrophic. Here, the Anthropocene has a powerful framing effect.

The Anthropocene goes by other names, including the Anthropozoic, the Androcene, the Age of Man, the Homogocene, the New Pangea, and the Great Acceleration. Many proponents place its dawning around 1800 with the advent of the Industrial Revolution. Others cite the explosion in human population and consumption after World War II.[4] Simon Lewis and Mark Maslin identify 1610 and 1964 as more promising start dates for the Anthropocene: 1610 marks the global integration of the Old and New Worlds with respect to biotic homogenization (also known as "the Colombian Exchange" and "Orbis hypothesis"), while 1964 marks changes in the atmosphere due to nuclear testing.[5] Adrian Franklin writes:

> The most recent phase of the Anthropocene, in the last 50 years, is distinguished by two unprecedented types of change. The first involved unparalleled levels of impact from new technologies, market expansion, unprecedented levels of population growth, settlement, consumption, and mobility. The second, a cultural change, involved the arrival of audacious projects (often multiple and contradictory) to take control of entire environments, to order and reorder entire landscapes, on national and international scales, often dedicated to reversing damaging levels of anthropogenic impact and restoring them to the imagined natures of earlier timelines.[6]

Niles Eldredge characterizes humans "as the first species in the 3.5-billion-year history of life to live outside the confines of the local ecosystem."[7] In this sense, the Anthropocene has been with us for a long time, emerging in tandem with the global diffusion of agricultural and civilizational modes of society and culture. Over the course of social evolution, the power elites of our species declared their independence from the world of nature and asserted their dominion over it in the name of their gods. Anthropocentrism historically has defined what it means to be fully "human" to justify dominion over those less than human. One can reconstruct a genealogy of Nietzschean-like "big men" who have re-engineered humanity and the planet. The Anthropocene represents the most recent wave of this human biopolitical will-to-power over life.

As an ideological doctrine, anthropocentrism places the human animal ontologically, epistemologically, and politically at the center of moral evaluation as the only known "God species" in existence. This exclusive and hierarchical prioritization of the human species is justified by invoking the factually constructed belief in our unique and overpowering mental traits. Animals and lesser humans are either excluded or occluded from the privileged center of moral consideration. The practical consequence of this is the conviction that fully human needs and interests should have priority over those of lesser humans and the nonhuman world. Furthermore, lesser and nonhuman lives have utility value as objects of use and means for the greater ends of those who are fully human. Anthropocentrism is not monolithic. There have been weak and strong, benign and malignant, and other variants in all historical cultures. These beliefs have historically justified the great dualisms and binary logics of sovereign power and authority—master/slave, human/animal, civilized/barbarian, culture/nature, soul/body, patrician/plebian, civilized/primitive, people of God/pagan, political life/bare life.

While this worldview has been with us since the advent of civilization, it is through the globalization of industrial modernity and changes in the planet's biosphere in real time that the Anthropocene has become a full-blown empirical reality. The influence of Western culture and civilization on other societies, species, and the planet reached its apex during the modern age. To speak of modernity is to make reference to the era of Western dominance that can trace its origins back to the fifteenth century and the discovery, conquest, and colonization of the Americas. Thanks to the Industrial Revolution, the West was able to successfully solidify its cultural, economic, political, and technological domination of the world. Earth has been under Western management for the past two hundred years. Today, we are witnessing the resurgence of non-Western societies under conditions of accelerated modernization. The key drivers of globalization today are fossil-fueled, consumption-based, high-tech, capitalist-growth economies; terrestrial re-engineering; population growth; mega-urbanization; the rise of a global middle class; and big industrial, monoculture farming.

Major works on the Anthropocene have already begun to appear, among them Jedediah Purdy's *After Nature: A Politics for the Anthropocene*, Jamie Lorimer's *Wildlife in the Anthropocene: Conservation after Nature*, and *Animals in the Anthropocene: Critical Perspectives on Non-human Futures* by the Human Animal Research Network (HARN) at the University of Sydney. Purdy approaches the Anthropocene from the perspective of American environmental history and law, defining it as a "threefold crisis" of ecology (the end of the Holocene honeymoon), economics (the twilight of modern economics), and

politics (the limits of the modern Western liberal-democratic, nation-state system).[8] He argues that we need a new "environmental imagination" and model of democracy ("a democratic Anthropocene") capable of solving the three main challenges of the twenty-first century—food and industrial agriculture, the treatment of animals, and climate change.[9]

Lorimer addresses the challenges facing wildlife in the Anthropocene from the vantage point of conservation biology and geography. The triumph and tragedy of modern Enlightenment sci-tech has resulted in the proliferation of novel ecosystems all across the planet characterized by destabilization, hybridization, territorial fragmentation, life on the move and on the run, and radical spatial transformation, all of which point to a "multinatural" biosphere. Traditional science and conservation biology are ill-equipped to deal with this new Earth in the making. What is required is a new "wildlife ontology" and paradigm shift in conservation practices commensurate with the Anthropocene's "multiple, fluid natures." We need a new conceptual approach as well as a new biopolitics.[10]

The essays in *Animals in the Anthropocene* are as much about the idea of the Anthropocene as they are about the future of animals. The Anthropocene enjoys a multiplicity of uses, intersecting, revitalizing, and problematizing many contemporary ideological and political positions. It reinforces and calls into question "humanity" as a Promethean-like force of evolutionary triumphalism and exceptionalism. It marks a new milestone for *Homo sapiens* as a planetary geological agent and, at the same time, the primary causal agent of a possible sixth mass extinction in Earth's evolutionary history. In one essay, Richie Nimmo comments that with the coming of the Anthropocene, "humans are finally unmasked as earthlings."[11]

The Planetization of Modernity

The planetization of modernity largely defines the Anthropocene. At the beginning of the Industrial Revolution, the human population was 1 billion. By 1930, it had reached 2 billion. By 1960, it had reached 3 billion; by 1974, 4 billion; by 1987, 5 billion; by 1999, 6 billion; and by 2015, 7.3 billion. By 2050, it is projected to reach 9.6 billion. The most recent study from the United Nations Population Division concludes there is an 80 percent chance that in 2100, 11 billion humans will inhabit Earth.[12] The twentieth century alone witnessed a population explosion from 1.6 billion to 6.1 billion. Thanks to modern advances in technology, energy, medical science, and food production, our species has managed to avoid a global Malthusian crisis, containing outbreaks of mass starvation, pandemic diseases, and mortality to local and

regional levels. Of course, these advances come at the expense of other species, as we invade, overcrowd, and alter habitats everywhere on the planet.

Some experts contend that the problem is not simply human population in the aggregate but rather its geographic distribution, density, and composition—the modernity of this population. Jack Goldstone has identified four demographic megatrends he believes will define human development in the twenty-first century.[13] One is the demographic and economic slowdown of the developed world (Europe, the United States, Canada, Japan, South Korea, Australia, New Zealand), with low fertility rates, aging and declining working-age populations, shrinking consumer markets, and rising medical and public-pension costs. In the developing world (Asia, Africa, and Muslim countries), we see the exact opposite trend: rapid population and economic growth, youthful populations, weak governments, and high levels of social and political conflict. The third trend is mega-urbanization. The fourth trend is the globalization of the consumer middle class driven by the developing world, particularly Asia.

Fertility rates in Europe and East Asia (Japan and South Korea) are below the steady state replacement rate of 2.1 children per woman. Canada, the United States, Australia, New Zealand, and most recently China and Brazil are at or just below the replacement rate. The rest of the world is above this rate. With fertility rates from 5 to 7 in many sub-Saharan countries, Africa's population is expected to quadruple by the end of this century to 4 billion. South Asia is expected to add a billion people by midcentury.[14] By 2050, the population of the West (Europe, the United States, Canada, and Oceania) will constitute 18 percent of the world's population; in 1913, it accounted for 35 percent of the world's population.[15]

By the middle of the twenty-first century, 70 percent of humanity will live in cities; in 1950, less than 30 percent of the world's population was urban. Two dominant trends of the twenty-first century will be rapid urbanization and the growth of megacities with populations greater than ten million in the developing world. China will jump from seeing 40 percent of its population urbanized to 74 percent by 2050, India from 30 to 55 percent, and sub-Saharan Africa from 40 to 67 percent. In the 1960s, there were two megacities: New York and Tokyo. In 2011, there were twenty-one. By 2030, there will be thirty. The majority of these megacities are in India (Mumbai, Delhi, Calcutta, and Chennai), China (Shanghai, Beijing, Guangzhou, and Shenzhen), Pakistan (Karachi and Lahore), Brazil (Sao Paulo and Rio de Janeiro), Mexico (Mexico City), and Africa (Kinshasa, Lagos, and Cairo).[16]

One billion people are urban outskirt dwellers, a number that is expected to triple by midcentury. Mega-urban outskirts are the key economic hubs of

the developing world. The global "slum economy" generates ten trillion dollars in economic flows per year.[17] Another trend is the convergence of megacities into "megaregions." Rio de Janeiro and Sao Paulo are on target to merge into a region of around forty-three million. Massive infrastructural projects are in the works to connect several Chinese cities in the Guangdong province and Pearl River delta economic zone (Guangzhou, Shenzhen, Dongguan, Foshan, Zhuhai, and Jiangmen) and link them to Hong Kong and Macao, thereby creating a region the size of Switzerland inhabited by more than fifty million people.[18]

Mega-urbanization is different from suburban sprawl in that it spatially concentrates humans and sends development upward in the form of superskyscrapers rather than simply outward. Nonetheless, it facilitates population growth and intensifies human consumption, thus putting more pressure on agricultural and energy production and therefore opening up even more land and water habitats to human development. At the center of this trend is an exploding, global, high-consumption middle class.

The gross world product (GWP) in 2012 was $72.44 trillion (in U.S. dollars). It is expected to increase fourfold by midcentury as the Emerging 7 (E7) economies (China, India, Brazil, Russia, Indonesia, Mexico, and Turkey) surpass the Group of 7 (G7) economies (the United States, Japan, Germany, the United Kingdom, France, Italy, and Canada). Before 2020, China will overtake the United States as the world's largest economy. By 2050, the world's largest economies will be China followed by the United States, India, the European Union, and Brazil. Europe and the United States will constitute 30 percent of GWP; in 1950, it accounted for 68 percent.[19]

Driven by the E7 and other emerging market economies, the world's middle class will mushroom by midcentury. Global middle-class status is defined by the United Nations and the Organization for Economic Co-operation and Development (OECD) as a person who earns $10 to $100 per day (in U.S. dollars) and has enough discretionary income to purchase durable consumer goods, such as automobiles, appliances, and telecommunication technologies. As of 2009, 1.845 billion people in the world were classified as "middle class." The global middle class is expected to increase to 3.249 billion by 2020 and 4.884 by 2030. In the case of Asia, the middle class is expected to explode from 525 million to 3.2 billion by 2030. One billion people in China will be middle class.[20]

Ecological footprint analysis, which measures the rate and scope of how humans consume resources and generate waste compared to nature's ability to absorb it and generate new resources, indicates that humanity currently uses the equivalent of 1.5 Earths; in other words, it takes Earth one year and

six months to replenish what we use in a year. At our current rate, by 2050, the human race will be using the equivalent of three Earths. If all of humanity were to live like the average American currently lives, our species footprint would require five Earths,[21] This estimate is precisely where Earth is headed in the twenty-first century, in the hands of a global civilization dedicated to American-style, high levels of consumption. The sustainability of the biosphere will be severely challenged, yet modern neoliberalism is confident in the ability of technology and institutional capacity to produce the equivalent of five Earths to keep pace with anthropocentric planetization. One could define the twenty-first century in terms of two forces headed for a reckoning—human technological systems and planetary biology.

Significant increases in human population and consumption will require equally robust increases in global energy production. Current global energy sources are roughly 32 percent oil; 28 percent coal; 22 percent natural gas; 5.7 percent nuclear; 2.3 percent hydropower; and 1 percent solar, wind, geothermal, and biofuels. On the basis of current known reserves and consumption patterns, oil and natural gas will be significantly exhausted by the end of this century. Coal is the world's most abundant energy source. Six countries—the United States, Russia, India, China, Australia, and South Africa—account for 80 percent of coal reserves, and these reserves are expected to last for two centuries. Nonrenewable fossil fuels account for 80 percent of global electricity generation, with 50 percent coming from coal. Worldwide energy demand is predicted to increase 25 percent by 2030 and up to 56 percent by 2040, largely driven by Asian economies. The highest projected annual growth rate for energy consumption over the next twenty years is 3.7 percent for Asia, and the lowest is 0.7 percent for Europe. If energy consumption in the United States, China, and India continues to grow at its current rates, by 2050 these three countries will consume close to 50 percent of the world's energy.[22]

The renewable-energy sector—nuclear, hydropower, solar, and wind—is predicted to grow in this century. Currently, nuclear energy and hydropower account for 20 percent of global electricity generation. Wind, solar, and geothermal energy account for 1 percent of the world's electricity production. With most of the world's major rivers dammed, hydroelectric power is at capacity. The nuclear industry continues to face challenges of high start-up costs, costly delays, waste disposal, and risks of human error and natural disasters whose consequences last for thousands of years. Wind has a promising future, with Europe leading the way. Large-scale solar-energy plants are already underway, with the goal of turning the world's deserts into vast solar farms—yet they can pose serious threats to desert environments, which are

home to fragile ecosystems and many rare and endangered species. Building solar farms requires stripping the landscape of vegetation and fencing it in. It has taken thousands of years for plants and animals to carefully adapt to desert conditions, so sudden changes can spell doom for desert species, such as tortoises and cacti. Solar-thermal plants require substantial groundwater for cooling, and the hotter temperature of the surrounding air poses threats to birds, whose feathers are literally burned in this environment.[23]

Yet despite growth in these energy sectors, by midcentury, fossil fuels will still account for 80 percent of world energy use. Human civilization remains committed to fossil-fuel economics, offshore and deep-water drilling, the exploitation of the melting Arctic, the mining and processing of oil sands, the hydraulic fracturing ("fracking") of rock veins to release natural gas and petroleum, and coal- and gas-fired power plants. The United States is in the midst of a fossil-fuel renaissance and is now the leading producer of oil and natural gas. The extraction of shale oil and gas in the upper Appalachian (the Marcellus deposit), Texas-Oklahoma-Louisiana (the Haynesville, Eagle Ford, and Woodford deposits), North Dakota (the Bakken deposit), and Wyoming accounts for one-third of natural gas production in the United States. The shale revolution has gone global, with major basins identified in Russia, Poland, Ukraine, China, Argentina, South Africa, Australia, Mexico, Libya, and Algeria. Fracking is at the center of the energy debate in America, with advocates stressing its potential for energy independence, jobs, wealth creation, tax revenues, and fewer carbon emissions than coal. Critics point out that fracking increases methane emissions; requires huge amounts of fresh water, which drawdown aquifers; creates huge, leaky wastewater ponds; increases the frequency of earthquakes as rock layers are weakened; has led to numerous railroad transportation accidents and explosions; and creates short-term boom-and-bust economies.[24]

Two key global effects of these powerful forces of anthropocentric planetization are habitat re-engineering and climate change. Combined, they threaten many species of life. A key indicator of the Anthropocene is the anthromization of the biosphere, which is the transformation of Earth's terrestrial landscape from mostly wild and seminatural territory to now largely anthropogenically re-engineered and human-occupied spaces. Most of Earth's natural ecosystems, or "biomes," have been transformed into anthropocentric biomes, or "anthromes." Using geographic information system (GIS) technology and vegetation, population density, and agricultural and urban land-use data sets and maps, a team of researchers has mapped the planet's biosphere over century-long intervals from 1700 to 2000.[25] The study identifies twenty-one anthrome classifications under six major groupings—dense settlements

(urban, suburban, and towns), villages (rice, irrigated, rainfed, and pastoral), croplands (residential, irrigated, rainfed, and remote), rangelands (residential, populated, and remote), seminatural lands (woodlands and forests), and wildlands (forests and savanna, treeless and barren tundra and desert). "Used lands" refers to the sum of all crop, pasture, and human settlements. Those lands designated as "unused" do, however, have significant areas under human management, such as parks and forests.

In 1700, 6 percent of the biosphere consisted of used anthromes, 45 percent of Earth's ice free land was seminatural with relatively low levels of human impact, and 49 percent of the biosphere was wildlands. By 2000, 40 percent of the biosphere consisted of used anthromes, 37 percent was classified as "novel ecosystems" (a mosaic of used and seminatural lands), and 23 percent of Earth's surface was wildlands primarily located in the coldest and driest regions of tundra and desert. In other words, 55 percent of the terrestrial biosphere was fundamentally transformed by humans in the twentieth century. Today, agriculture accounts for 39 percent of the world's ice free land use. Human agriculture is the largest contributor to global warming, the largest user of fresh water, the primary cause of biodiversity loss, and a major contributor to species extinction.

Biologist Michael L. Rosenzweig has popularized the terms "Homogocene" and "New Pangea" to describe how anthromization has resulted in the fundamental breakdown of barriers between biogeographical regions, the rapid introduction of new invasive species into established habitats, and the resulting homogenization of the world's ecosystems into one single province. The speed and scope of global biotic homogenization decrease biodiversity and speciation rates while increasing extinction rates. Eventually, a new equilibrium or "steady-state global diversity" will be achieved, but in the short term, we can expect significant turbulence in ecosystems. While species diversity will increase in some local and isolated areas, globally "the real damage to diversity will come from shrinking areas of the Earth that harbor wild species."[26] George Newcombe and Frank M. Dugan contend that with regard to plants, the Homogocene began around 1500, which coincides with the genesis of early modernity.[27]

Climate change will likely be the defining event of the twenty-first century. Changes in atmospheric greenhouse-gas concentrations and global temperatures have occurred throughout Earth's history as a result of volcanic activity, changes in the planet's axis and orbit, tectonic plate movement, changes in solar brightness, and shifts in the movement of global oceanic currents known as the "thermohaline circulation." Climate scientists are convinced that current global warming levels and significant increases in

atmospheric carbon dioxide, methane, and nitrous oxide are mainly due to industrial modernization. In the four hundred thousand years leading up to the Industrial Revolution, carbon-dioxide levels fluctuated between 180 and 280 parts per million (ppm), and only once did they reach 300 ppm. In the eight thousand years prior to 1750, carbon-dioxide levels varied between 260 and 280 ppm. By the mid-nineteenth century, levels were at 295 ppm. By 2005, they were at 379 ppm. The level in 2013 reached 400 ppm. The last time carbon-dioxide levels were this high was three million years ago.[28]

The foremost authority on climate change is the United Nations Intergovernmental Panel on Climate Change (IPCC). It comprises more than six hundred climatologists from more than one hundred countries organized into three major working groups—physical science; impacts, adaptation, and vulnerability assessment; and mitigation. The IPCC has issued major reports in 1990, 1995, 2001, 2007, and 2013–2014.[29] Earth's average temperature rose one degree Fahrenheit during the twentieth century. The IPCC, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers all estimate a global temperature increase of three to four degrees and a rise in global sea levels of three to five feet by the end of the twenty-first century. Add to this an extra five to ten feet of storm surge. A 2014 IPCC time series analysis of atmospheric carbon-dioxide concentration estimates a conservative stabilization scenario of 550 ppm to a high of 950 ppm by the end of the century.[30] The Environmental Protection Agency (EPA) estimates a 450 ppm stabilization scenario to a high of 850 to 950 by 2100.[31]

The last time the planet experienced carbon-dioxide levels close to 1,000 ppm was fifty-six million years ago during the Paleocene-Eocene Thermal Maximum (PETM). This global warming event played out over two hundred thousand years, with its most intense period in the first ten thousand to thirty thousand years, and kept Earth in warm greenhouse conditions for roughly seven million years. It was caused by major volcanic eruptions that accompanied the final stages of the breakup of the Pangea supercontinent. Not only the atmosphere but also the oceans were warmed, and the warming of the oceans resulted in the release of frozen methane locked in the seabed, which caused acidification and shut down and reversed ocean current circulation belts.[32]

The effects of climate change today are already underway in the warming of the polar ice caps, melting glaciers, the collapse of massive ice sheets, and the increased incidence of extreme weather events and patterns. Scientists predict that by century's end, the great mountain glaciers in the Rockies, Andes, Alps, and Himalayas will disappear, causing sea levels to rise by one foot.

Increased oceanic thermal expansion, the melting of Greenland, and the now-inevitable collapse of the two-mile-thick Pine Island and Thwaites glacier basins in West Antarctica will result in another two- to three-foot rise in sea levels. Researchers have concluded that several major glaciers in West Antarctica are beyond the point of no return,[33] thus threatening heavily populated coastal areas around the world, where many megaport cities sit on giant artificially created deltas. Those hardest hit will be Bangladesh, Indonesia, the Mekong Delta, the Chinese coast, the Amazon River basin, the Gulf and East Atlantic coasts (Louisiana and Florida), Cuba, Denmark, the Netherlands, and the Adriatic coast. The "Venicization" of many of the world's major coastal cities—New Orleans, Miami, Mumbai, Dhaka, New York, Shanghai, Guangzhou, and Ho Chi Minh City—has already begun.[34]

Earth's warming has accelerated incidents of not only extreme weather but also prolonged extreme-weather patterns. The warming of the Arctic has slowed down the jet stream, resulting in blocked weather systems, meaning that weather patterns become stuck or locked into place, which leads to much longer and colder winters, longer and hotter summers, and shortened spring and autumn seasons. Several areas of the world are in the midst of transitioning from persistent drought to "megadrought" conditions lasting several decades to more than one hundred years. The cause of this change is ongoing global warming combined with continued, multiyear La Niña conditions. Megadroughts are underway in southern Europe, North Africa, East Africa (the Sahel region), Australia, and the American Southwest and Great Plains.[35]

Another critical consequence of anthropocentric climate change is the thawing of permafrost, or permanently frozen soil found throughout the higher latitudes of the Northern Hemisphere in northern Alaska, Canada, Greenland, and Siberia. Permafrost soils consist of thick layers of dead vegetation that freezing temperatures do not allow to fully decompose. The top "active layer" thaws in the summer, but the lower frozen layer can extend several hundred feet down. Most of the Arctic is a vast compost heap that is thousands of years old. This vast expanse of frozen organic mulch is rich in carbon and methane. Half of the planet's soil carbon is found in the Arctic permafrost, which composes roughly 21 percent of the planet's landmass. Climate models estimate that by the mid-twenty-first century, the northern planetary permafrost will be reduced by 25 percent, and by 2080 up to 50 percent could be thawed. A recent United Nations Environment Program report predicts that if current rates of climate change continue, we could see as many as 135 gigatons (a gigaton equals a billion metric tons) of carbon dioxide and methane released.[36] Methane is a much more powerful greenhouse gas than carbon dioxide and has 25 percent more warming power.

Permafrost melting affects millions of animals living in the tundra and boreal forests as well as thousands of indigenous peoples, most of whom are nomadic reindeer herders.

All of these forces in the planetization of late modernity—exploding population growth; terrestrial re-engineering; mega-urbanization; a global, consumption-driven middle class; fossil-fuel economics; biogeographical homogenization; climate change; and big, corporate monoculture farming—have accelerated and converged to the point that the fates of many animals now hang in the balance. The obliteration and transformation of vast spaces of wild habitats have weakened and fragmented many established ecosystems to the point that many species find themselves on the path to extinction.

More than this, many scientists believe we could be in the early stages of a mass extinction event, a large-scale collapse in the diversity and abundance of plant and animal species in a geologically short time frame. There have been five known mass extinctions in planetary history in which 75 percent or more of all known species were wiped out in a few hundred thousand to fewer than 2 million years: the end of the Ordovician Period (440 million years ago), the end of the Devonian Period (370 million years ago), the end of the Permian Period (251 million years ago), the end of the Triassic Period (210 million years ago), and the Cretaceous Period or "K-T Extinction" (65.5 million years ago), which ended the great age of the dinosaurs. Signs indicate that we may be in the early stages of a big sixth. If this is the case, it would be the first mass extinction principally caused by a living species rather than physical processes, such as supervolcanoes, rapid glaciation, or an asteroid.[37]

Species extinction is a normal part of evolution—all species eventually become extinct. Catastrophic collapses are rare but natural occurrences, and there have been many "lesser extinction" events as well as major or mass events. Calculating extinction rates is not an exact science. One general yardstick is the "background" or "natural" extinction rate, which is a mathematical estimate of how fast species have disappeared before human activity dominated the planet (pre-*Homo*) and not under catastrophic or mass-extinction conditions. This formula is derived from the study of marine fossils and postulates that on average, a species of life tends to last about one million years before it goes extinct. As a general rule, if there were a million species on Earth, one species would go extinct every year. If there were only one species of life on the planet, it would likely go extinct in one million years, assuming relative environmental stability (1E/MSY).[38] A different calculation known as the "ecological extinction rate" occurs when a species drops to such a low number of individuals that it no longer has an input or function in the ecosystem it inhabits. It is on its way to extinction.[39]

Of course, the overall current extinction rate is calculated against the number of identified species, which most biologists regard as a small percentage of all life on the planet. Scientists have named 1.25 million species, yet the most recent scientific estimate of the total number of species on Earth is roughly 8.7 million—6.5 million on land and 2.2 million in the oceans.[40] Scientists believe they have accounted for most of all mammal, bird, and reptile species, yet they have cataloged only an estimated 45 percent of amphibians, 20 percent of insects, 17 percent of arachnids, around 15 percent of aquatic species, and only 7 percent of fungi.

The estimated number of species believed to be on the path to extinction ranges from a conservative low of five hundred to a high of thirty-six thousand.[41] Of the 5,501 known mammal species in the world today, 1,199 (22 percent) are listed as threatened with extinction. A staggering 41 percent of amphibians have been designated as vulnerable to extinction. Many species have been listed as "likely extinct" because they have not been seen for decades. A recent study of the world's seventy-four largest terrestrial herbivore species—among them, the elephant, rhinoceros, hippopotamus, giraffe, camel, tapir, zebra, wildebeest, moose, elk, gorilla, and orangutan—concluded that forty-four can be categorized as threatened with extinction.[42] The main causes of the rapid decline in animal populations and species extinction are human—43 percent related to habitat loss and degradation, 37 percent due to exploitation (hunting, fishing, and extermination), 7 percent due to climate change, 5 percent due to invasive species, 4 percent due to pollution, and 2 percent due to disease.[43] Scientists estimate that 30 percent of all known plants and animals will be on their way to extinction by century's end. They further estimate that if trends continue, a sixth mass extinction will be fully underway by 2200.

The Brave New World that we face in the twenty-first century is not a science-fiction novel but a rapidly unfolding empirical reality. The biosphere and its inhabitants, who have lived under the ten-thousand-year dominion of a clever, handy, aggressive, prolific, globalizing, agricultural, civilized, and high-tech great ape, are at a crossroads. It is therefore not an exaggeration to hypothesize that the consequences of the Anthropocene will likely define the twenty-first century and beyond.

Beyond the Tipping Point

How does one respond to the Anthropocene hypothesis? The question is as much normative as it is empirical. It is also a function of how one assigns meaning and value to the biosphere and to late modern civilization. The way

I see it, there are three main options: (1) one could dispute the empirical evidence, saying it is not occurring as described and/or at the scope and rate portrayed; (2) one could accept the validity of the hypothesis (with some reservations) but remain confident that we have not reached the tipping point and possess the civilizational resources to mitigate and reverse late-modern anthropocentric planetization; and (3) one could accept the Anthropocene hypothesis, believe we have gone beyond the tipping point (or act as though we have, even if we cannot conclusively validate it), and lack confidence in the ability of late-modern civilization to effectively mitigate or reverse these current trends.

I endorse the third option and work through the logic of its operating premise. My reasons for adopting a strong empirical, ethical, and political reading of the Anthropocene hypothesis are posthumanist. My priority concern is the fate of animals under looming conditions of anthropocentric planetization. My standpoint is one of nonanthropocentric, posthumanist ethics and politics. I am convinced that the late-modern social contract can no longer underwrite the kind of society and world many humans and most animals would want to live in.

In disputing the empirical evidence for the Anthropocene, one could make the following argument. Many demographers project that while Earth will likely reach eleven billion by century's end, this number will be our peak and then the world's population will level off. All modernizing countries go through a demographic transition that involves a population boom followed by a stabilization period when birth rates decline, life expectancy increases, and the population ages to where the birthrate drops below the replacement level. This was the case with modern Western civilization in the twentieth century and will be the case with Asia, Latin America, Africa, and the Middle East in the twenty-first century. Europe and Japan are in a fertility decline, while China and Brazil are now slightly below replacement fertility. Demographers also contend that it is not the world's population in the aggregate that is the problem but rather its location and distribution across the planet, which is uneven. World population density is the major challenge.

All of this speculation, of course, comes from a human-centered perspective. Earth may be able to support eleven billion people thanks to the technology and ingenuity of late-modern civilization, but it will not be able to support current levels of biodiversity. Habitat loss will accelerate, as will species extinctions. Most animals, which require larger and more stable habitats, will not be able to survive.[44] Furthermore, the problem is not simply total population but its modernity. The consumption patterns of an exploding global middle class pose a major threat to the biosphere and its inhabitants.

Levels modeled on the world's wealthiest nations will be difficult to sustain globally. Given these variables, what *is* the preferred human population? From the perspective of anthropocentric late modernity, eleven billion people is doable. Yet for posthumanists, the outlook is very different. Human overpopulation is a problem and a legitimate line of evidence in support of the Anthropocene hypothesis.

One could accept some or most of the Anthropocene hypothesis and still believe that a more progressive humanist and sci-tech reform program can alter the path of late modernity and reclaim the damage done to the biosphere and its inhabitants. This position has been articulated by advocates of neoliberalism, technotopian engineering, ecomodernism, sustainable development, and transhumanism.

The dominant civilizational worldview and institutional reality today, especially in the West, is late-modern, big sci-tech, corporate-market globalism. Neoliberals believe that the intensification of high-tech innovation and free-market capitalism is the optimal formula in meeting the challenges of the Anthropocene. The central driving institution of late modernity is and should be the transnational corporation.[45] Furthermore, we should not abdicate our unique species ability to radically re-engineer reality itself. The capability of late-modern civilization to achieve ever-higher levels of growth and deliver consumable goods to more people is largely unquestioned. Human population growth, mega-urbanization, an exploding global middle class, and the current fossil-fuel renaissance are all proof of the success of neoliberal globalization. As for the plight of animals, endangered species, and a possible sixth mass extinction, these costs can be more than made up for by corporate-backed conservation efforts and more efficient means of animal production for an even greater variety of human uses.

Another approach to the Anthropocene is big sci-tech, which continues to be a pillar of late-modern civilization. Ultramodern, mega-engineering solutions—such as mass producing genetically engineered carbon-eating trees, as proposed by Freeman Dyson, and geoengineering Earth's atmosphere, as advocated by Crutzen and David Keith—are two such examples. Both proposals are presented as relatively low cost and low risk. Since plants are good at absorbing carbon dioxide, we can manufacture special superplants that would not only absorb most of the excess carbon dioxide in the atmosphere but also convert it into a chemical compound that could either be safely stored underground or converted into something useful, such as a new liquid fuel.[46] Geoengineering involves putting several million tons of sulfur dioxide into the upper atmosphere via a fleet of planes or balloons; this substance would turn into sulfate aerosol particles that reflect sunlight. Since

these particles would remain in the air for only two years, the process would be ongoing until the planet cooled.[47]

Advocates of sustainable development, also known as ecological or reflexive modernization, seek a balance between neoliberalism and environmental protection in "green capitalism." Sustainable development zeroes in on the central doctrine of justification that underpins modern civilization—modern economics. It calls into question the conventional principles and models of micro- and macroeconomics, such as rational-choice cost-benefit analysis, how gross domestic product (GDP) is calculated, how businesses externalize the environmental and social costs of production, and how short-term return on investment drives contemporary capitalism. It equally questions technocratic policy making, wherein the near-exclusive emphasis is placed on technical solutions to all problems.[48]

The ecological modernization of our technocratic corporate civilization is pursued through a variety of means, including a shift from fossil fuels to cleaner, renewable energy; steady-state economics; appropriate technologies; and a new model of ecological citizenship. Sustainable development emphasizes the need for a balanced triangulation of economic growth, environmental protection, and social justice. Its long-range goal is to preserve the carrying capacity of a finite planet for future societies. It is a benign form of anthropocentric humanism that is dedicated to modernity lite, one that is ecological rather than Newtonian and industrial. It is more accepted in northern European countries and Japan, in part because these societies have already slowed down in terms of population growth, production, and consumption, thus making them more amenable to a steady-state economy and society. By contrast, neoliberalism is an Anglo-American ideology that largely rejects the idea of a finite biosphere in favor of technological triumphalism and a view of a human-centered world without limits.

Transhumanism is similar to posthumanism in that it seeks to fundamentally redefine the human condition and human nature, but the similarity ends there. Transhumanists, such as computer engineer, entrepreneur, and futurist Ray Kurzweil, envision the twenty-first century as the time of "technological singularity." A firm believer in "the law of accelerating returns," which is currently driving high-tech innovation, Kurzweil envisions major breakthroughs in biotechology, nanotechnology, robotics, and artificial intelligence (AI) converging around midcentury to produce "human enhancement" technologies that will literally liberate us from the confines of our biologically retrograde bodies and minds. Kurzweil predicts that the coming transhumanist supertech revolution will be greater than the Neolithic, civilizational, and Industrial Revolutions and send history into hyperdrive.[49]

Transhumanism takes neoliberalism and technological triumphalism to a new level. Just as industrial machinery, mass production, plastic, penicillin, and petroleum facilitated the unprecedented expansion of human population and civilization in the twentieth century, so too will nanotechnology, robotics, AI, whole-brain emulation or "mind uploading," synthetic biology, and geoengineering propel humanity to new heights of progress in the twenty-first century. We will enter a new post-Darwinian era of evolution where the physical world and biological organisms can be redesigned as biology and technology become one seamless reality. This will be a world of high-tech megacities; bio-reengineered plant, animal, and human DNA; new drugs, life-forms, and bioweapons; robots everywhere; life extension well beyond one hundred years; and a superintelligent cyborg elite.

Despite their different outlooks on the Anthropocene, the prevailing ideologies of our time—neoliberalism, neo-Keynesianism, technotopian megaengineering, ecological modernization, reflexive modernization, sustainable development, and transhumanism—all share a common commitment to the central concern of human progress in the twenty-first century. They are all anthropocentric, neohumanist ideologies committed to various models of the next modernity. What is in the best interests of humanity—individually, collectively, and as a species—in the twenty-first-century Anthropocene? How should we re-engineer the biosphere, society, and human nature so that our species can extend the promise of modernity even further and maintain planetary dominion and stewardship?

This question is not the focus of this book or the ethics and politics of posthumanism. The principal question here asks how animals will fare under conditions of accelerating anthropocentric planetization. What is the fate of animals in the age of man? What does a world look like that ethically and politically prioritizes nonhuman life and places it on par with human life? What might a paradigm shift in human culture and politics from modern humanism to posthumanism look like? These are the driving concerns of a social and biopolitical compact very different from the one that underwrites globalized late modernity.

Like posthumanists, transhumanists speak of a postmodern civilization in the sense of moving beyond outdated modern humanist norms, ways of life, and institutional structures. Yet they diverge in locating the heart and soul of the next social contract: one is an ultramodern technological vision where humans transcend biology, and the other is a coevolutionary vision where humans reconnect to the biosphere and its inhabitants. While posthumanists emphasize the importance of new human-animal or *humanimal* social and cultural practices, transhumanists see most problems and solutions

in terms of organism-machine (i.e., cyborg) re-engineering. Furthermore, the primary infrastructure that will deliver a transhumanist future is corporate capitalism, while for posthumanists, it is new communities.

Modern humanists, posthumanists, and transhumanists agree that animals should not live under conditions of suffering and extermination. Modern liberal humanists and animal welfarists recommend continued reforms of existing institutional practices to further lessen pain and suffering and to conserve more habitats. Posthumanists advocate a culture shift away from utilitarian anthropocentrism and the incremental abolition of animal exploitation, which implies the dismantling and reinventing of many existing institutions. Transhumanists recommend genetically engineering new animals designed to not experience pain and suffering, eliminating their "wildness," bringing online new strains of domesticated or tame animals, and creating new synthetic meat products grown from stem cells.

I am opposed to neoliberalism on the grounds that it is an extremely aggressive, unequitable, narrowly self-maximizing, environmentally damaging, and animal-exploiting form of anthropocentric modernity. However, I admit that it has a strong hold on the minds and bodies of modern humans in the West and across the world. As for mega-engineering and transhumanism, I regard them as narrowly and excessively technotopian. They have a nearly unreflective, secular faith in technology as the solution to all problems. While not a neo-Luddite, I am concerned about the establishment of one-dimensional technocultures where efficiency trumps all other values and interests and humans are happy adjuncts to and nearly completely dependent on high-tech and biotech assemblages.

My worldview shares much with that of sustainable development but, unfortunately, not its ecomodern optimism. The 2014 IPCC report concludes that anthropogenic climate change is unequivocal and that unless there is a massive shift in our civilizational paradigm within the next twenty to thirty years, the planet will be locked into a warming pattern for the next several centuries. Nothing less than major structural and cultural changes will reverse this trend. A major global agreement among nations that results in major shifts in energy, consumption, population, and neoliberal economics is not a realistic possibility, in my opinion.

As a posthumanist, I endorse the Anthropocene hypothesis and regard our current civilization being on the wrong track with no signs of a serious course correction. I believe it is reasonable and prudent to think and act as though we have gone beyond a critical tipping point. Posthumanism places human civilization on an equal footing with the biosphere and nonhuman species and prioritizes the plight of animals. It also calls into question the deeper logic of

late-modern civilization and the ontology of late modernity—its framing of reality; radical anthropocentrism; corporate-controlled, high-consumption culture; and treatment of animals as inferior objects of propertied use. It equally questions the logic of modern-growth economics, the nation-state, and transnational corporation as the sovereign containers and delivery systems of high-end modernity and of technology as an end rather than a means.

The fates of Earth and its inhabitants lie in the hands of the human animal. I see modern humans as contented captives of a high-tech, global juggernaut largely run by machines programmed to deliver more high-end modernity and neutralize all systemic-level challenges. It is as though we are passengers on a high-speed train, watching the scenery of "nature" and "animals" passing us by as artifacts of a soon-to-be-bygone era. Without a significant cultural shift and institutional reforms, we will continue to accelerate our current practices of pushing ecosystems to the limits of collapse, sentencing thousands of species to extinction, exploiting and killing animals under conditions of institutionalized normalcy, and stretching the limits of civilization to the point of systemic overload. If we truly are a wise ape, then the social contract we negotiate over the next century or two may put the planet and its inhabitants on a trajectory of biosphere recovery. If not, then we will fulfill the Hobbesian vision of not only the state of nature but also the state of civilization, as a condition of life increasingly "poor, nasty, brutish, and short." As mentioned, it is no exaggeration to admit that the task before us is nothing less than a labor of Sisyphus.