"Spaceship Earth": Envisioning Human Habitats in the Environmental Age

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A Conservationist Mission

The opening sequence of a science-fiction film released in 1972 begins with close-up views of an Edenic garden of plants—plentiful, precious, pure, and peaceful. It soon becomes clear, however, that the richness on display is as unique as the biblical paradise. As the camera draws back, we see that this botanical abundance is quite limited, contained within a large glass dome. Pulling back still further, the camera discloses that the encapsulated environment is actually situated in deep space; the dome is part of the *Valley Forge*, a huge American Airlines space freighter.

Accompanied by majestic music, the first sequence of the movie culminates in the revelation of the awe-inspiring extent and importance of this US mission. A solemn voice reads out a declaration written at the beginning of the twenty-first century, in which the last surviving forests on Earth are dedicated to a conservationist journey through outer space that, as the story begins, has been in progress for eight years. Astronaut and botanist Freeman Lowell, one of four spacemen aboard, tends the precious cargo that will one day be returned safely to its earthly home. Freeman is a true disciple of the environmental movement of the 1960s and early 1970s. He still remembers when vegetables had taste, smell, and color, when the air was fresh and the skies were blue (a time evoked by the film's soundtrack of Joan Baez performing folk music). Through Freeman we learn that, despite the warnings of environmental activists, the earth of the future has become a bleak and monotonous place with a uniform temperature of seventy-five degrees. The planet is so densely populated that it has grown into one massive, completely defoliated city; trees and plants are no longer essential for (human) life, as nutrients are now manufactured in a laboratory.

The Spaceship, a Modern Container of Life

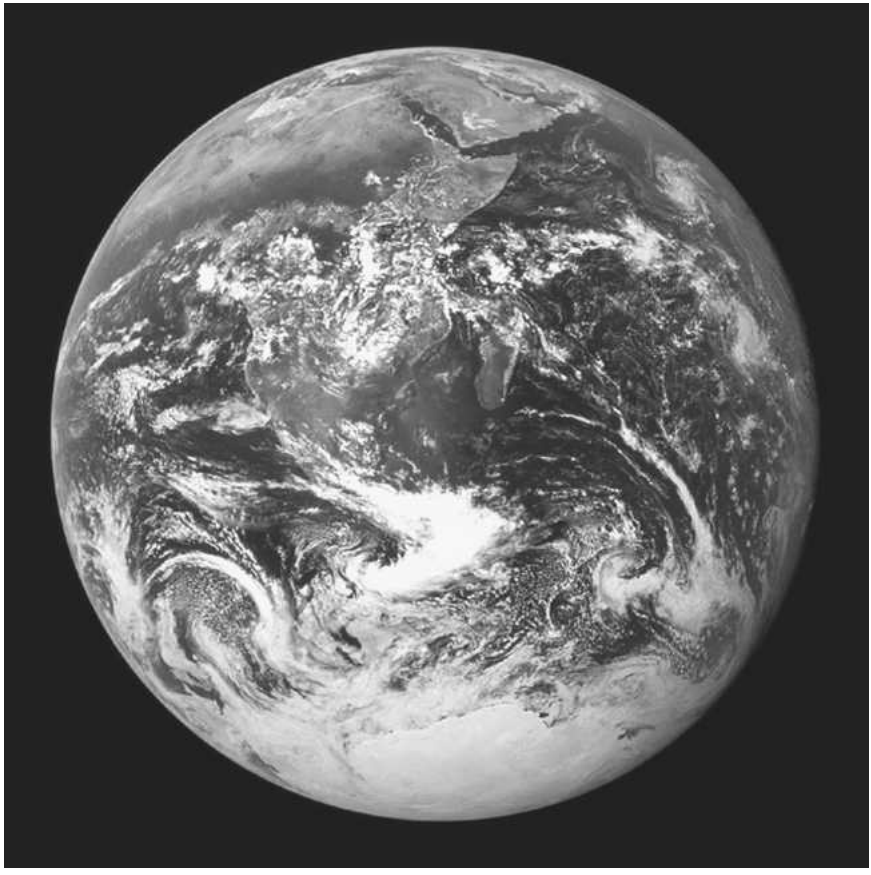
The startling contrast between the richness of life and the fragility of its artificial environment, as well as the consequences of changed attitudes toward nature, are the issues on which the 1972 movie *Silent Running*

focuses.[1] The film was produced amid heated debates on resource scarcity, environmental pollution, and overpopulation. It reflects the popular images of impending ecological catastrophe and the questionable survival of humankind. It is certainly no coincidence that the film is set entirely on a spaceship, which had become a major symbol of both the fears and the hopes associated with Earth's transformation into an endangered planet. "Whole Earth" or "Full Earth" was first pictured and repeatedly represented through photographs taken on the Apollo missions during the 1960s.[2] At this time, the "Blue Planet" became an icon of Earth's singularity, one that would endure throughout the second half of the twentieth century. The dynamic green and blue colors in this image of Earth are attributed to three billion years of converting sunlight into processes of life. James Lovelock would later state that it was "this kind of evidence from space research that led me to postulate the Gaia hypothesis," which views Earth as a single, organic whole.[3] It is not without irony that it was this distant vision of the earth that focused attention on life's fundamental conditions, believed to be unique within the universe.

The figure of the spaceship merged notions about the fragility of life with the triumphs of science and technology. Inside this discursive frame, it took only a small step to imagine the newly discovered "Planet Earth" as a spaceship. The predicaments of the late twentieth century seemed to find a perfect expression in the phrase "Spaceship Earth."[4] In 1965, the US ambassador to the United Nations, Adlai E. Stevenson, used the metaphor in an appeal to the international community, referring to the earth as a little spaceship on which humankind traveled together as passengers, dependent on its threatened supplies of air and soil.[5] In 1966, the English economist and political scientist Barbara Ward chose the term to advocate a new "balance" of power between the continents, of wealth between North and South, and of understanding and tolerance in a world of economic interdependence and potential nuclear destruction.[6]

The true engineers of "Spaceship Earth," however, used the term not as a metaphor of vulnerability and community, but to describe an innovative technological *model* of a natural environment yet to come. The architect and designer Richard Buckminster Fuller published his *Operating Manual for Spaceship Earth* in 1969, summoning the engineering elite to take control of an environment in bad repair.[7] The economist Kenneth E. Boulding, in his programmatic lecture "The Economics of the Coming Spaceship Earth,"[8] delivered in 1966, chose the spaceship to prefigure the "closed earth of the future."[9] He advocated replacing the wasteful "cowboy economy" of the past with a frugal "spaceman economy," a cyclical ecological system capable of continuous reproduction of material form.[10]

My research explores the cultural horizons that were opened—and closed—by the image of Spaceship Earth in the so-called "Environmental



"Full Earth". A view of the Earth as seen by the Apollo 17 crew traveling toward the Moon in 1972. Source: GRIN—Great Images in NASA library of images. URL: http://dayton.hq.nasa.gov/IMAGES/SMALL/GPN-2000–001138.jpg (last visited on January 22, 2008)

Age," the decade ranging from the mid-1960s to the mid-1970s.[11] I begin by examining the meaning of the ship in Western culture. I see the figure of the ship as linked to narratives of fragility and transience on the one hand and exploration and expansion on the other; these themes continue in narratives of the spaceship. Imagining Earth as a spaceship made it possible to combine concerns about the planet with visions of global control in order to address the question of mankind's "survival." At a time when the earth seemed like a paradise in jeopardy, the spaceship, like the ark, held out the hope of preserving life in all its diversity. I will then discuss "Spaceship Earth" as a mythical structure that illuminates the double strategies involved in representing the planet as a spacecraft:

A singular site in the universe, Spaceship Earth also signified the growing scientific fascination with natural-technological environments on earth—and beyond. I contend that this mythically resonant metaphor marked Earth as a temporary environment and introduced the idea of human survival elsewhere, a survival that would be based on rational scientific management.

As a historian of science and technology, I am interested in how the economy of obsolescence and utility operates in the discourse of the earth's finite "carrying capacity." I look at the sciences of ecology and human ecology, or population biology, and ask how the earth turned into a complex and self-contained circulatory system and the earthly biosphere into a "life-support system." I explore how the metaphors of ship and lifeboat were used to express the problem of global "overpopulation."

From a cultural history perspective, I am interested in the frontier mythology that is contained and repeated in the ship and spaceship metaphors and narratives. The frontier mythology suggests that the heart and fate of a growing nation is to be found at its limits, that a people is defined by the territory it must conquer and cultivate. The history of the American frontier can be understood as a narrative of national origin that was crafted to explain why the people of the United States were destined to colonize a newly discovered continent. I am interested in how the concept of "manifest destiny," of a fate that fulfills an ordained purpose, is mirrored in the figures of the spaceship and of "Spaceship Earth."

The space freighter *Valley Forge* in *Silent Running* is named after the battlegrounds near Philadelphia, where General George Washington endured the hard winter of 1777 with the army of the newly formed United States of America, and where he waged a heroic struggle against the elements and the sinking morale of his soldiers. Valley Forge still ranks as a foundational element in the national historical consciousness of Americans. It signifies a place where immeasurable suffering and sacrifice will finally be transformed into hope and renewal.[12]

The Ship, a "Swimming Endosphere"

From the early modern voyages of discovery to the Apollo missions, the ship has served as a reservoir of collective memory and imagination. Symbolizing spatial expansion and exploration of the unknown, as well as fragility, transition, and transience, the image of the ship has been at the heart of Western culture's most powerful narratives. Michel Foucault considered the ship to be the "heterotopia par excellence." "Heterotopia" is his term for an exceptional site that exists within the world and, at the

same time, lies far remote from or beyond it. Heterotopias, according to Foucault, are in relation with all other places and spaces and yet in opposition to them. The ship he describes as a "floating piece of space, a place without a place, that exists by itself, that is closed in on itself and at the same time is given over to the infinity of the sea."[13] Roland Barthes likewise saw the ship as a symbol of seclusion and refuge from life's raging storms. Barthes refers to the fictional narratives of Jules Verne, in which the ship replicates and preserves the world on a small scale. In a very confined space, it keeps at the traveler's disposal the utmost number of valued objects, a singular universe floating amid the violent tempests of time.[14] Barthes describes Verne's ships as vehicles of the encyclopedic project of the nineteenth century, designed to encompass and conserve *en miniature* all elements of a finite but rapidly proliferating world.

Appropriating space by compiling, registering, and neatly arranging the elements within it is a strategy not limited to the modern era of scientific collecting, archiving, and interpreting of the world. The procedure recalls the primal ship representing the inventory of the world, the biblical ark. This vessel from the Old Testament (Genesis 1:6–9), furnished with specimens of life on earth, differs in a significant way from Verne's crammed but comfortable floating interiors: Noah's ark is the paradigmatic heterotopia, a storm-tossed place of survival and salvation in the face of catastrophe. In the second volume of his work titled *Sphären*, Peter Sloterdijk analyzes the ark as the perfect example of an "ontology of enclosed space."[15] Ark, from the Latin *arca*, is the word for "case" or "compartment." To Sloterdijk, the ark denotes an artificial interior space, a "swimming endosphere," that under certain conditions provides the *only possible* environment for its inhabitants.[16]

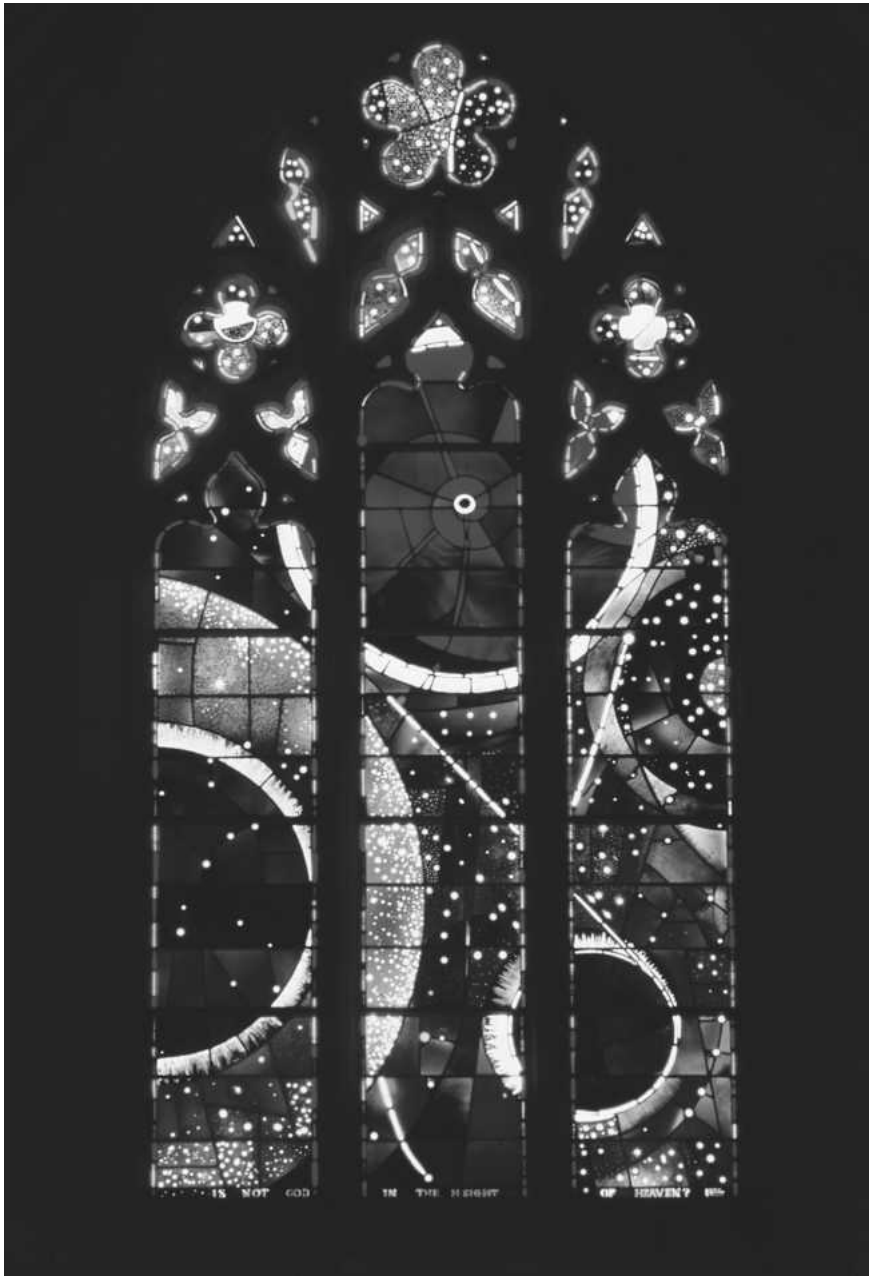
Like Sloterdijk's "swimming endosphere," the spaceship constitutes an insular habitat for a small group of living beings facing a hostile outside world. In the twentieth century, when the "World Frontier" closed and the formerly distant "lost horizon" of the seas and the unknown continents became familiar territory, it was outer space that seemed to hold new possibilities for exploration and expansion.[17] "What was once the furthest outpost on the old frontier of the West will be the furthest outpost on the new frontier of science and space," US President Kennedy declared in 1962 on the occasion of his famous "moon speech" at Rice Stadium, which committed the nation to its ambitious space program.[18]

"The existence of an area of free land, its continuous recession, and the advance of American settlement westward, explain American development."[19] Frederick Jackson Turner proposed his "frontier thesis" in the year 1893, asserting that the center of American history was actually to be found at its edges. Turner's frontier was neither a spatial location nor a

geographical zone, but a historical process. "His most compelling argument about the frontier," according to historian of the American West William Cronon, "was that *it repeated itself*."[20] To quote his colleague Patricia Nelson Limerick, "the West is wherever the American mind puts it."[21] The "frontier" is a timeless place, an imaginary site. It is renewed wherever the narrative of a chosen people, driven from their homeland to settle a new continent, in a New World, constitutes its collective identity. The spaceship—scientifically and technologically propelled and sustained—promised the opportunities and the rewards of a utopian society flourishing in a re-created Eden.[22]

The National Cathedral in Washington, DC, is a monument almost as impressive as Westminster Abbey, but much younger. This majestic structure, the world's sixth-largest cathedral, was built in Gothic style in the twentieth century and finished only in 1990. The "National House of Prayer," which actually belongs to the Episcopal Church, identifies itself as embracing all religions. Even the cultural belief in science and technology finds a place in its congregation. Notable among the many beautifully colored windows is the "Space Window." It stands in deep contrast to more traditional stained-glass artworks in churches. A single image stretches across the three-part arched window. Colored spheres represent planets floating in the deep blue of space. Thin white lines circling the spheres represent the orbits of a spaceship. Dedicated in 1974 on the five-year anniversary of the Apollo 11 moon landing, the window contains colors that are said to be based on photographs taken during the mission. In its center is a two-and-a-half-inch chip of basalt rock brought back from the moon by the Apollo 11 astronauts.[23] One of the ceiling vaults nearby is ornamented with a sculpted lunar surface marked with astronauts' footprints. And it should be noted that among the many grotesque and fanciful gargoyles on the cathedral façade appears the figure of Darth Vader from George Lucas's science-fiction saga *Star Wars*. Because of his evil character, Darth Vader was placed on the north face of the dark northern tower.

The state-sanctioned intersection of religion, science, and science fiction within the National Cathedral is striking. Since we must presume that no element of this cathedral is ironic in character, but that every detail was chosen with care and gravity, we must also accept that human space flight is here being advanced as a literal *expression* of religious belief. At the lower edge of the space window is written in capital letters: "IS NOT GOD IN THE HEIGHT OF HEAVEN?" Space flight, both that already mastered (*science*) and that only imagined (*fiction*), participates in a larger discourse of divine authority into which humans inscribe themselves by means of their civilizing accomplishments and, not least, by their scientific and technical achievements.



Washington National Cathedral's "Space Window." Courtesy of Washington National Cathedral.

Myth as Reconciliation of Antagonisms

The spaceship did not serve simply as a metaphor to express perceptions of environmental problems in a contemporary way; rather, it informed and organized the rhetoric of the Environmental Age. "Spaceship Earth" opened up a discursive horizon, against which certain formulations of and solutions to environmental dilemmas became dominant points of reference and the core of a modern mythology. I regard myth not as a fiction opposing a reality, but as a narrative that meaningfully describes collective human experience. This culturally shared narrative is performed and sustained through stories, traditions, rituals, images, and objects, and is consolidated in institutional settings.[24] The power of mythical narrative lies in its synthesis of traditional elements and time-specific variants of a story. In ever-changing versions, the myth's core elements are combined and intertwined with particular situations. "Spaceship Earth" took the ancient motif of the ship as the "greatest reserve of the imagination"[25] and united it with the modern image of human technological supremacy in space. Moreover, the power of myth derives from its ability to reconcile conflicting arguments: "Spaceship Earth" simultaneously represented "crisis" and "progress," the era's two prevailing attitudes toward environmental issues. The oppositional reference to the "cowboy" ideology makes a good example: The spaceship works as an alternative to reckless expansionism on the one hand and as an extension of it on the other.

The mythological perspective explains how both optimistic space-age "cargoists"[26] and "survivalists"[27] of the so-called "counterculture"[28] could argue radically different positions on and in the same terms. This perspective can contribute to an environmental historiography that avoids the fallacy of simply taking one side in the ongoing debate between supporters of *sufficiency* and advocates of *efficiency*. Neither can it be my goal to resolve these debates. My research addresses the more fundamental question of how the ideas that environmental resources should be managed scientifically, and that limitation can be overcome by new, technologically controlled living spaces, achieved wide acceptance.

Metabolism under Control: "Life Support"

When Kenneth Boulding in 1966 suggested thinking and acting in terms of the "closed earth," he argued for a cyclical economic and ecological system, capable of continuous material reproduction and sustained entirely by solar energy. The "spaceman economy" was envisioned as a rational management of circular material flows in order to secure "stock maintenance."[29] His programmatic vision of an efficient technologically

maintained ecosystem was shared across disciplinary boundaries and by much of the general public. As "Spaceship Earth" was fused with "System Earth," the planet became a habitat based on cybernetic principles. The global environment was conceptualized as functioning by means of technology-driven control systems, similar to the control systems integrated into space capsules. Ecosystems sciences regarded the environment as an economy of efficiently cooperating parts, composed and operated like a machine. Life in System Earth was increasingly reduced to its essential conditions and functions, similar to those in a space capsule: *life support* became the term proper.[30]

Buckminster Fuller stretched the spaceship metaphor provocatively, arguing, "We are all astronauts."[31] "We have not been seeing our Spaceship Earth as an integrally-designed machine which to be persistently successful must be comprehended and serviced in total."[32] But because "no instruction book came with it,"[33] humankind was confronted with the challenge of learning on its own how to operate "Spaceship Earth and its complex life-supporting and regenerating systems."[34]

Carrying Capacity: "Lifeboat Ethics"

These statements do not indicate who exactly would be the global captain steering the ship through space; it is obvious, however, that the idea of "Spaceship Earth" was successfully transforming the planet into one gigantic life-support system.[35] At first glance, this discursive shift may seem small, yet it demonstrates how this powerful metaphor reorganized the traditional inclusive image of the "good ship Earth"[36] on the verge of sinking. Speaking about Earth in terms of a planetary complex of "life-support and maintenance systems" did not include all of life; "Spaceship Earth" would sustain instead the *optimum* combination of collaborating organisms.

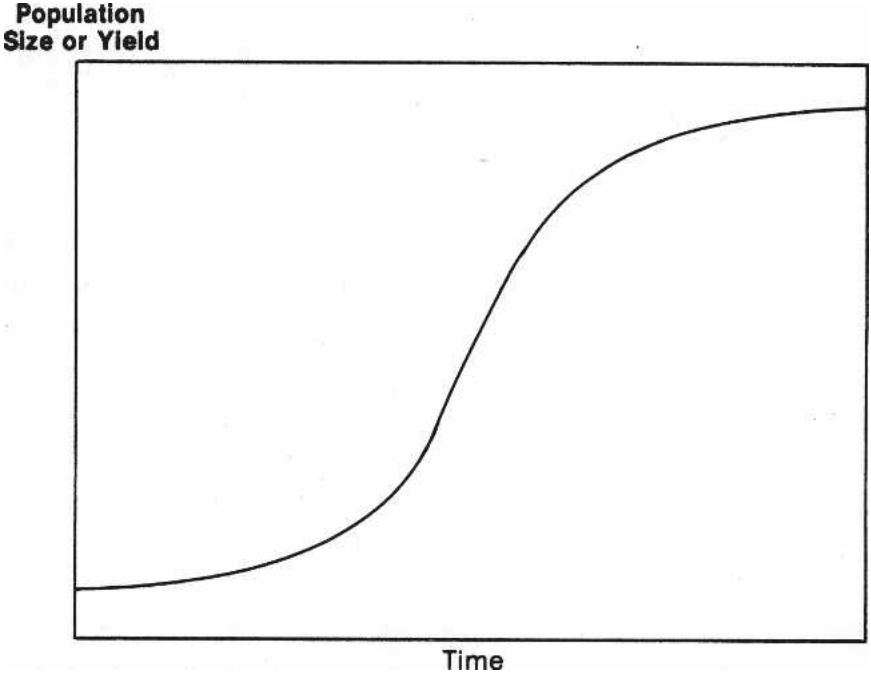
This applied also to population policies that proliferated during the 1960s, when ideas of "overpopulation" and "population control" moved to the vanguard of state politics. While in the 1950s the term population was used in policy statements essentially as an equivalent to concrete social collectivity, during the 1960s, demographic assessments and statistical population forecasts entered developmental discourse.[37] "Few issues in the world have undergone such a rapid shift in public attitudes and government policies over the last decade as the problems of population growth and fertility control," George H. W. Bush, then US Representative to the United Nations, proclaimed in 1973.[38] Development programs began to include population as a field for international technical aid, especially in the so-called underdeveloped nations. The 1972 UN conference on the "Human Environment" in Stockholm popularized the

"One Boat" concept, the thought that all of humanity shared a common fate within absolute limits.[39] The year 1974 was declared "World Population Year."

Global population growth curves plotted empirical population figures and extrapolated back into ancient times and up to the year 2000. These curves marked the contemporary situation as unique in history, not because the absolute number of people in the world had reached roughly three billion, but because of the "exponential nature" of growth. Within less than a century, world population had doubled, and it was increasing at a rate that indicated another doubling within just one generation. Population growth threatened to surpass the ongoing economic expansion of the postwar period: "DNA was greater than GNP," as David Brower, managing director of the Sierra Club, put it.[40] The underlying Malthusian arithmetic had been translated into the "laws of population growth" by biologist Raymond Pearl in the 1920s.[41] According to his law of "natural" growth, the size of any population over time, be it animal, plant, or human, could be described by a symmetrical S-shaped curve, sometimes known as the "logistic curve." The constraining factor in the growth pattern, biologists explained, consisted in the restriction of most populations to a limited area. Framed by such boundaries, population development was thought to grow exponentially up to a point of inflection, when environmental feedback would cut in and, subsequently, progressive deceleration and regression would occur. The asymptote of the logistic growth curve of world population became known as the earth's ultimate ecological "carrying capacity." In line with models of ecological balance, "carrying capacity" equaled the maximum number of lives that could be sustained within the finite limits of the planet.[42]

In 1972, a study titled *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* proposed different future scenarios based on the logistic growth model.[43] The study employed four basic types of "survivorship curves" to describe the "behavior modes of the population-capital system" over time. According to this report, a population growing in a limited environment could approach its "ultimate carrying capacity" in several possible ways: It could "adjust smoothly to an equilibrium below the environmental limit by means of a gradual decrease in growth rate"; it could "overshoot the limit and then die back again in either a smooth or an oscillatory way"; or it could "overshoot the limit and in the process decrease the ultimate carrying capacity by consuming some necessary nonrenewable resource."[44]

Natural and life scientists tried to answer the question "How Many People Can the World Support?" by numerical means.[45] Human ecologists like Paul Ehrlich brought this question to a point by asking, "What is the *optimum number* of human beings that the earth can support?"[46] All



The S-Shaped Biological Growth Curve. Source: Lester R. Brown, *The Twenty-Ninth Day: Accommodating Human Needs and Numbers to the Earth's Resources* (New York: W. W. Norton, 1978), 69.

of these scientists framed the world's population problem as a matter of efficiently allocating "human elements"[47] within a limited cargo area or storage space. In these calculations, colonial history, global power relations, and disparities of wealth were rarely taken into account. Biologist Garrett Hardin, professor of human ecology at the University of California at Santa Barbara, demanded in 1968 a "fundamental extension in morality," in the Old Testament formula *Thou shalt not*:[48] "Thou shalt not exceed the carrying capacity"[49] became Hardin's quasi-biblical commandment of ecological correctness in the 1970s. He took on a godlike authority when demanding that society should "close the commons" in breeding and oppose the "present policy of *laissez-faire* in reproduction."[50]

Hardin's claim articulates the notion that the ultimate carrying capacity of "Spaceship Earth" involved not only a zero-sum economy, but also, to refer to a term Lorraine Daston introduced to science studies, a "moral economy"[51] for deciding who was to live and who was to die on a global scale. Hardin altered the image of the earth as "One Boat" or a "sinking ship" to a "lifeboat,"[52] stressing not unity and cooperation, but limited capacity. He based his "Lifeboat Ethics" on the claim that assur-

ing survival in a lifeboat depended on the efficient allocation of provisions and the disposal of dead weight. In his "Case Against Helping the Poor," Hardin argued against the "fundamental error of the ethics of sharing" in international aid programs, urging wealthy nations to close their doors to acts of charity like immigration and food aid. In his opinion, the optimum world population would have to be reached via a Darwinian process of selection that reflected a nation's "fitness."[53] He defined *fitness* according to the classical liberal logic of achieved economic prosperity. Socially and historically developed problems he regarded as biological in origin and individual in character.

"The demoralizing effect of charity on the recipient has long been known," Hardin claimed.[54] An international food bank, he argued, would be simply "a disguised one-way transfer device for moving wealth from rich countries to poor." Without conscious population control, a nation's population would endlessly repeat the cycle of overpopulation followed by a drop back to "the 'normal' level—the 'carrying capacity' of the environment—or even below." If such countries were able to draw on world food-bank resources in times of emergency, the normal cycle would be replaced by the "population *escalator*": The input from a world food bank would act as "the pawl of a ratchet," pushing the population upward.[55] The "ratchet effect" would end only with the total collapse of the entire system.

Building a "Glass Ark": Biosphere 2

From today's point of view, these schemes for deciding who would remain on the planetary ship and who would have to be rejected as "surplus"[56] may seem at best irrelevant and at worst aberrant. When considered as part of a theory of earth's maximum "carrying capacity," however, they are plausible and rational—and this is what makes them so disturbing. We need to sharpen our focus on conceptualizations of *environment* that prefer scientific, technological, and bio-economical aims over social and cultural principles. Lifeboat and spaceship economies not only created new metaphors for understanding the fragility of the planet, but also inspired a rigid classification and selection of life and nature in order to establish a rational scientific basis for determining what would be useful and what was redundant, what was to be conserved and what discarded.

Sloterdijk points to the selectivity that characterizes all ark narratives, in which the choice of the few is declared a holy necessity and salvation is found only by those who have acquired one of the few boarding passes to the exclusive vehicle.[57] The selective mechanisms employed on "Spaceship Earth" become visible in the Biosphere 2 project that was realized in

Biosphere 2, Aerial View. Courtesy of Global Ecotechnics (*http://www.biospheres.com*)

the Arizona desert during the 1980s. The "Second Biosphere" was based on the idea that the most powerful way to understand biospheres was to build and operate them. Biosphere 2 was designed as an "experiment" to study Earth's biosphere in an artificial system on the small scale of about three acres. It created a new type of ecological laboratory, in which an ecosystem's functions and interactions could be studied and in which the impact of humans and their technologies on the overall biospheric system could be researched. Biosphere 2 was also the attempt to develop a robust ecological system capable of longer duration and supporting greater diversity than common "life support systems" in space. Anticipating that in the long run, Earth life would have to expand to other planets, the experimenters hoped to develop "a prototype for a space colony."[58] The architect of the project summarized its aims with the provocative question, "Why not build a spaceship like the one we've been traveling on—along with all its inhabitants?"[59]

While Hardin's "lifeboat" continued to be fraught with terrestrial problems and solutions, "Spaceship Earth" projected the planet as a *temporary* environment, opening up the prospect of leaving the planet altogether. "Men in a spaceship are not locked in one place, but become perpetual travelers," William Kuhns remarked in 1971.[60] Sloterdijk reminds us that the ark mythology includes the radical idea of completely removing the "endosphere" from nature.[61] The Biosphere 2 project rep-

resents just such an artificial construct of a nature materially isolated from the outside environment, to allow the study of closed ecological systems and the development of a self-contained and ultimately self-sustaining "living" system.[62]

"Biosphere 1," as the project managers started to call the Earth's biosphere, was recreated under a single roof. The architecture was inspired by Buckminster Fuller's geodesics, and the modular structure of space frames was designed by Peter Pearce, one of Fuller's collaborators. In 1991, seven defined ecosystems—tropical rain forest, ocean and savannah, marsh and desert, as well as an intensive agricultural area and a small "city" including eight human "Biospherians"—were sealed inside the dome.[63] The five wilderness biomes were to cooperate in the effort to "sustain" the human habitat at the top of the food chain. Ecological connections were translated into biological, physical, and chemical cause-and-effect relations. An elaborate infrastructure of electrical, mechanical, chemical, thermal, and hydraulic transmissions formed the basis of a new hybrid version of "nature," a thin organic skin stretched across the surface of huge machinery. A circuit of cables, ventilators, pumps, and turbines was responsible for circulating, flushing, cleaning, and cooling the air and the water, for moving wind and waves, and for regulating the climate—air pressure, temperature, humidity, and precipitation. An intricate network of more than two thousand sensors, the "nerve system" of the plant, would assure continuous monitoring and automatic regulation of designated parameters and thus control the stability and safety of this biospheric life-support system.[64] The "Glass Ark,"[65] as it was called, emphasized not completeness but systemic integrity, following an economy of modular combination and substitution of single components. To select the 3,800 species to be taken on board, not natural affluence but systemic "diversity"[66] was modeled, based on biological agents selected according to criteria of efficiency, practicality, and replaceability.[67] And, indeed, neither acid rain nor "overpopulation" nor "pollution" posed a problem within this artificial environment. Rather, a drastic decline in pollinating insects and losses of other species had to be taken into account, and the slow decline of oxygen called for an oxygen injection one and a half years into the experiment.[68] Like so many myths, the story of the Second Biosphere met its fate in hubris: the *endosphere* turned out to be an *exosphere*, where the only environment in which it was possible to survive was *outside*.

The end of "Biosphere 2" came about even faster than the end of its science-fiction double *Valley Forge* in the movie *Silent Running*. In both cases, political resolutions ended the projects ahead of their scheduled time. Shortly after the unsealing of the glass dome at the end of the initial two-year closure, the owners of Biosphere 2 decided to use the facility for

research purposes only. In the movie, decisions made at the base station on Earth led to termination of the conservationist mission in space. Following a short battle and a long solitude, Freeman Lowell as the sole human survivor blows up his spaceship. He arranges for a last bubble of life to survive floating in space. Significantly, this ark is devoid of humans: the dispatched biospheric idyll of plants and animals is cared for devotedly by a small robot.

Ecology and Space Flight

By turning the conventional biosphere "preserve" into a material reserve for newly created environments, both technonatures—Biosphere 2 and the *Valley Forge*—carry to extremes the image of nature in a "state of exception," realizing in environmental terms a concept developed by Giorgio Agamben to describe a different state of emergency rule.[69] This nature comes attached to exclusive claims of reservation and rights of access that determine who in a "state of emergency" will be able to command, to dispose of, to optimize, and to alter it. Following Michael Jäger and Gudrun Kohn-Waechter, "someone may soon contend that ecology boils down to space flight."[70]

Whether the twentieth century's unprecedented integration of ecology, geopolitics, and technoscience is ultimately directed toward "leaving the earth," as they presume, may be arguable. The association of environmental degradation and the flight into space, however, has become common. Taking up this motif, the popular American cartoonist Gary Larson published a cartoon in 1980, in which animals, two of each kind, select a NASA spaceship as their salvaging ark.[71] While the animals clearly sense impending catastrophe, the humans appear to be clueless. Their elaborate technoscientific apparatus of monitoring and control has failed; *Homo sapiens* does not have the imminent ecocide on screen. Larson inverts the power relations in the biblical story of the ark, reversing the Christian teleology of the species selected for survival being the one made in God's image. Similarly, he gives an ironic modern twist to the story by having the animals choose as their lifeboat a spaceship, the epitome of human technologies designed to achieve world control!

Pictures of the spaceship as an ark, as well as suspicions concerning an ecologically motivated abandonment of the earth, show how visions of "Spaceship Earth" can generate strategies neither intended nor sought by ecologists or ecologically minded economists. Spaceflight and the view of Earth from space do not necessarily lead to environmentally correct conduct. Just as often, spaceflight seems to be viewed as an exit strategy—a means for escaping an environment we have worn out. In the summer of 2006, the British physicist Stephen Hawking revitalized the discussion

The Gary Larson cartoon mentioned in the text is reproduced in the printed issue. Unfortunately, our copyright permission does not extend to the online version.

about colonizing space with a question he posed in the *Yahoo!* Internet forum: "How can the human race survive the next hundred years?"[72] Addressing the future of mankind as it faces viruses, terror, and war, along with resource exploitation and global climate change, Hawking answered his own question by saying that the survival of humankind could in the long run be secured only by humans swarming out into space and colonizing other planets. He suggested that by manipulating their genetic material, humans could be bio-engineered to make them capable of tolerating environmental conditions on other planets. A new species adapted to life elsewhere in the galaxy—*Homo spaciens*[73]—could be created.

Hawking's question calls new attention to a much older theme: the alleged power of humanity to choose a technologically enhanced nature over a once-pure but now polluted environment by constructing a more sustainable Earth than the one that is now literally at man's disposal. What is at stake in these debates is not so much the moral issues of a "natural" versus an "artificial" environment and whether humans should abandon their home planet or stay and act responsibly; rather, it is vital that we think more critically about the consequences of humans' renewed confidence in their ability not only to pose these questions, but also to resolve them.

Notes

[1] *Silent Running*, Universal, 1972. Directed by Douglas Trumbull, starring Bruce Dern in the role of Freeman Lowell.

[2] Denis Cosgrove, "Contested Global Visions: *One-World*, *Whole-Earth*, and the Apollo Space Photographs," *Annals of the Association of American Geographers* 84 (1994): 270–294; Sheila Jasanoff, "Image and Imagination: The Formation of Global Environmental Consciousness," in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, ed. Clark A. Miller and Paul N. Edwards (Cambridge, Mass., 2001), 309–337; Wolfgang Sachs, "Satellitenblick. Die Ikone vom blauen Planeten und ihre Folgen für die Wissenschaft," in *Technik ohne Grenzen*, ed. Ingo Braun and Bernward Joerges (Frankfurt am Main, 1994), 305–346; Wolfgang Sachs, "Der blaue Planet. Zur Zweideutigkeit einer modernen Ikone," in *Moderne Zeiten: Technik und Zeitgeist im 19. und 20. Jahrhundert*, ed. Michael Salewski and Ilona Stölken-Fitschen (Stuttgart, 1994), 197–209.

[3] James E. Lovelock, "The Gaia Hypothesis," in *Gaia in Action: Science of the Living Earth*, ed. Peter Bunyard (Edinburgh, 1996), 15–33, 16.

[4] Hans J. Achterhuis, "Van Moeder Aarde tot ruimteschip: humanisme en miliuecrisis," in Hans J. Achterhuis, *Natuur tussen mythe en techniek* (Baarn, 1995), 41–64; Sabine Höhler, "'Raumschiff Erde': Lebensraumphantasien im Umweltzeitalter," in *Welt-Räume: Geschichte, Geographie und Globalisierung seit 1900*, ed. Iris Schröder and Sabine Höhler (Frankfurt am Main, 2005), 258–281; Sabine Höhler, "Raumschiff Erde, eine mythische Figur des Umweltzeitalters," in *Beam us up, Boulding! 40 Jahre "Raumschiff Erde,"* ed. Sabine Höhler and Fred Luks, *Vereinigung für Ökologische Ökonomie—Beiträge und Berichte* 7 (2006): 43–52.

[5] Barbara Ward and René Dubos, *Only One Earth: The Care and Maintenance of a Small Planet* (New York, 1972), xvii-xviii.

[6] Barbara Ward, *Spaceship Earth* (New York: Columbia University Press, 1966). See also William G. Pollard, *Man on a Space Ship: The Meaning of the Twentieth-Century Revolution and the Status of Man in the Twenty-first and After* (Claremont, California, 1967).

[7] Richard Buckminster Fuller, *Operating Manual for Spaceship Earth* (Carbondale, 1969); Joachim Krausse, "Buckminster Fullers Vorschule der Synergetik," in *Richard Buckminster Fuller: Bedienungsanleitung für das Raumschiff Erde und andere Schriften*, ed. Joachim Krausse (Amsterdam, 1998), 213–306; Anker, Peder, "Buckminster Fuller as Captain of Spaceship Earth," *Minerva* 45 (2007): 417–434.

[8] Kenneth E. Boulding, "The Economics of the Coming Spaceship Earth," in *Environmental Quality in a Growing Economy*, Essays from the Sixth RFF Forum on Environmental Quality held in Washington, March 8 and 9, 1966, ed. Henry Jarrett (Baltimore, 1966), 3–14; Höhler and Luks, *Beam us up, Boulding! 40 Jahre "Raumschiff Erde."*

[9] Boulding, "The Economics of the Coming Spaceship Earth," 9.

[10] Boulding, "The Economics of the Coming Spaceship Earth," 9.

[11] "Environmental Era"; also "Environmental Decade"; see Richard N. L. Andrews, *Managing the Environment, Managing Ourselves: A History of American Environmental Policy* (New Haven, 1999), 228. In 1977, Donald Worster dated the beginning of the "Age of Ecology" back to the explosion of the first atomic bomb in Alamogordo, New Mexico, in July 1945; Donald Worster, *Nature's Economy: A History of Ecological Ideas* (Cambridge, 1977). The 1960s are considered the "time of awakening" when environmental problems were identified and an environmental movement was formed, and the years around 1970 are regarded as the beginning of the "environmental era" in the Western world. See Samuel P. Hays, *A History of Environmental Politics since 1945* (Pittsburgh, Pa., 2000); Samuel P. Hays, *Explorations in Environmental History: Essays* (Pittsburgh, Pa., 1998); Samuel P. Hays, *Beauty, Health and Permanence: Environmental Politics in the United States, 1955–1985* (Cambridge, Mass., 1987); Hal K. Rothman, *Saving the Planet: The American Response to the Environment in the Twentieth Century* (Chicago, 2000); Andrew Jamison, *The Making of Green Knowledge: Environmental Politics and Cultural Transformation* (Cambridge, 2001).

[12] These considerations point to much larger and more complicated questions that this project cannot explore in detail. They involve the problem of whether and to what extent the imagery, the mythology, and the cultural concept of spaceflight in the twentieth century derives from, reflects, or embodies the Judeo-Christian religious tradition that shaped Western culture and is characterized by a teleological understanding of development and expansion, which for the earth and for humankind promises either salvation or doom.

[13] Michel Foucault, "Of Other Spaces," *Diacritics* 16 (1986): 22–27, 27 [orig. 1967 "Des Espaces Autres"].

[14] Roland Barthes, "The *Nautilus* and the Drunken Boat," in Roland Barthes, *Mythologies* (New York, 1972), 65–67 [orig. *Mythologies*, Paris, 1957].

[15] Peter Sloterdijk, *Sphären* (Frankfurt am Main, 1998–2004), Vol. 2: *Globen (Makrosphärologie)* (1999), Chapter 3, "Archen. Zur Ontologie des ummauerten Raumes," 251 (translation mine).

[16] Sloterdijk, *Sphären*, "schwimmende Endosphäre"; "schwimmende Innenwelt" (translations are mine).

[17] Fairfield Osborn, *The Limits of the Earth* (Boston, 1953), 78.

[18] President John F. Kennedy's Address at Rice University on the Nation's Space Effort, September 12, 1962, NASA History Division, Key Documents in the History of Space Policy, http://history.nasa.gov/spdocs.html (accessed November 30, 2007).

[19] Frederick Jackson Turner, *The Frontier in American History* (New York,1921), 1. The term "frontier," originally meaning border or borderline, obtained a new meaning in the course of the settlement of the American West in the eighteenth and nineteenth century. For an analysis of the plot and the main features of the narrative of the American Frontier, see Patricia Nelson Limerick, *The Legacy of Conquest: The Unbroken Past of the American West* (New York, 1987).

[20] William Cronon, George Miles, and Jay Gitlin, "Becoming West: Toward a New Meaning for Western History," in *Under an Open Sky: Rethinking America's Western Past*, ed. William Cronon, George Miles, and Jay Gitlin (New York, 1992), 3–27, 6 (emphasis in the original).

[21] Patricia Nelson Limerick, "Making the Most of Words: Verbal Activity and Western America," in Cronon et al., *Under an Open Sky*, 167–184, 171.

[22] Rebekka Ladewig, "Das Raumschiff," in *Orte der Moderne: Erfahrungswelten des 19. und 20. Jahrhunderts*, ed. Alexa Geisthövel and Habbo Knoch (Frankfurt am Main, 2005), 57–67.

[23] Elody R. Crimi and Diane Ney, *Jewels of Light*: *The Stained Glass of Washington National Cathedral*, Photographs by Ken Cobb (Washington, DC, 2004).

[24] On myth as cultural narrative, see Sabine Höhler, *Luftfahrtforschung und Luftfahrtmythos: Wissenschaftliche Ballonfahrt in Deutschland, 1880–1910* (Frankfurt, 2001), 36–57.

[25] Foucault, "Of Other Spaces," 27.

[26] On "Space Age Cargo Cults" see William R. Catton, *Overshoot: The Ecological Basis of Revolutionary Change* (Urbana, 1980), 187–195.

[27] The movement of "Survivalism" was based on the contention that the earth is fitted with a limited stock of resources and prescribed drastic and multidimensional action to prevent global disaster; John S. Dryzek, *The Politics of the Earth: Environmental Discourses* (Oxford, 1997).

[28] Andrew Kirk, "Appropriating Technology: The Whole Earth Catalog and Counterculture Environmental Politics," *Environmental History* 6 (2001): 374–394.

[29] Boulding, "The Economics of the Coming Spaceship Earth," 9.

[30] On the connection of ecology and space flight in architecture, see Peder Anker, "The Ecological Colonization of Space," *Environmental History* 10 (2005): 239–268; Peder Anker, "The Closed World of Ecological Architecture," *The Journal of Architecture* 10 (2005): 527–552. For the shift of life to "survival," see Jean Baudrillard, "Überleben und Unsterblichkeit," in *Anthropologie nach dem Tode des Menschen. Vervollkommnung und Unverbesserlichkeit*, ed. Dietmar Kamper and Christoph Wulf (Frankfurt am Main, 1994), 335–354.

[31] Buckminster Fuller, *Operating Manual*, 46.

[32] Fuller, *Operating Manual,* 52.

[33] Fuller, *Operating Manual,* 52.

[34] Fuller, *Operating Manual*, 54. Biologist Paul Ehrlich and political scientist Richard Harriman organized their 1971 book *How to be a Survivor: A Plan to Save Spaceship Earth* around the metaphor of Spaceship Earth, with chapter titles such as "The Size of the Crew" and "The Control Systems," along with one chapter describing the new "Spacemen" culture that would have to develop; Paul R. Ehrlich and Richard L. Harriman, *How to be a Survivor: A Plan to Save Spaceship Earth* (New York, 1971).

[35] Wolfgang Sachs discusses the concept of sovereign technological control in "Astronautenblick—Über die Versuchung zur Weltsteuerung in der Ökologie," in *Jahrbuch Ökologie 1999* (Munich, 1998), 199–206. See esp. 204–205 on the "metaphor of the governor (from the Greek *kybernetes*)" and Plato's "ship of the state" as a basis for calling out the "rule of the competent" (204; translations mine). Sachs warns of "ecocracy" (205; translations are mine). Anker makes a similar argument in "Buckminster Fuller as Captain of Spaceship Earth."

[36] "It is obvious that we cannot exist unaffected by the fate of our fellows on the other end of the good ship Earth. If their end of the ship sinks, we shall at the very least have to put up with the spectacle of their drowning and listen to their screams." Paul R. Ehrlich, *The Population Bomb* (New York, 1969), 132 [4th edition; orig. 1968].

[37] Barbara Duden, "Population," in *The Development Dictionary: A Guide to Knowledge as Power*, ed. Wolfgang Sachs (London, 1992), 146–157. On the history of population discourse in relation to issues of environment and development, see also Matthew Connelly, "To Inherit the Earth: Imagining World Population, from the Yellow Peril to the Population Bomb," *Journal of Global History* 1 (2006): 299–319; Paul Neurath, *From Malthus to the Club of Rome and Back: Problems of Limits to Growth, Population Control, and Migrations* (Armonk, N.Y., 1994); Björn-Ola Linnér, *The Return of Malthus: Environmentalism and Post-war Population-Resource Crises* (Leverburgh, Isle of Harris, 2003). Sabine Höhler, "Die Wissenschaft von der 'Überbevölkerung': Paul Ehrlichs 'Bevölkerungsbombe' als Fanal für die 1970er-Jahre," *Zeithistorische Forschungen/Studies in Contemporary History* 3 (2006): 60–64; Sabine Höhler, "The Law of Growth: How Ecology Accounted for World Population in the 20th Century," *Distinktion: Scandinavian Journal of Social Theory* 14 (2007), 45–64.

[38] George H. W. Bush as quoted in Phyllis Tilson Piotrow, *World Population Crisis: The United States Response* (New York, 1973), vii.

[39] Rafael M. Salas, *International Population Assistance: The First Decade. A Look at the Concepts and Politics Which have Guided the UNFPA in its First Ten Years* (New York, 1979), 125.

[40] Ehrlich, *The Population Bomb*, Foreword by David Brower, 14.

[41] Höhler, "The Law of Growth," 49–51.

[42] Sabine Höhler, "'Carrying Capacity'—the Moral Economy of the 'Coming Spaceship Earth,'" *Atenea: A Bilingual Journal of the Humanities and Social Sciences* XXVI (2006): 50–74.

[43] Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (New York, 1972). Other popular "blueprints" for the future of this time included Edward Goldsmith, Robert Allen, Michael Allaby, John Davoll, and Sam Lawrence, *A Blueprint for Survival* (London, 1972), and Medard Gabel, *Energy, Earth and Everyone: Energy Strategies for Spaceship Earth*, with the World Game Laboratory, Foreword by R. Buckminster Fuller, Afterword by Stewart Brand (Garden City, N.Y., 1980 [1974]). Gabel proclaimed that "the future is not to be predicted, it is to be planned," 246. On the rise of systems scientific approaches to the management of global phenomena, see Geof Bowker, "How to be Universal: Some Cybernetic Strategies, 1943–1970," *Social Studies of Science* 23 (1993): 107–127; Paul N. Edwards, "The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models," in *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*, ed. Agatha C. Hughes and Thomas P. Hughes (Cambridge, Mass., 2000), 221–253; Wolfgang Sachs, "Natur als System: Vorläufiges zur Kritik der Ökologie," *Scheidewege: Jahresschrift für skeptisches Denken* 21 (1991–92): 83–97; Fernando Elichirigoity, *Planet Management: Limits to Growth, Computer Simulation, and the Emergence of Global Spaces* (Evanston, Ill., 1999).

[44] Meadows et al., *The Limits to Growth*, 91–92.

[45] J. H. Fremlin, "How Many People Can the World Support?" *New Scientist* 415 (1964): 285–287.

[46] Ehrlich, *The Population Bomb*, 167 (my emphasis).

[47] Foucault, "Of Other Spaces," 23.

[48] Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1243–1248, 1248, 1244. Hardin was not the only protagonist of carrying-capacity-based calculations of maximum human numbers and of resource distribution. For other works in this vein, see Karl Sax, *Standing Room Only: The World's Exploding Population* (Boston, 1960) [orig. 1955 *Standing Room Only: The Challenge of Overpopulation*]; William Paddock and Paul Paddock, *Famine—1975! America's Decision: Who will Survive?* (Boston, 1967); Georg Borgstrom, *Too Many: A Study of Earth's Biological Limitations* (London, 1969).

[49] Garrett Hardin, "Carrying Capacity as an Ethical Concept," in *Lifeboat Ethics: The Moral Dilemmas of World Hunger*, ed. George R. Lucas, Jr. and Thomas W. Ogletree (New York, 1976), 120–137, 134.

[50] Hardin, "The Tragedy of the Commons," 1248, 1244.

[51] Lorraine Daston, "The Moral Economy of Science," in *Constructing Knowledge in the History of Science*, ed. Arnold Thackray, *Osiris*, Second Series, vol. 10 (1995): 3–24.

[52] Garrett Hardin, "Lifeboat Ethics: The Case Against Helping the Poor," *Psychology Today* 8 (1974): 38–43; 123–126; Garrett Hardin, "Living on a Lifeboat," *BioScience* 24 (1974): 561–568.

[53] Peter Næss, "Live and Let Die: The Tragedy of Hardin's Social Darwinism," *Journal of Environmental Policy & Planning* 6 (2004): 19–34.

[54] Hardin, "Living on a Lifeboat," 565.

[55] Hardin, "Living on a Lifeboat," 564 (emphasis in the original).

[56] Ehrlich, *The Population Bomb*, 20, 167.

[57] Sloterdijk, *Globen*, 260–261.

[58] John Allen, *Biosphere 2: The Human Experiment* (New York, 1991), 1; John Allen and Mark Nelson, *Space Biospheres* (Oracle, Arizona, 1989) [2d ed., orig. 1986].

[59] Architect Phil Hawes as quoted by Allen, *Biosphere 2*, 16.

[60] William Kuhns, *The Post-Industrial Prophets: Interpretations of Technology* (New York, 1971), Chapter 10, "Leapfrogging the Twentieth Century: R. Buckminster Fuller," 220–246, 222. In a comment written in 1980, Kenneth Boulding referred to the colonization of space as a vision closely connected to the metaphor of the spaceship; Kenneth E. Boulding, "Spaceship Earth Revisited," in *Economics, Ecology, Ethics: Essays Toward a Steady-State Economy*, ed. Herman E. Daly (San Francisco, 1980), 264–266.

[61] Sloterdijk, *Globen*, 254.

[62] These artificial constructions of nature have been called "Second Nature"; Sloterdijk, *Globen*, 255; Dorion Sagan, *Biospheres: Metamorphosis of Planet Earth [Reproducing Planet Earth]* (New York, 1990), 195.

[63] Allen, *Biosphere 2*, Chapter 5 "Technics," 59, Paragraph "Making an Enclosure," 62. On the "Human Experiment," see Jane Poynter, *The Human Experiment: Two Years and Twenty Minutes inside Biosphere 2* (New York, 2006); Abigail Alling and Mark Nelson, *Life Under Glass: The Inside Story of Biosphere 2* (Oracle, Ariz., 1993).

[64] Allen, *Biosphere 2*, Chapter 9 "Cybernetics," 115.

[65] Linnea Gentry and Karen Liptak, *The Glass Ark: The Story of Biosphere 2* (New York, 1991).

[66] Allen, *Biosphere 2*, "Diversity," 48–49.

[67] Baudrillard, "Überleben und Unsterblichkeit"; Timothy W. Luke, "Environmental Emulations: Terraforming Technologies and the Tourist Trade at Biosphere 2," in Timothy W. Luke, *Ecocritique: Contesting the Politics of Nature, Economy, and Culture* (Minneapolis, 1997), 95–114.

[68] Kevin Kelly, *Out of Control: The New Biology of Machines, Social Systems and the Economic World* (Reading, Mass., 1994), Chapter 9, "Pop Goes the Biosphere," 150–165.

[69] Giorgio Agamben, *State of Exception* (Chicago, 2005); Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life* (Stanford, 1995).

[70] "Perhaps a direct path leads from the 'planetary' experience of Sputnik via Sänger's Malthusianism and Boulding's 'Spaceship Earth' to the 'ecological' problem of overpopulation brought up by the Club of Rome, and from there to the Greens on the one hand, and via Global 2000 [1977] back to the American President on the other, who meanwhile was named not Kennedy but Reagan and who sent NASA to its 'second stage.' Going one step further, someone might soon contend that ecology boils down to space flight." Michael Jäger and Gudrun Kohn-Waechter, "Materialien zur ökologischen Katastrophe: Das Verlassen der Erde," *Kommune* 1 (1993): 33–38, 35 (translation is mine).

[71] The cartoon panel *The Far Side* by Gary Larson ran from January 1, 1980 until January 1, 1995. During these 15 years the panel appeared in more than 1,900 daily and Sunday newspapers worldwide and was translated into 17 languages. It is still syndicated in 45 newspapers in 17 countries. The cartoon panel was also published in 23 *Far Side* books, including 16 collections, five anthologies and two retrospectives. *The Far Side*® and the Larson signature are registered trademarks of FarWorks, Inc.

[72] Stephen Hawking, "How can the human race survive the next hundred years? In a world that is in chaos politically, socially and environmentally, how can the human race sustain another 100 years?" *Yahoo!* Answers, http://answers.yahoo.com/question/index?qid=20060704195516AAnrdOD (accessed November 30, 2007).

[73] Peter R. Sahm, Hinrich Rahmann, Hans J. Blome, and Gerhard P. Thiele, eds., *Homo spaciens: Der Mensch im Kosmos* (Hamburg, 2005); Ernst Sandvoss, *Vom homo sapiens zum homo spaciens: Eine Sinnperspektive der Menschheitsentwicklung* (Berlin, 2002).