Playing Gaia: Simulation, Science, and the Significance of Video Games for Environmental History

CAMDEN BURD, Clemson University

In 1990, video game publisher Maxis released *SimEarth*. Designed by Will Wright, the game tasked users to consider atmospheric, geologic, and biological variables to simulate a global system. Wright based the game on James Lovelock's Gaia hypothesis—a theory of Earth that posited that the planet was a singular cybernetic system. Throughout gameplay, players are introduced to Lovelock's ideas both through explicit text and implicit visual design. In short, *SimEarth* served as a powerful tool of argumentation for Lovelock's Gaian system. Exploring *SimEarth* and Wright's interpretation of Lovelock's work, this essay encourages environmental historians to examine video games for their unique visual form and style of argumentation.

A pixelated collage of Earth suspended in space greets gamers as they boot *SimEarth* (fig. 1). The granular blues, greens, browns, and whites appear in stark contrast to the cosmic black. "*SimEarth: The Living Planet*" appears in vibrant teal, blue, and purple as dull introductory music plays through the speakers of their personal computers. The names of the game's lead designers, Fred Haslam and Will Wright, are printed below the scribbled text. But theirs are not alone. Interestingly, their credits are listed alongside those of James Lovelock, a

Electronically Published on December 15, 2025.

Environmental History, volume 31, number 1, January 2026. Published by The University of Chicago Press for the American Society for Environmental History and the Forest History Society. https://doi.org/10.1086/738836

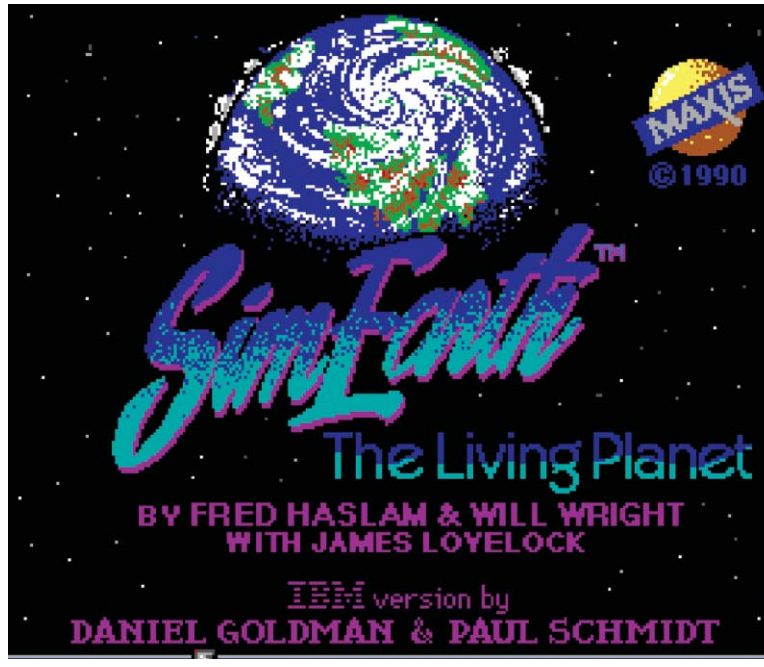

Figure 1. Opening image when starting *SimEarth* game on DOS version (1990). Credit: *SimEarth,* 1990.

popular scientist who, with biologist Lynn Margulis, developed this novel theory about the grand connectedness of Earth's systems—the Gaia hypothesis—in the 1970s.[1] Perhaps users were familiar with Lovelock's work when they decided to purchase and play *SimEarth*. Perhaps not. Regardless of their own history with the scientist's ideas, those who played *SimEarth* were thrust into a curated representation of Lovelock's theories, complete with digital facsimiles of biological actors, ecological systems, and natural laws.

At the time of *SimEarth*'s release, the video game industry was on the rise. The advent of personal computers and home gaming systems during the late 1980s and early 1990s created more opportunities for consumers to engage with the medium. Relatedly, game developers and software companies expended a great deal of energy to design, market, and sell games in an attempt to capture their share of the seemingly ever-expanding market.[2] Indicative of the medium's meteoric rise in popularity, the industry surpassed both film and music by the first decade of the twenty-first century.[3] In recent years, historians and media studies

scholars have turned their attention to the video game, grappling with the cultural contexts and meanings embedded in the creation and reception of the flickering screen.[4] The medium is a rich, though understudied, source of material for environmental historians as well. For example, Sherri Sheu has explored how games become powerful meditating tools to depict digital ecologies. The act of playing can imaginatively transport users to new virtual environments and landscapes. In this sense, video games "bring the lake to your living room."[5] But video games are also artifacts of historical movements, politics, and ideas. Historian Jeremy Saucier argues that "like other cultural products, such as film, literature, or music, video games express cultural tensions and anxieties."[6] In short, video games are not developed in a vacuum. They reflect the development of technology, the desires of corporations, the philosophies of designers, and the concerns of consumers.

That is not to say that working with video games does not provide challenges. Unlike film, music, and literature, video games do not always follow clear narrative structures. They do not move from scene-to-scene, measure-to-measure, or page-to-page. Almost no game will be played the same way twice. Although they lack the similar composition or explicit argumentation like those found in other mediums, they do express a sort of persuasion through what video game scholar Ian Bogost calls "procedural rhetoric." It is a style of persuasion "tied to the core affordances of the computer" including complex calculations, simulation, and manipulation.[7] Designers imagine scenarios, write code, and build worlds for players to inhabit. The "argument" of a video game is built into the very structure of its mechanics. Understanding the entirety of that system reveals how designers believed "the way the world does or should function."[8] By grappling with the historical context of games as well as the representations, rules, and goals embedded within, historians can better understand how the medium reflected, represented, and transmitted ideas across pixelated screens.

In marketing materials, Maxis labeled *SimEarth* as "a planet simulator."[9] The project was ambitious in scope and represented a more complicated sequel to the company's massive commercial success, *SimCity*, which was released in 1989. Unlike *SimCity*, where users were tasked to consider urban design, road building, and zoning practices, *SimEarth* prompted gamers to navigate complex global systems with ever-changing chemical, geological, atmospheric, biological, and social variables. The bulk of the design work fell on the shoulders of Maxis

cofounder Will Wright. Born in 1960, Wright came of age alongside the rise of the computer. He shuffled between multiple universities before dropping out and moving to Oakland, California, where he quickly took to computer programming. In particular, he was drawn to simulation games. It was a genre that rose in popularity because of the ever-increasing technical capacity of computers during the second half of the twentieth century. With access to increased processing power, designers programmed games with interconnected algorithms that could be run simultaneously. These computations were often obscured from the user who only experienced their output as seamless gameplay.

Not all simulation games were made equal. As the genre grew, critics quickly established guidelines as to what separated a good simulation game from a bad one. In a special issue of *Computer Gaming World*, editors turned their attention to examine the merits of the genre. A good simulator, they argued, "needs to have a basis in the real world" and designed with "hard scientific facts." It "must approximate the functions of the simulated item" with appropriate inputs and a "reasonable facsimile of a response." Such commitment to accuracy meant that a good simulator should reflect a certain realism. The game must make "you *feel* as if you're really there."[10] Wright agreed. Game designer and theorist Chaim Gingold writes that, at his core, Wright was a "simulation native." He "knew the joy and craft of model making and knew simulation as a medium representation."[11] Simulation games, Wright argued, created space for empathy and understanding because they "give you a much wider game-space to explore."[12] By providing players the autonomy to explore digital environments, Wright believed users would gain a better understanding of real ones.

Concern for realism and the promise of technical accuracy were not limited to game designers and their critics. For many, new computing technologies including games could be powerful tools to explore a variety of social and environmental processes. It was Stewart Brand, founder of the *Whole Earth Catalog*, who optimistically declared that the rise of computers was "good news, maybe the best since psychedelics."[13] Like mind-altering hallucinogens, Brand saw advancements in computing as a tool for introspection, observation, and inspiration. As Andrew G. Kirk has argued, Brand separated himself from the environmental doomsayers of the 1960s and 1970s. Instead, he promoted a philosophy that embraced "individual agency and technological enthusiasm" as an effective approach to environmental problems.[14] As Neil

Maher has argued, Brand embraced technologies that he believed could be "used in an environmentally sensitive way."[15] This fact is made clear when perusing the pages of the *Whole Earth Catalog* and the shorter-lived *Whole Earth Software Catalog*—both of which regularly featured articles on the underlying potential of computing technology for individual, societal, and environmental improvement. "Personal computers are automobiles of the mind," Brand argued. "They empower. They can also estrange, but information has a greater capability for self-correction than gasoline and steel."[16] Computers could change the world, Brand argued, as long their software was designed correctly.

Brand and Wright spent time in similar social circles after the young programmer moved to California. It was there that Wright encountered James Lovelock, the scientist who had been developing a grand theory of Earth's system. Originally proposed in the 1960s and regularly promoted in Brand's *Whole Earth Catalog*, Lovelock's "Gaia hypothesis" proposed that the Earth System was a single "complex entity involving the Earth's biosphere, atmosphere, oceans, and soil; the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on this planet."[17] The theory stressed balance or homeostasis, positing that all elements of the Earth from weather patterns to animal consciousness, from human action to tectonic movements, from plagues to water currents, were connected as an intelligent cybernetic system, "Gaia." Gaia made biological life possible despite the virulent swings of Earth's planetary history. This was not a substitute metaphor for the relationship between living and nonliving things in an ecosystem. Gaia was singular and all-encompassing. In the decades since Lovelock first introduced Gaia, scientists have lobbed critiques at various components of the theory. They noted that Lovelock's ideas were difficult or impossible to test and prove. They denounced the notion that Earth was a single organism or system. And they correctly noted that Lovelock's theory of homeostasis lacked any form of regulation or natural selection.[18]

Although much of the scientific community criticized Lovelock's ideas in the second half of the twentieth century, the Gaia hypothesis did find captive audiences. New Age intellectuals, ecocentrists, proponents of cybernetics, and techno-utopians all found something of value in the Gaia hypothesis.[19] Lovelock's ideas even found a receptive audience among the globe's most prominent polluters. Companies such as Royal Dutch Shell eagerly funded the scientist's work hoping to prove

that their impact on global climate change might be offset by some larger, self-regulating system.[20] Game designers, too, were drawn to Lovelock's system of earth science. "I was very interested in certain theories, most notably in Gaia hypothesis," Wright later reflected. He "thought it would be very interesting to have a model of a global ecosystem."[21] With Gaia in mind, he designed a game that reflected the fundamental underpinnings of Lovelock's global cybernetic system.

Wright's design philosophy was the virtual embodiment of popular environmentalism at the close of the twentieth century. As Finis Dunaway has argued, this was an era when environmental spectacle, green consumerism, and personal responsibility became the primary ways of interpreting environmental crises and forming a response. Overlapping and compounding catastrophes such as "ozone depletion, global warming, and rainforest destruction . . . merged into an all-encompassing vision of global environmental crises."[22] This flattening of environmental doom was almost Gaia-like in its conception and created the sense that all environmental problems were connected—that humanity only needed to save the planet. But humanity wasn't obligated to coordinate efforts in the neoliberal age. That work would be left to consumers in the marketplace. Here too, Dunaway argues, companies and politicians assured concerned onlookers that their anxieties could be soothed with "short-term, consumerist solutions."[23] These solutions were individualized and lacked a call for political mobilization. Consume consciously; plant a tree; and always—always!—recycle.

They could buy a video game too. In fact, proponents often celebrated *SimEarth* for its ability to teach environmental lessons from the comforts of one's own home. In July 1992, news correspondents T. R. Reid and Brit Hume broke away from their traditional political beat to review a suite of games from Maxis, including *SimEarth*. "The folks who created Maxis have a naturalistic, environmentally oriented mindset," they observed. "Nuclear is bad, 'back to nature' is good, and every environment is a closed loop in which each decision has consequences all over the place." Gaia had been gamified, they reviewed, and this was a good thing. Some software might be expensive, but programs like *SimEarth* "are worth the money." Still, be careful, they noted. "The darn stuff is addictive. You can blow hours, days, whole weeks wrapped up in this simulated world."[24] *SimEarth* was a product coded with corporate idealism, celebrated for its perceived environmental message, and enjoyed because it enabled gamers to know and manage

Earth's geomorphology in its most extreme conditions. In short, *SimEarth* allowed players to substitute saving the real world with a digital one.

The structure of the game and the options made available to players were intended to showcase the large scheme built into the Gaian system (fig. 2). Here, players had the power to adjust aspects of geological, biological, and atmospheric variables. Players expend "Energy" through various tools. For example, the "Place Life" tool allows users to place arthropods, fish, dinosaurs, insects, and mammals, among others, on their planet. They can use the "Plant Biome" tool to create grasslands, jungles, swamps, deserts, and others. The "Trigger Events" tool allows players to unleash a hurricane, crash a meteor, start fires, or oversee an atomic test. Players explore the feedback loops posited in Lovelock's thesis through a series of "Models"—pop-up windows with adjustable scales. The Geosphere Model allows players to increase or decrease several variables including the planet's core heat, volcanic activity, continental drift rate, erosion, core formation, axial tilt, and the rate of meteor impacts. Solar input, cloud formation, rainfall, cloud albedo, surface albedo, greenhouse effect, and air-sea thermal transfer are similarly adjustable variables in the Atmosphere Model. Players could tinker

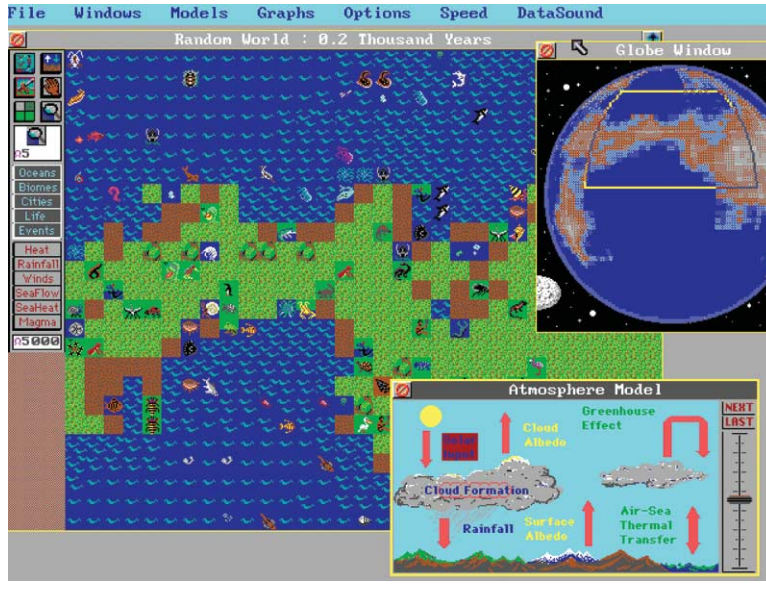

Figure 2. Various forms of life are depicted on land and in the water. The user can toggle through windows to adjust atmospheric variables, among others. Credit: *SimEarth*, 1990.

with the biological material on Gaia as well. Variables such as thermal tolerance, reproduction rate, mutation rate, and the rate at which vegetation could absorb carbon dioxide all provide gamers with the power to shape plant and animal life. When players reached the point of human evolution in *SimEarth* they could allocate energy and resources to advancements in agriculture, philosophy, science, medicine, and art or media. As players made decisions, Wright's program calculated new outputs based on the interconnected variables. Players never knew those calculations, but they did come to understand these Gaian premises as flickering pixels on a screen.

The player's view of Gaia is always from above, an ideal position to monitor and fiddle with their creation. "I was really trying to avoid a human-centered approach to the game," Wright later reflected. There are no protagonists or antagonists. Instead, players are intended to see the entirety of the system. "Really," Wright continued, "the focus of the game was supposed to be on the planet."[25] For example, when beginning a new game, players can select to begin their simulation as far back as 4.5 billion years. There, users find digital terrain colored red and black. There is no life on this planet—just rock. A text box appears: "Out of the interstellar dust a planet begins to form" (fig. 3). The first task is clear. Players must "promote the formation and survival of life." They can place life such as humans, dinosaurs, or prokaryotes—but they will probably die. The young planet, in this form, does not have the proper atmosphere, geosphere, or hydrosphere to sustain biota. Creating the conditions to support biological life can be achieved in various ways. Players can adjust planetary temperatures, establish water, or cultivate biomes. They had the freedom to explore, but they would ultimately be bound by the programmatic representation of Gaia.

Although manuals and advertisements often described the game as completely open-ended, Wright designed several game modes for users with clear goals and objectives. One mode, titled "Stag Nation," situated the player in the distant past, encouraging the user to "help civilization out of the Stone Age." "The civilization on this world is trapped in the stone age," a text box prompts the user. "The sentient mammals are stuck on a small island. Their population is too small to generate the energy for a technological jump." The goal was simple: "increase population so that technology can improve." By using the "Moving" tool, players could simply select and place an existing sentient being on another land mass. For more involved processes players might try to

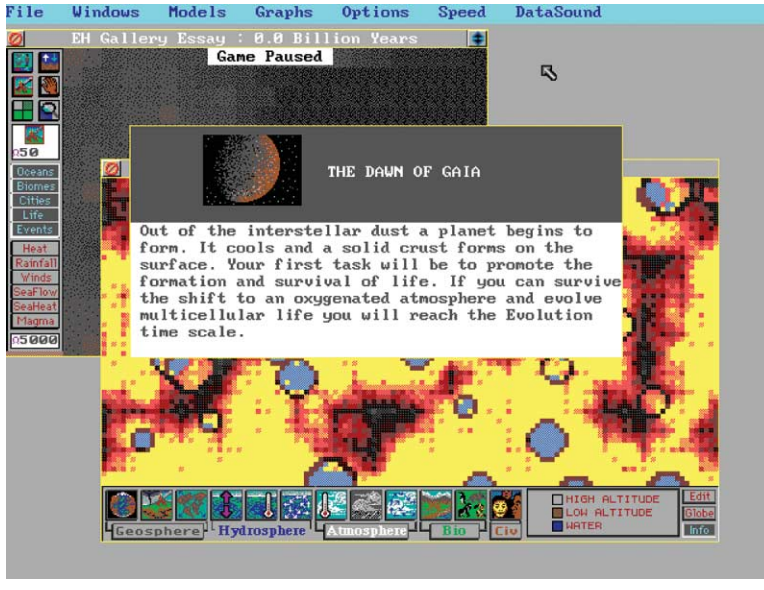

Figure 3. The opening sequence of *SimEarth* reveals a text box and corresponding visuals to demonstrate that this planet was hot but cooling, ready for the player to cultivate life. Credit: *SimEarth*, 1990.

build a land bridge either by altering the elevation with the "Set Altitude" tool or, perhaps more creatively, use the "Volcano Tool" to build new earth (fig. 4). But if a player wanted to truly explore Wright's simulation, they could adjust the overall atmosphere through the various windows. Either heating the globe or causing an ice age might serve to connect the continents. But be careful, Wright warned. Such actions might cause mass extinction events.

If the structural mechanics of *SimEarth* provided one way for users to engage with Lovelock's theories, Wright's inclusion of the "Daisyworld" game mode provided a more direct form of persuasion. The designer based the simulation on an article in *Tellus B* in 1983. Hoping to dampen the criticism of the Gaia hypothesis, Lovelock and coauthor Andrew J. Watson sought to prove their cybernetic feedback system through the hypothetical planet "Daisyworld." Daisyworld was not complex. It was "a cloudless planet with negligible atmospheric greenhouse on which the plants are two species of daisy of different colours."[26] Their goal was to illustrate how the two types of daisies, white and black, could influence, and be influenced, by adjustments in global temperature. A black daisy reflects less light, and was thus warmer. Alternatively, the

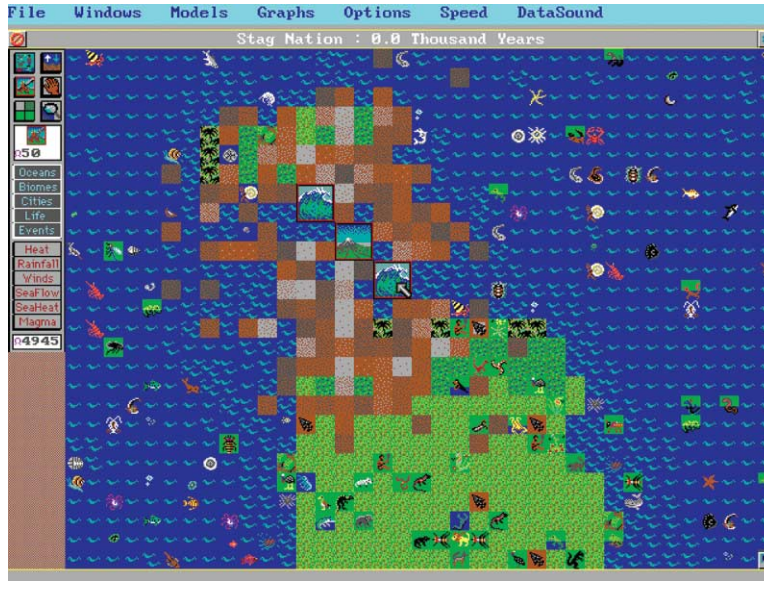

Figure 4. By using the Volcano Tool, two separate pieces of land were connected through the creation of new terrain. Credit: *SimEarth*, 1990.

white daisy reflects light and was cooler. If temperatures began to drop in Daisyworld, the black daisies would soon outnumber white ones. But as that species of daisy increases in number, it would emit more heat because of its ability to absorb warmth. According to the authors, the daisies and temperature would respond accordingly if the variables were flipped. In the end, the temperature of the planet would remain stable. This represented a "biological feedback system."[27] Although hypothetical, Lovelock hoped the Daisyworld scenario might further support the broader Gaia idea with a measurable example of planetary homeostasis.

In Wright's version of Daisyworld, eight shades of the flower, ranging from white to black, sprawl across the pixelated landscape (fig. 5). An introductory text box greets the gamer, "This scenario is based on the original Daisyworld program by James Lovelock." After a brief overview of the Gaia thesis, players hover above Daisyworld, where they are tasked to explore and "test Gaia's ability to regulate temperature." As in other game modes players can introduce insects, birds, and humans. They can build new land, cause floods, and adjust their digital planet from the comfort of their chairs. Yet, as the temperature rises, players

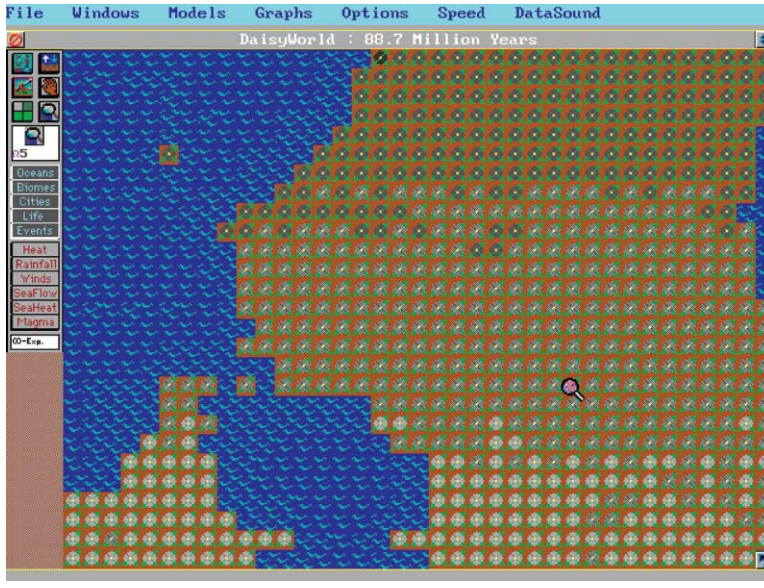

Figure 5. In the Daisyworld simulation, the digital planet is covered with several shades of daisies to represent the scenario laid out in Andrew J. Watson and James Lovelock, "Biological Homeostasis of the Global Environment: The Parable of Daisyworld," *Tellus B: Chemical and Physical Meteorology* 35 (1983). Credit: *SimEarth*, 1990.

turn their attention to the premise of this Gaia scenario. They must tend to the daisies. Players can increase or decrease solar inputs; tinker with frequency of cloud formation; toggle the rate at which greenhouse gases accumulate. Of course, they can plant more daisies, considering how each shade will affect surface albedo. Embracing the laws of Lovelock's Gaia hypothesis, players decide for themselves. They are in control.

Although tinkering with variables such as cloud formation or surface albedo did compel users to consider how Gaia worked, the gamer's position—floating above Earth with models, graphs, and adjustable windows—did shift the fundamental premise of Lovelock's work. In the scientist's formulation, Gaia was a self-regulated system and the human's place in it minuscule. Humans existed, acted, and were acted on. But in Wright's version, the player controlled the variables. They could melt ice caps, raise sea levels, plant forests, or set off atomic bombs. They could create and sustain life—or destroy it. Wright designed *SimEarth* as if each gamer were something of a god. But even God had to play by Gaia's rules.

The open-ended nature of the simulation also meant that users might take a range of lessons from *SimEarth*. Perhaps, they would become environmental empaths as Lovelock and Wright had hoped. Contemplating how biological life interacts with sea temperatures, oxygen levels, and human activity, players might feel compelled to consider the deeper lessons of Gaia. However, the structure of the game also encouraged users to imagine environmental changes as manageable problems. Rising temperatures, for example, could be just another variable to be adjusted or offset by creating more cloud cover and reducing solar inputs. In short, the game might cultivate bleeding heart ecocentrists or techno-utopian geoengineers—or neither.

SimEarth would never match the commercial success of other Maxis titles like *SimCity* and *The Sims*. For some users, the game was complicated and its objectives unclear. As one reviewer noted, "*SimEarth* may be less inviting" than other Maxis games. "It's more complex, and the intricacies of the 'ologies—geology, meteorology, biology, and technology—are scary compared to the simple city planning" found in *SimCity*.[28] Even Wright would later admit that "it wasn't a terribly fun game."[29] But the mixed reviews should not be confused for cultural impact. Although the game was originally released for DOS and Macintosh computers in 1990, the simulation continued to resonate with consumers. *SimEarth* was rereleased in 1991, 1992, 1993, and 1997 to accommodate new operating systems and gaming consoles including Windows, Atari ST, Amiga, and the Super Nintendo. The software was often available in computer labs at schools across the country. In fact, it was not uncommon for Maxis games to be incorporated directly into K–12 curricula.[30] Whether at home or school, several hundred thousand gamers have played *SimEarth* since its initial release.

Traditionally, scholars of environmental thought are more comfortable grappling with the impact of Lovelock's ideas by tracking his influence in scientific journals and other printed materials. But doing so obscures the fuller picture. By limiting our study to textual sources, we miss the diverse and influential ways in which environmental and scientific ideas can move through society. We miss the significance of video games. One reviewer reflected on the game, outlining what made *SimEarth* so compelling. The software "offers a chance to make some of those 'divine' decisions oneself and observe how they affect the other laws and systems."[31] The appeal of agency, escapism, and experimentation are certainly compelling ways to understand the power of video

games. However, we should look more closely at those "laws and systems" embedded in each game. They reveal contemporary understandings of nature, the gamer's place within it, and why such a game might appeal to potential consumers. From the ideological origins of *SimEarth* to the procedural rhetoric embedded within, players encountered, navigated, considered, and made their own sense of Lovelock's ideas and the nature of global environmental change.

Camden Burd (cburd@clemson.edu) is an assistant professor of history at Clemson University. He is the author of *The Roots of Flower City: Horticulture, Empire, and the Remaking of Rochester, New York* (Cornell University Press, 2024). His work on environmental and digital history has appeared in various journals and edited collections.

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