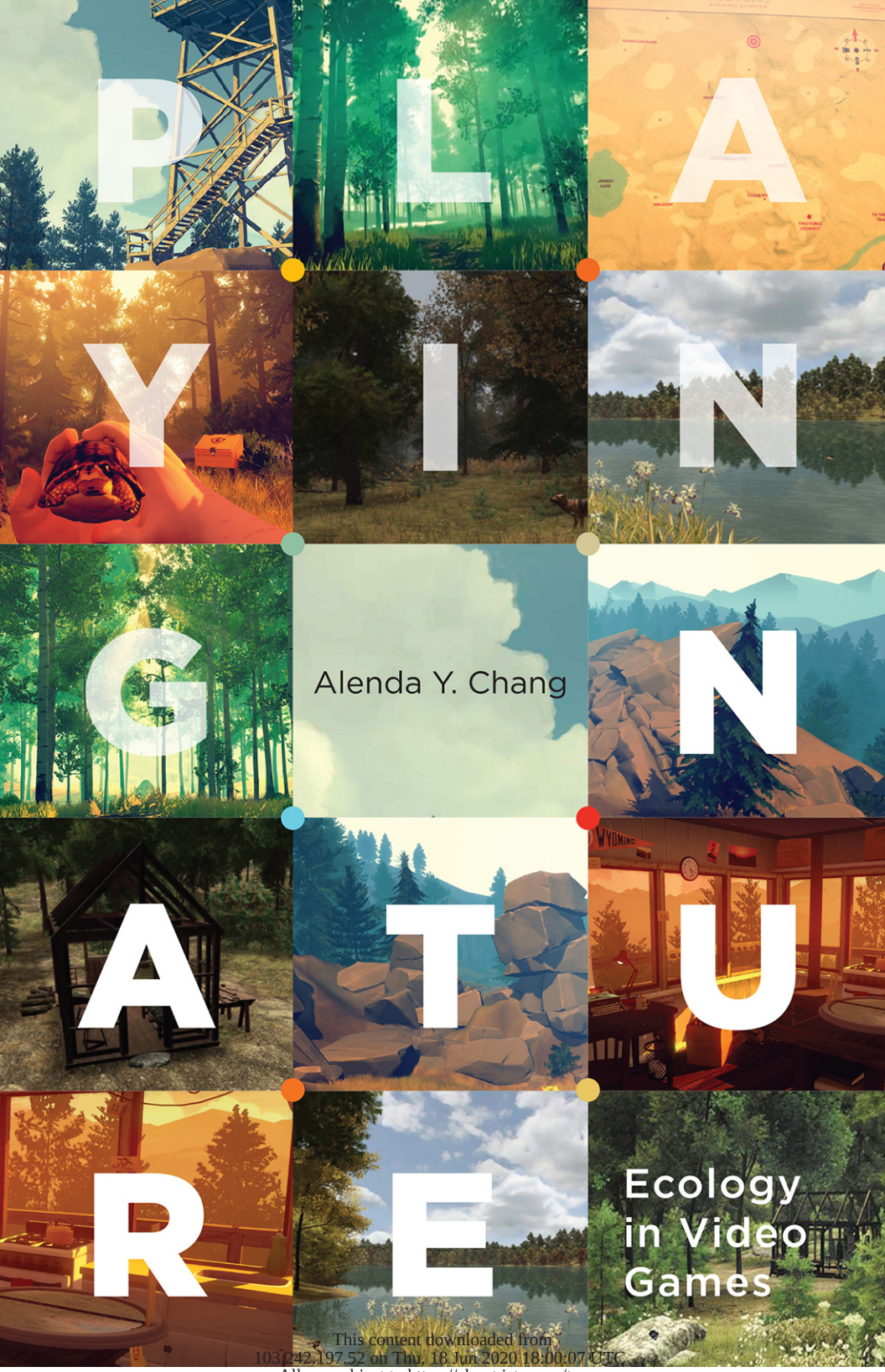

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

PLAYING NATURE

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

Electronic Mediations

Series Editors: N. Katherine Hayles, Peter Krapp, Rita Raley, and Samuel Weber
Founding Editor: Mark Poster

58 *Playing Nature: Ecology in Video Games*
ALENDA Y. CHANG

57 *Sensations of History: Animation and New Media Art*
JAMES J. HODGE

56 *Internet Daemons: Digital Communications Possessed*
FENWICK MCKELVEY

55 *What Is Information?*
PETER JANICH

54 *Deconstruction Machines: Writing in the Age of Cyberwar*
JUSTIN JOQUE

53 *Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Breaking Videogames*
STEPHANIE BOLUK AND PATRICK LEMIEUX

52 *The Perversity of Things: Hugo Gernsback on Media, Tinkering, and Scientifiction*
HUGO GERNSBACK, EDITED BY GRANT WYTHOFF

51 *The Participatory Condition in the Digital Age*
DARIN BARNEY, GABRIELLA COLEMAN, CHRISTINE ROSS, JONATHAN STERNE, AND TAMAR TEMBECK, EDITORS

50 *Mixed Realism: Videogames and the Violence of Fiction*
TIMOTHY J. WELSH

49 *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet*
JENNIFER GABRYS

48 *On the Existence of Digital Objects*
YUK HUI

(*continued on page 295*)

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

PLAYING NATURE

ECOLOGY IN VIDEO GAMES

Alenda Y. Chang

Electronic Mediations 58

UNIVERSITY OF MINNESOTA PRESS
MINNEAPOLIS • LONDON

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

Every effort was made to obtain permission to reproduce material in this book. If any proper acknowledgment has not been included here, we encourage copyright holders to notify the publisher.

Different versions of portions of the Introduction and chapter 1 were previously published as "Games as Environmental Texts," *Qui Parle* 19, no. 2 (Spring/Summer 2011): 57–84. An earlier version of chapter 2 was previously published as "Think Galactically, Act Microscopically? The Science of Scale in Video Games," *Sustainable Media*, ed. Janet Walker and Nicole Starosielski, 215–31 (New York: Routledge, 2016). Portions of an earlier version of chapter 4 were previously published as "Back to the Virtual Farm: Gleaning the Agriculture-Management Game," *Interdisciplinary Studies in Literature and Environment* 19, no. 2 (Spring 2012): 237–52, reprinted by permission of Oxford University Press.

This project was supported in part by funding from the University of California Presidential Faculty Research Fellowships in the Humanities, MR-15328710.

Copyright 2019 by the Regents of the University of Minnesota

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

Published by the University of Minnesota Press
111 Third Avenue South, Suite 290
Minneapolis, MN 55401-2520
http://www.upress.umn.edu

Printed in the United States of America on acid-free paper

The University of Minnesota is an equal-opportunity educator and employer.

Library of Congress Cataloging-in-Publication Data
Names: Chang, Alenda Y., author.
Title: Playing nature : ecology in video games / Alenda Y. Chang.
Description: Minneapolis : University of Minnesota Press, [2019] |
Series: Electronic mediations ; 58 | Includes bibliographical references and index.
Identifiers: LCCN 2019007795 (print) | ISBN 978-1-5179-0631-3 (hc) |
ISBN 978-1-5179-0632-0 (pb)
Subjects: LCSH: Nature in video games.
Classification: LCC GV1469.34.N37 C43 2019 (print) | DDC 794.8—dc23
LC record available at https://lccn.loc.gov/2019007795

UMP BmB 2019

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

For Ed
who made this possible

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:07 UTC
All use subject to https://about.jstor.org/terms

Contents

	Introduction: Edge Effects	1
1.	Mesocosm	17
2.	Scale	69
3.	Nonhuman	107
4.	Entropy	145
5.	Collapse	187
	Acknowledgments	237
	Notes	241
	Gameography	275
	Index	283

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:10 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:10 UTC
All use subject to https://about.jstor.org/terms

Introduction

Edge Effects

> Perhaps it is precisely in the realm of play, outside the dictates of teleology, settled categories, and function, that serious worldliness and recuperation become possible.
>
> —DONNA J. HARAWAY, *Staying with the Trouble*

Walden is now a video game, and that's really not as heretical as it sounds.

In April 2016, I watched as Tracy Fullerton, director of the Game Innovation Lab at the University of Southern California, ambled through a nearly complete prototype based on Henry David Thoreau's classic nature memoir, *Walden.*[1] Fullerton is one of the first game designers to receive funding under revised and more inclusive National Endowment for the Humanities grant guidelines, and she and her team have spent more than a decade transforming this staple of nineteenth-century American literature into a compelling playable experience. Over the years, they have purposefully engaged with a diverse network of specialists, not just game designers and developers, but also experts on Thoreau's life and literary philosophy. Even those unfamiliar with Thoreau's writing are likely to associate him with his two-year stint at Walden Pond in Concord, Massachusetts, from late March 1845 to September 1847, what he dubbed an experiment in self-reliance but what today we might anachronistically label "going off the grid" or an early form of survivalism. And despite some recent disfavor, Thoreau remains an indispensable name in the nature-writing canon.[2] *Walden, a game* was released in July 2017 to coincide with the bicentennial of Thoreau's birth, and has since garnered

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

numerous awards, including Game of the Year at the 2017 Games for Change Festival and Best Overall Game at the 2018 Intentional Play Summit. Yet if the idea of living deliberately in nature through a video game still seems a little farfetched, this book will endeavor to understand why it should not, and to articulate a new rationale for digital environmental play.

To begin with, most of us reflexively treat nature and technology as mutually exclusive realms. Technology, particularly electronic technology, figures as the apotheosis of either human megalomania or human ingenuity, depending on your attitude toward post-industrial capitalism, while nature historically has oscillated between being that which is (terrifyingly or reassuringly) beyond human control and that which is expressly subject to such control. The human occupies an uneasy and liminal position in this dichotomy—sometimes natural, sometimes not, at once the supreme artificer and humbly beholden to circumstance. Evidence of these deeply rooted assumptions is pervasive and mundane: you might get dark looks for using a phone while walking in the woods; heroic caregivers try to divert children from staring at screens with the injunction to spend more wholesome time outdoors; and video games, whether played on computers, consoles, mobile devices, or arcade cabinets, are reviled as the most unnatural of offenders against environmental communion. Indeed, most people now live in cities or incorporated areas,[3] 95 percent of Americans now own a cellphone (77 percent own a smartphone, up from just 35 percent in 2011), and nearly three-quarters of American adults own a desktop or laptop computer.[4] Scores of analysts have shown how difficult we find it to detach ourselves from our electronic devices, and our corresponding tendency to look to the outdoors for a vital sense of *dis*-connection in our otherwise always-on, continuously plugged-in lives. Yet even as we romanticize the salutary effect of fresh air and greenery, nature as depicted and animated in all manner of media has only grown more and more prevalent—and, I would add, inviting.[5] How is it, then, that the video game—a cultural form that matured in the same period as modern environmentalism and the academic disciplines of environmental science and environmental studies, but remains the most polarizing of media in its relation to the ideal of unmediated natural experience—has never been explicated in such terms?

Playing Nature is my attempt to bridge the nature–culture divide in the study of games.[6] As the example of *Walden, a game* begins to demonstrate, games, like the natural world, can provoke curiosity, interaction, and reflection. Thoreau's self-described experiment in independent living makes sense

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

as a game, because games are themselves open-ended and existential experiments that combine subjective and objective facets of everyday experience. In *Walden, a game*, you play as Henry himself, in the same period during which he lived at Walden Pond. The available tasks are drawn from his documented activities—finish constructing the cabin, grow or gather food, walk the woods, visit town, or row on the pond. Players must decide for themselves how much time and energy they will devote to wage-earning labor, which enables the purchase of conveniences like better tools, versus living more simply and cheerfully within cruder means. Exploring the surrounding land reveals Native American arrowheads that unlock tidbits of Thoreau's journals and some of his literary influences. In one of the most interesting mechanics of the game, exploration and reading raise Henry's inspiration level, while too much work leads to dispiritedness. Both states are reflected in the game's visual environment, with inspiration characterized by a rosier tinge and dispiritedness reflected in a world literally drained of color. Although you cannot die in *Walden, a game*, you can grow feeble and faint from exhaustion.

For those versed in Thoreau's Transcendentalist principles, derived largely from his friend and mentor Ralph Waldo Emerson and characterized by solitary communion with nature and a corollary disdain for society and worldly goods, a game may seem the furthest thing from an appropriate homage to his environmental philosophy. PlayStation marketers even capitalized on this obvious incongruity when *Walden, a game* was released for the PlayStation 4 in May 2018, by taking up one reviewer's quip that the game was "The world's most improbable video game."[7] However, Thoreau's many aims, to escape the drudgery and for him soul-killing nature of daily work for wages, to explore and know the natural world within walking distance of his home, and to avoid unnecessary social contact, are arguably compatible with the stereotyped qualities of games—after all, his tenure at Walden Pond was, in some sense, playful, escapist, and antisocial. At the same time, Thoreau surreptitiously sought out human contact and did not shirk from manual labor and exercise, building his one-room cabin, planting beans, fishing and sounding the pond, and, of course, roaming the countryside, often for many miles at a time. While he often appeared to prioritize physical contact with the world, he also on occasion rhapsodized on the border between mediation and materiality, as in the serialized account of his trip to Maine's Ktaadn peak: "Talk of mysteries!—Think of our life in nature,—daily to be shown matter, to come in contact with it,—rocks, trees, wind on our cheeks! the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC 56 UTC
All use subject to https://about.jstor.org/terms

solid earth! the *actual* world! the *common sense! Contact! Contact! Who* are we? *where* are we?"[8] As we will see in chapter 1 with the uproar over "walking simulator" games (of which *Walden, a game* is an example) and the surprising health benefits of exposure to virtual environments, games are intermediary objects through which swirl both imaginative fantasy and real activity and places, with real, if not directly predictable effects. Put in the language of Thoreau's rapturous cries, are we not, in playing games, shown matter, and also coming into contact with it? We may choose to play deliberately, and when we do, we underscore the slippage between solitude and community, wildness and civilization, matter and media, not unlike Thoreau himself.

Predictably, most environmental educators and other advocates of unmediated natural experience are loath to acknowledge these possibilities. Enough readers sympathize with Richard Louv's pronouncement in *Last Child in the Woods*—that generations born since the 1970s are victims of what he calls "nature-deficit disorder"—to make his books national and international bestsellers, despite the pseudo-medical character of the diagnosis, designed to echo the alarm over attention deficit hyperactivity disorder.[9] Primed to fear their own or their loved ones' arrested development, Louv's supporters presumably share both his apportioning of the blame and his proposed solutions. Thus the primary culprits behind "NDD" are television and the electronic devices that have indeed come to occupy a disproportionate amount of our time. And the antidote? "Vitamin N," where N stands for a distinctly capital-N Nature, one that long ago went out of fashion in environmental history and philosophy. Louv's work has sparked valuable efforts to reclaim wild land for the education and spiritual growth of young people, but a crucial problem remains in that Louv, like the nature–technology dichotomy itself, leaves little room for forms of media to be productive agents for social and environmental change.[10] Significantly, many of the advantages of natural experience that Louv celebrates can be found in computer and video games—free, unstructured play without adult supervision; a chance to learn about natural processes and life cycles, or how people, animals, plants, and inorganic matter are connected; educated mentorship, or a guiding presence knowledgeable enough to provide more information about what one is experiencing; and hands-on activity with actual consequences. Although game environments, no matter how lovingly realized, are not substitutes for direct experience of the natural world, more and more

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

people are turning to simulated worlds not only for entertainment but also for challenge, companionship, and even civic participation—why not embrace and encourage game design in forms that recall our favorite modes of natural play? As the many examples detailed in this book will reveal, games can offer a compelling way to reconcile a deep connection to nature and the nonhuman world with an equally important connection to technology and the virtual. Even Louv might agree that this is a defining dilemma of our times, or at least of the generations raised with a walking stick in one hand and a joystick in the other.

What fears over the insular artificiality of games (and by extension, other electronic media) fail to acknowledge is that games have undergone a cultural transformation, from being a largely private and youthful subculture to being a ubiquitous phenomenon that now spans domestic and public space and all demographic categories. Those who have reported on the rise in casual and mobile gaming have captured the technological, social, and ontological shifts in the nature of games and game devices, without necessarily recognizing that these shifts could also be characterized in part as a changing relationship between players and play spaces, and between real and virtual worlds. Games researchers could learn a great deal from television studies in this regard. Scholars like Lynn Spigel, Sheila Murphy, and Anna McCarthy have amply charted television's fascinating march from the fifties living room to public "nonspaces" and digital platforms. Inasmuch as gaming is a televisual phenomenon, games have undergone a similar expansion from domestic to "public" space,[11] and it remains to be seen how the increasing convergence between game worlds and real locations will affect both games and everyday life. Where McCarthy was intent on excavating site-specific practices of watching in chronicling television's lives outside the home, labeling it "ambient" TV, we might as readily discern a trend toward "ambient" gaming, with all of the auditory and environmental connotations the term usually carries. Of course, games have always been ambient, or they have always been part of their surroundings, but the restrictions and cultural mores that once relegated games to arcades, bedrooms, basements, and designated game nights have eased. From live-action role-playing, affectionately known as LARPing, to "BarCrafting," the familiar prosocial practice of gathering to watch competitive league matches at bars (in this case of Blizzard Entertainment's long-running *StarCraft* [1998] games), to the fugue-like wandering of people playing augmented-reality games such as Niantic's *Pokémon Go*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

(2016), the old assumption that games are escapist fantasies defined mainly by their narrative fictions no longer holds as solidly as it once did. Whether it involves watching a computer or video game in a crowd or at home, using a phone or other mobile device to play games, taking part in an alternate-reality game, or indulging in some costumed creative anachronism, it is clear that the world in which we walk, gesture, observe, and act is more than ever constitutive of the game experience. Eventually, ambient gaming will come to seem less a novelty or a limit case than a common state of affairs.

Yet what follows is not chiefly a cultural geography of games, but rather a foray into developing analytical frameworks for games that cull from the evolving fields of ecology and environmental science. Tellingly, in 2008, in the midst of an efflorescence in video game scholarship, noted game designer and researcher Katie Salen Tekinbaş released an edited volume entitled *The Ecology of Games: Connecting Youth, Games, and Learning.*[12] As part of a MacArthur Foundation series on digital media and learning, the book gathered important contributions from experts in the cultural anthropology and educational potential of play, among them Mizuki Ito, James Paul Gee, Kurt Squire, Jane McGonigal, and Ian Bogost. Missing, however, was any substantive engagement with ecology, per se; for Salen and the series editors, ecology functioned as convenient shorthand for the interconnectedness of media technologies, young consumers, and the sociocultural contexts of play. Without denying the value of the volume or the broad, media ecological take on media forms, user communities, and practices, the work ahead asks what it would mean to take seriously the idea of an ecology of gaming, one in which the term ecology required little qualification. What new or neglected aspects of games and gaming might ecology, for now defined as the science of interrelation between organisms and between organisms and their environments, enable us to see?

For one, it would allow us to think in a more sophisticated way about game environments, which continue to grow more computationally and graphically complex, but often rest on relatively simplistic environmental models, for instance, those of resource extraction (where the game world is primarily a source of building materials) or visual spectacle (where the game world is primarily a scenic backdrop to player action). Ecology and its sister disciplines would also help us to reframe games beyond the domestic interior. We still tend to imagine gaming within the home, with players hunched at desktop personal computers or lounging in front of the living room television,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

but computer and console play has in large measure been challenged by new forms of mobile gaming. Experimental games across diverse platforms have also progressively enfolded more and more of the outside world, whether as inspiration, model, or the space of play itself. Finally, for those invested in both media analysis and environmental literacy, an ecological perspective on video games might cement games' place alongside more mature media like film and television, where maturity is defined not only by aesthetic development but also the capacity for sociopolitical relevance.

Anthromes

In the same year in which *The Ecology of Games* was published, the environmental scientists Erle Ellis and Navin Ramankutty authored the lead paper in the journal *Frontiers of Ecology and Environment*. Their paper, entitled "Putting People in the Map," introduced the concept of anthropogenic biomes, or anthromes, as a replacement for the standard system of natural biomes based on vegetation, climate, and geology.[13] Ellis and Ramankutty were well aware that their new system, while commonsensical, flew in the face of generations of ecological and earth imaging tradition, a tradition that normally excludes humans in its focus on nonhuman species and environments. Like the Anthropocene, which scientists Paul Crutzen and Eugene Stoermer proposed in 2000 as a more accurate name than the Holocene for our current, human-dominated geological epoch,[14] the term "anthrome" suggests that human beings have had such an enormous impact on the Earth's surface that it no longer makes sense to speak of our world without reference to our planet-changing ways. Unlike regional biomes dictated primarily by climate and terrain, anthromes are also determined by the density of human settlement and human activities such as farming and herding.

An important corollary to this reclassification, in Ellis and Ramankutty's view, is ridding ecology of the antiquated but persistent notion of our environment as "natural ecosystems with humans disturbing them." Instead, as they explain, "Anthropogenic biomes tell a completely different story, one of 'human systems, with natural ecosystems embedded within them.' This is no minor change in the story we tell our children and each other. Yet it is necessary for sustainable management of the biosphere in the 21st century."[15] In the end, Ellis and Ramankutty propose eighteen classes of anthropogenic biomes, of which only three are categorized as "wildlands." Sparsely and completely unpopulated areas are far outnumbered by various kinds of "dense

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

settlements," villages, croplands, and rangelands. Still, the authors carefully explain that the old categories of wild biomes, for example, the boreal, polar, and tropical, are not obsolete, but rather incomplete. Given that humans have settled or modified nearly four-fifths of the world's ice-free land, congregating in fertile regions and creating "mosaic" landscapes studded by different kinds of land use and natural features, to willfully exclude humans and human impacts from ecological study not only seems like poor science, but also limits our understanding of the full range of ecological interactions. Human and nonhuman futures, they note, will only grow more entangled, and we desperately need the knowledge to support coexistence. Ellis and Ramankutty thus end their paper with a call reminiscent of criticisms often leveled at travel writing, documentaries, anthropological fieldwork, and environmental activism: "Ecologists have long been known as the scientists who travel to uninhabited lands to do their work," they write, but now it is time for ecologists to "go home!" In other words, "ecologists can and should do more to 'come home' and work where most humans live."[16]

On the surface, little seems to connect Ellis and Ramankutty's anthrome manifesto and Katie Salen Tekinbaş's social design perspective on games. Yet both invoke ecology to gesture at the complex interrelation of human and nonhuman actors, contexts, and things. As I will argue throughout this book, ecology and environmental science offer compelling ways to understand game worlds, beyond the mostly metaphorical paradigm of media ecology and even spatially informed traditions of environmental storytelling, as seen in theme park design. Already, for example, some contemporary games like *Don't Starve* (2013) and *Minecraft* (2011) have adopted the language and structure of natural biomes (Figure 1). However, these game biomes would be more precisely classed as anthromes, given that their express purpose is to support player activity, and their complicated, even oxymoronic condition of natural artifice. In this way, a recent concept from the scientific universe usefully foregrounds the constructedness of even the wildest game worlds, while acknowledging the defining give-and-take that occurs between players and game environments, as it does between humans and real environments. Games, it turns out, inadvertently but aptly emblematize one of the ongoing debates in ecological circles regarding community classification and human practice.

In keeping with this book's theoretical emphasis on ecology and environmental mediation, the chapters ahead focus on not only traditional digital

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

Figure 1. The meeting of three biome types (forest, ocean, and savanna) in Klei Entertainment's survival game *Don't Starve*.

games—games reliant on electronic components and the computational processing of modern computers, ordinarily called computer or video games—but also analog games, mobile games, alternate-reality games, augmented-reality games, "biotic" games, and outdoor play. Common to all of these latter genres is an interest in weakening or even collapsing the fourth wall between play and reality, whether that means playing while walking, interacting with living organisms, or building games that bridge built and natural landscapes. Digital games will still figure largely in the following pages, but so too will board games, card games, games played with microscopes, games exhibited at museums and gardens, and even escape rooms. After all, digital games did not become mainstream objects until the 1970s, while play has been central to human culture for millennia (take the board games Senet, Backgammon, and Go, all played thousands of years ago in what is today Egypt, Iran, and China, respectively). The first prototypes of digital games were only created in the 1950s and 1960s, with games like *Tennis for Two* (1958) and *Spacewar!* (1962), and they were often accessible only to a small group of programmers and engineers. Since then, even though digital games have greatly proliferated in terms of both quantity and variety, we would do well to remember that digital games are just a subset of games, in general, and that games are themselves a subset of playful activity. Along similar lines, academic writing

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

on computer and video games emerged only toward the end of the twentieth century, while scholarly interest in play and games extends at least as far back as Plato.[17] The earliest treatments of computer and console games from designers and theorists like Katie Salen Tekinbaş and Eric Zimmerman, Espen Aarseth, Alexander Galloway, Noah Wardrip-Fruin, Ian Bogost, and Jesper Juul all attempted to isolate the distinctive characteristics of digital games as a new form, while social scientists, ethnographers, and behavioral researchers like Constance Steinkuehler and Dmitri Williams, Nicholas Yee, Edward Castronova, and T. L. Taylor devoted their attention to player populations and the dynamics of virtual worlds.[18] Much of this work helpfully countered the usual criticisms leveled at games, that they are lowbrow popular indulgences, suitable only for frivolous-minded youth, in favor of extolling games and their ability to generate creative player behavior and to enact rhetorical arguments in a distinctively interactive medium.

That said, formal interest in the medium's technological and narrative specificity and social interest in player behaviors and attitudes have dominated game studies since its inception, to the detriment of other modes of scholarship. In *Playing Nature*, I consider the ecology of games in a more literal sense not to indulge in either a theoretical conceit or a positivistic recourse to the "hard" sciences. Instead, I employ it as an exciting means to displace our existing understandings of games, players, and play contexts using a vital and widely accessible framework for describing interaction across species, scalar levels, and ontological categories. My work suggests that, while there are many reasons why game studies and environmental criticism have had little congress to date, none of those reasons are particularly unyielding, and we will be amply repaid if we move past the assumption that the natural and the digital are realms inherently inimical to each other. At the same time, there has been an upwelling of interest in the environmental humanities, a positive sign that humanists refuse to be sidelined in the collective response to environmental quandaries. Yet these approaches have also largely passed over game environments as environmental media on par with nature writing, documentary film, and place-based art. As I will argue in chapter 1, although some of the most sophisticated scholarship on natural representation has evolved within literary environmental criticism, sometimes simply called ecocriticism, ecocriticism has historically excluded designed landscapes and methods of mediated interaction perceived as detracting from direct experience of the natural world. Much the same is the case with

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

environmental education and activism, where technology is typically cast as the enemy already within the gate, and until recently, new media theory and practice, which often overlook the ways in which emerging technologies are dependent on natural systems. All of these tendencies speak to the tenacity of the human cultural bifurcation between nature and technology.

Chapter 1 thus sets forth my core argument that games straddle multiply real and imagined worlds and therefore can be uniquely illuminated by both scientific and literary theories engaged with environmental questions. We humans may have crept inexorably into all aspects of the world around us, but the first chapter reminds us that the world has also inevitably permeated into our technical artifacts, including games. Scholars of literature have for decades already puzzled over the pleasures and pitfalls of environmental representation in poetry and nature writing, and their longstanding conversations will help me to establish some early and important limit cases for my approach to game environments, both regarding the role of graphics, and to a lesser extent the historical contexts for game development and reception. Literary analysis turns out to be especially fitting when discussing the text-based dungeon of one of the earliest computer games, *Adventure (1975–76)*, and as a medium that has lost its formal salience after hundreds of years of relative ubiquity, the printed word provides a convenient bridge between the well-traveled terrain of literary criticism and its associated gravitas and the still volatile and undertheorized realms of digital entertainment. Put another way, debate over the nature and value of environmental mediation is hardly new, although video games present a novel and particularly unwelcome challenge to proponents of direct contact with the natural world. The first chapter in particular uses the ecological concept of the *mesocosm*, or an experimental enclosure halfway between unbounded nature and the tidy lab setup, to frame games as boundary objects that facilitate passage between the material and seemingly immaterial contexts of the physical world and virtual playspace.

Acknowledging that ecology's history and lexicon are themselves considerable subjects for study, chapter 2 presents a more tractable model of ecological game analysis by examining game environments from the standpoint of *scale*. Although I concede that scale is a notoriously contested term in both science and social science, it also highlights a significant environmental affordance of games, namely their knack for dramatizing life in many dimensions. A game like Maxis's *Spore* (2008) allows us to perform an ecological

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

version of vertical integration, in the process urging us to mind our origins as well as organisms and natural phenomena both great and small. Extending that multiscalar outlook, chapter 3 goes on to chart the growing intersections between game studies and theories of *nonhuman* or *more-than-human* life and worth, among which I include animal studies, some variants of posthumanism, and recent philosophical churnings in speculative realism and new materialism. Ecology itself has always skewed toward the nonhuman, although Ellis and Ramankutty's anthrome taxonomy and the growing subfields of change and restoration ecology demonstrate that many baseline assumptions within the environmental sciences, about humans and their proper place in the world, are gradually shifting. I examine increasingly inventive scenarios for animal, vegetable, and mineral play, while suggesting that games also exhibit nonhuman agency as a manifestation of software, hardware, and infrastructural processes, and may thereby call attention to heterogeneous and diffuse webs of influence that go far beyond the human, and even the living. Accordingly, chapter 4 takes up the concept of *entropy* to convey often-neglected material aspects of games and game platforms, from sourcing and disposal in game manufacturing to the omission of waste and bodily disorderliness from the experience of play. As a case in point, I consider the postmillennial outpouring of casual games, in particular the farm game and its egregious abstraction from the realities of environmental degradation and exploited labor. Finally, in chapter 5, I close by considering ecological notions of *collapse* and how they figure in games, not only through narratives and spectacles of destruction and decay, but also through experiments in game life and death, either of the player-character or the game world. Rather than replicate the apocalyptic tone of a great deal of contemporary environmental discourse, I argue that failure and loss as felt through play can lead to a collective, multispecies, and multiscalar awareness that promises hope in the face of ecological precarity.

Effective Edges

A last concept borrowed from ecological jargon bears mentioning at the start, both as a caveat and a design directive. Imagine having to set up an aquatic experiment on the feeding habits of freshwater fish. One could attempt to study these behaviors in the wild, using tried-and-true methods of field observation; one could cordon off part of the environment in question, sacrificing some fidelity to natural conditions for experimental tractability; or

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

one could, as many ultimately do, opt to use aquariums built to closely resemble the desired ecosystem. Particularly in the latter two circumstances, one is likely to encounter phenomena produced by the very act of enclosure, not unlike the more abstract principles popularized by physicists Niels Bohr, Erwin Schrödinger, and Werner Heisenberg noting the inevitable impact of measurement on that which is being measured.[19] In terms of a hypothetical fish tank, picture researchers coming in one morning to find that nearly all of one prey species had been eaten overnight! After careful replication, they might discover that the species tends to congregate in unusually large numbers at the tank walls, making them easy targets for predation. Scientists call these kinds of effects *edge effects*, and use them to describe life at the boundary zones between distinct ecosystems (say, between forest and meadow) as well as the unwanted experimental artifacts created by the presence of margins in mesocosm (chapter 1) and laboratory studies. Of course, outside of biological experiments, humans create edges all the time. Our buildings, farms, power lines, and roads have carved innumerable hard contours out of other species' habitats, which have had diverse ripple effects—some species may thrive in the resulting zones of disturbance, while others fade away.

Consider a much grander-scale experiment in environmental edge-making. In the late 1970s, ecologist Thomas Lovejoy and his collaborators embarked on what has been called "the largest and longest-running experiment in tropical ecology" and "the most important ecological experiment ever done,"[20] essentially clear-cutting the land around almost a dozen parcels of otherwise intact Amazon rainforest in order to study the long-term effects of habitat fragmentation (Figure 2). As Lovejoy and his students discovered, even though the rainforest parcels were untouched by cutting and burning, clearing around them left them isolated and weakened. In essence, they were islands, exposed on their perimeters and left vulnerable to colonization by "invasive" species.[21] Some four decades later, the Biological Dynamics of Forest Fragmentation Project continues, and is credited with producing generations of "fragmentologists," scientists whose primary focus is the impact of human settlement and activity on habitat and species distribution. Lovejoy's work has proven central to what is now known as the SLOSS (Single Large or Several Small) debate, namely, whether conserving one large area or many small areas works to better preserve natural environments and functions.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

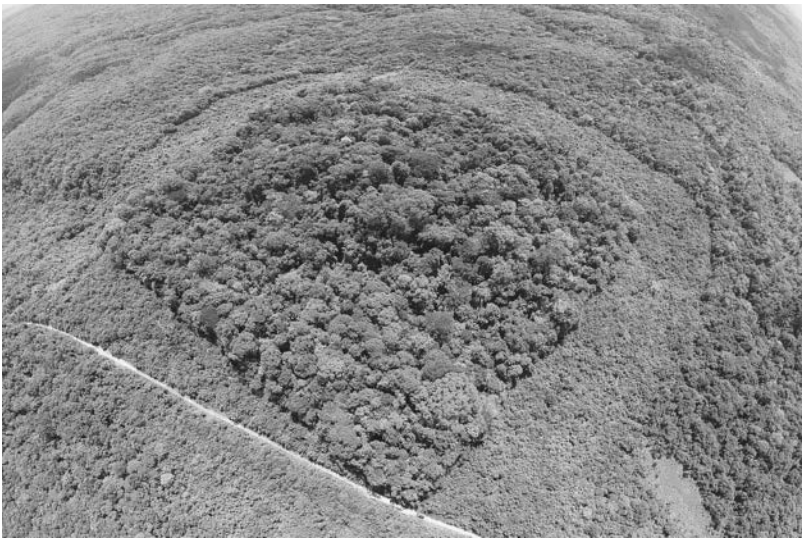

Figure 2. Edge effects created in the long-running Biological Dynamics of Forest Fragmentation Project in the Brazilian Amazon. This ten-hectare forest fragment at the Amazon Biodiversity Center's research reserve was captured by unmanned aerial vehicle. Photograph by Luciano Lima.

As I will elaborate further in chapter 1, game environments share more than a passing resemblance to Lovejoy's forest fragments. Even as many designers and critics emphasize the immersive qualities of virtual experiences and our propensity to forget their outer limits,[22] we ought to attend simultaneously to these limits as a way of thinking through what games are and how they relate to nongame contexts. To characterize games as having both distinct and indistinct edges is to inadvertently assess the benefits and drawbacks of ludic environmental simulation. Seen one way, games can only be impoverished shadows of the real. Unlike the edges spoken of in new media theory (abstract lines that connect nodes on a network diagram) or game studies (the spatially and temporally demarcated "magic circle" in which play occurs),[23] ecological edges are by definition untidy and can be places of increased contest and attrition as well as greater productivity. For biologists, especially those embroiled in the SLOSS debate over reserve size and arrangement, connectivity is less a matter of routers and broadband infrastructure than literal habitat contiguity. Yet in games, abstraction may also be

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

a boon, distilling the overwhelming scope and massive data of real-world phenomena into manageable experiences. For Lovejoy, the introduction of synthetic edges led to pernicious "simplification" as specialist species in the forest remnants were driven out by generalists and pioneers. The parallel process of differentiation in game production is arguably constitutive of games' aesthetic value. These two readings—game as debased copy, game as artful imitation—are fractious neighbors, neither likely to displace the other. Here, biogeochemical edge effects are a means to resituate games as living artifacts, and to raise critical questions at the threshold of the magic circle: how virtual is the virtual when the ubiquity of digital technology is premised on globe-spanning resource extraction and waste? Are the integrity and joy of play sacrificed by exposing games to the real world, as argued in critiques of gamification, playbor, and even serious games? Would ecologically minded games represent mere slacktivism, or might they propel us past the confines of "fun" to live and act differently?

The impetus to study games as environmental mediators stems only in part from their tremendous popularity. Granted, for many people, the hours spent in game environments vastly outnumber those spent in wilderness areas, or engrossed in books, movies, and television. Like all other forms of mass media, games encapsulate tacit ecological lessons that partially shape our sense of environmental self-efficacy. From education and communication perspectives, games offer less didactic, less moralizing, and therefore less off-putting ways to encourage people to consider environmental problems and their solutions. Games and digital media more broadly leverage unique affordances that enable often abstract information and otherwise distant threats of ecological calamity to take very real and even operable form, combating the twin hazards of apathy on the one hand ("I live in Minnesota. Why should I care about a hole in the ozone above the South Pole?") and paralysis on the other ("What difference can one person possibly make?"). But most important, computer and video games present a rich limit-case for the claims of environmental scholarship—ontologically and epistemologically speaking, they are a place where the natural and the digital collide and prompt careful reexamination of our assumptions about nature, realism, and the virtual.

In the chapters ahead, I will detail how studying games through an environmental lens suggests several methodological transects for games, approaches that cut across the historical ludology versus narratology conflicts in game

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

studies and widen the discussion around games to include environmental scientists, historians, educators, and advocates.[24] This will require drawing insights from fields as diverse as literary criticism, ecology and environmental science, film and media studies, and environmental philosophy. Notably, that does not mean I will limit my analysis to games with clear environmentalist or activist agendas, worthy though those may be. Neither will I attempt an encyclopedic or taxonomic project that systematically examines all games by genre or core mechanics, aesthetics, or material provenance. Rather, *Playing Nature* proposes new methods and objects for environmental inquiry through ecologically informed engagement with video game worlds. It is a call to game researchers to expand the usual ambit of their investigations, and a call to scholars in the environmental humanities and sciences to consider cultural forms hitherto deemed irrelevant, or worse, abhorrent. My hope is that it will also provide a theoretical blueprint for innovative game design. Given the present, fraught historical moment, in which scientists, activists, and educators are often stymied in their efforts to depict the scope and urgency of global environmental crisis, games remain largely untapped in terms of their potential to create meaningful interaction within artificially intelligent environments, to model ecological dynamics based on interdependence and limitation, and to allow players to explore manifold ecological futures—not all of them dystopian.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:31 UTC
All use subject to https://about.jstor.org/terms

1

Mesocosm

> Things don't have purposes, as if the universe were a machine, where every part has a useful function. What's the function of a galaxy? I don't know if our life has a purpose and I don't see that it matters. What does matter is that we're a part. Like a thread in a cloth or a grass-blade in a field. It is and we are. What we do is like wind blowing on the grass.
>
> —URSULA K. LE GUIN, *The Lathe of Heaven*

Displayed on a wall in the Exploratorium science museum in San Francisco, greenish oblong microorganisms appear to be swimming around on a magnified field, and I watch with delight as they scoot away from a sudden swoop of bright light. A player is running her fingers across a giant touchscreen rigged to a microscope-turned-projector, creating light barriers that effectively repel these photosynthetic protists, known to scientists as *Euglena gracilis* (Figure 3). This exhibit, part of a new breed of "interactive biology" or "tangible biology" games coming out of Ingmar Riedel-Kruse's bioengineering lab at Stanford University,[1] and its emphasis on real-time, optical-haptic, and ultimately playful interactions with living organisms, for me perfectly dramatizes what has always been true, but is now becoming increasingly visible—namely, the permeability between game environments and real environments. Acknowledging that games may be part of one's everyday ambient experience leads in this chapter to the related scientific framing of the mesocosm, which I suggest is central to an environmental understanding of games and gameplay.

In ecology, mesocosms are experimental enclosures intermediate in size and complexity between small, highly controlled lab experiments and large, often unpredictable real-world environments. Historically, aquatic mesocosms

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Figure 3. Ecologist Danielle Christianson interacts with living microbes in the East Gallery Corridor of the San Francisco Exploratorium in 2018. The "Visitor Interactions in Microbiology" project prototype was organized by the Riedel-Kruse lab at Stanford University and Senior Researcher in Visitor Research and Evaluation Joyce Ma, as part of the museum's "Cells to Self (Living Systems)" collection.

have been the most successful, although terrestrial mesocosms are also used, and while some mesocosms are small enough to fit in the lab—say, a vat of algae grown in pumped pond water, left under a sunny window—most attempt to impose artificial boundaries on habitats in the field (Figure 4). For researchers,

> Such mesocosms provide a powerful tool to link between in situ but often only correlative field studies on the one side, and small-scale far from natural laboratory experiments including a single or a few species only, on the other side. Thus mesocosm studies have the advantage compared to laboratory approaches that [*sic*] it maintains a natural community under close to natural conditions, taking into account relevant aspects from 'the real world' such as indirect effects, biological compensation and recovery, and ecosystem resilience.[2]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Of course, there are also latent drawbacks to using mesocosms. As briefly outlined in the introduction, scientists are well aware that wall or edge effects may affect the relevance of a mesocosm to natural circumstances. In their retrospective analysis of two aquatic mesocosm experiments, Matthew C. Watts and Grant R. Bigg note several difficulties, from bags of water prone to cutting out light for photosynthesis to mesocosms' vulnerability to "mixing regimes," for instance through storm events. Watts and Bigg express concerns over the ability of mesocosm experiments to scale up to "oceanic conditions," but eventually allow that they may have some use, particularly if the experimental design is first run past modelers so that appropriate data can be gathered to later test the validity of findings.[3] In a discussion of mesocosm-based climate research, Rebecca Stewart and her coauthors take a similarly targeted view. For their purposes, "realism is used in the sense of the ability to reproduce key properties of natural systems."[4] It is in this manner that I would argue that games, like mesocosms, are "mini-ecosystems"—functional arenas of a size usefully intermediate between field experiments

Figure 4. A floating structure containing twelve outdoor pelagic/marine mesocosms in western Norway, run by the University of Bergen Mesocosm Centre. Photograph by Dr. Stella A. Berger.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

and laboratory conditions, which replicate select aspects of the surrounding world.

Designating game environments as mesocosms is, perhaps, simply another way of stating what many researchers have said before—namely, that games represent some combination of the "real" and the simulated, from Jesper Juul's "half-real" and Edward Castronova's synthetic worlds to the ubiquitous "virtual worlds" of massively multiplayer online games (MMOGs). Again, however, my purpose is not to use ecology as mere rhetorical embroidery—although it may function analogically, I wish to take seriously the premise that games and scientific experimentation are cut from the same cloth. The term mesocosm in this context should do more than acknowledge the permeability of games' "magic circle," as first famously proposed by Dutch historian Johan Huizinga in *Homo Ludens* and ever since regularly aired and debunked by researchers interested in the social, political, and economic aspects of games and player behavior. Describing games as mesocosms is for me an ideal way to characterize the subtle negotiations that take place between human and nonhuman actors and technological assemblages during play, while also taking into account diverse situational and interpretive contexts. Rather than see games as real rules embedded in fictional worlds, as Juul does, we could make the case that games blend real worlds and fictional rules. This is strikingly apparent, for instance, in farm games (chapter 4), where the playable terrain of orderly farms and fields is unquestionably of our world, while the rules are not—farmers and plants always prosper, despite the fact that in the first *FarmVille* (2009), you did not even have to water your crops. Needless to say, game worlds like *The Legend of Zelda*'s (1986) Hyrule or *World of Warcraft*'s (2004) Azeroth are not real, in any conventional sense, but I would argue that even entirely fictional game environments are experienced *as* real, something that Castronova also concludes in his socioeconomic studies of massively multiplayer online roleplaying games (MMORPGs) and his discussion, and ultimate rejection, of the term "virtual reality."[5] What's more, Juul's real-rules-and-fictional-worlds paradigm treats only games themselves, neglecting the multilayered reality of both players and the contexts of play.[6] Like the early sound studies theorists who charted music's passage from the living room and bedroom to car and street,[7] this book considers how the very act of playing (and making) games has increasingly moved from private into public spaces, and from the indoors out.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

To this end, this chapter brings literary environmental criticism into conversation with discourse about media and mediation in order to better describe the mesocosmic qualities of games, in particular game landscapes, locations, and navigational strategies. I look deeply at a classic text game from the 1970s, a contemporary art game for the PlayStation Network, and the "first-person walker" *Firewatch* (2016), as well as at the growing ranks of alternate- and augmented-reality games, in order to assess seriously digital games' capacities for environmental representation, from their knack for drawing attention to the ways in which we traverse and occupy space to their startling ability to express significant ties to real places. Like portions of a field sectioned off for study, or partially enclosed waters, game ecologies toy with select variables within environments that remain close to, but apart from life. And the best games, like the most successful ecological experiments, tread a fine line between bounded tidiness and inclusive reality, heightening our awareness of mechanism while providing ample outlets for our energy and curiosity.

"SORRY, BUT I AM NOT ALLOWED TO GIVE MORE DETAIL": Ecomimesis and a Seventies *Adventure*

Even if one grants that digital games are played in ever more diverse settings and can offer an astonishing range of in-game environments, one may still balk at the idea that all games are therefore environmental. What, then, constitutes an environmental game? In my view, a game's "environmentality" does not at all depend on its possessing an overt environmentalist rhetoric,[8] but rather follows from its modeling of ecological states and relations, however admirable or terrible that modeling may be. At present, most games commit at least one if not all of the following missteps in their realization of in-game environments: relegating environment to background scenery, relying on stereotyped landscapes, and predicating player success on extraction and use of natural resources. In the first and most common scenario, a game flaunts its environment to the extent that it provides gratifying visuals, while the environment itself remains inert, the functional equivalent of theater flats or greenscreen technology. Action takes place within or in front of such digital set pieces, and it is in this vein that volumes devoted to the artificial intelligence (AI) of games carefully outline the behavior of non-player characters and monsters (mobiles), but leave the articulation of the game environment to artists.[9] Such a spatial hierarchy is readily apparent in

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

games like Nintendo's old Mario platform games, which featured the iconic plumber running, bouncing, and sometimes falling through a series of obstacles set against a simple, side-scrolling backdrop. Artist Cory Arcangel effectively parodied this layering in his *Super Mario Clouds* series, by playing hacked Nintendo game cartridges in which all but the fluffy white clouds on a blue background had been erased. Although some might argue that the newer virtual worlds offered by MMOGs appear to exchange background and foreground distinctions for a more immersive experience of space, the range of possible interaction with such game environments remains disappointingly slight.

Game environments also tend to lean heavily on clichéd landscapes, abandoning any attempts at regional specificity for prepatterned and ultimately generic scenes. Such environments may give players the disorienting and somewhat anaesthetizing sense that *this could be anywhere or nowhere at all*, conveniently overlooking ecological concerns with the finite character of the natural world and entropic limitations on energy and throughput, or carrying capacity (chapter 4). In an era of widespread anxiety over climate change, increasingly scarce fuel reserves, and population control, it should come as no surprise that an especially popular recourse is the abstract, ever-receding pastoral ideal that Raymond Williams once derisively called "a babble of green fields" (in a nod to Shakespeare),[10] which lurks in all the medieval and pre- or alter-industrial lands of games like Blizzard's *World of Warcraft* or Nintendo's *Legend of Zelda* series, and rather explicitly in the multitudes of crop-management games like *Harvest Moon* (1996) and *FarmVille.* Ecological specificity and accuracy are neither necessary nor sufficient criteria for successful commercial games, but when we measure games as instruments of public knowledge, it suddenly becomes worthwhile to make games that are more meaningfully local, which take seriously the goal of environmental realism—not solely in terms of visual rendering, but also in sound design, weather, species density and distribution, and the arrangement of organic and inorganic actors in complex interrelation. Pilloried on other fronts, industry bad boy Rockstar Games has taken positive steps in this direction with the *Grand Theft Auto* (1997–) games, which evolved from taking place in "Anywhere, USA" to site-specific installments that unfold in fictional cities modeled closely on San Francisco, Las Vegas, and Los Angeles. The company also released the "open-world" game *Red Dead Redemption* in 2010, which plays out in the last days of the settler-colonial frontier in the American West

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

and features over forty species of wildlife (including bison) as both potential predators and prey.

Both criticisms—treating game environments as mere scenery, falling back on caricatures of landscapes rather than attempting to plumb their complexity—already suggest within them the third major issue: game designers have yet to develop more sophisticated rules for interaction between players and game environments. Most game environments are predominantly visual, with the majority of the environments remaining functionally inert. Actionable parts of those environments are most often things a player can use immediately (a power-up, like a health or speed boost), acquire for later use (an item such as a key for a locked door further in the storyline), or destroy (panes of glass between you and your target, a creature you didn't like the looks of). The genre of "god games" is emblematic in this regard, typically granting players formulaic rights to strip or alter landscapes. Many celebrate games for this player-centered paradigm, what Bonnie Nardi calls "performative mastery," a tribute to player agency and skill that tries to dissociate itself from critiques that games are virtual Skinner boxes producing addiction in return for randomized reward.[11] Although I do not discount the value of player agency, too often this kind of skill mastery equates to mastery of the external environment, and games often naïvely reproduce a whole range of instrumental relations that would be better reimagined. Games are opportunities to create entirely new sets of relations, outside of those based on dominance or manipulation. More environmentally realistic games could enhance our understanding of real-world environmental issues (not just crises), either by implicitly or explicitly modeling different forms of our individual and collective environmental agency.

Some games elegantly avoid many of these common pitfalls, and perhaps surprisingly, we can begin with an example not far from the origin of modern computer games, one that took the longest known cave system in the world as its inspiration and used only text to communicate ambient detail. The game, *Adventure* (sometimes called *Colossal Cave Adventure*, or simply ADVENT, due to an archaic FORTRAN six-character identifier limit), was designed by William Crowther in 1975–76 while he was an employee at Bolt, Beranek, and Newman (BBN), best known for developing the ARPANET. Crowther developed *Adventure* using BBN's PDP-10 computer in his off hours, and the game quickly became something of a craze among early computer enthusiasts; it was significantly extended by Don Woods at Stanford in

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

1977, and throughout the next decade other player-fans would revamp the game for newer platforms like the TRS-80 and the Atari 2600, eventually adding graphics. While the original, text-only *Adventure* seems primitive by contemporary game standards, it successfully foregrounds environment and environmental knowledge because of and not despite its textual limitations. Indeed, the spare, linguistic crafting of *Adventure*'s site-specific subterranean world exemplifies what philosopher Timothy Morton calls ecomimesis, which he defines as the project whereby nature writers and ecocritics alike attempt to bring the natural world into their writing through evocative, present-tense descriptions, like the following snippet from prominent ecocritic Lawrence Buell: "The grove of second-growth pine trees . . . sway at this moment of writing, with their blue-yellow-green five-needle clusters above spiky circles of atrophied lower limbs."[12] Though Morton's ruminations on environmental aesthetics, written in the context of literary ecocriticism, may at first appear to have little to do with game criticism, literary environmental criticism and game studies have much to gain from breaking disciplinary isolation. Having been saturated for some time by sometimes amorphous notions of play, narrative, and computation, games are sorely in need of more diverse forms of critical articulation even as they offer particularly fertile terrain upon which to raise questions of environmental representation, knowledge, and ethics—questions that have dogged ecocritical attempts to reconcile the natural and the ecological with the literary and the artistic.

In its early years, game studies addressed much of its energy to bridging internal rifts, most prominent among them the storied conflict between ludologists and narratologists. Narratologists purportedly insisted on the continuity between games and other storytelling media, while ludologists sought to disentangle themselves from methodologies traditionally associated with literature and film, stressing the unique mechanics of game design and predicating the computer and console game's medium specificity on the basis of code and microchip, binary streams of data and algorithmic or procedural operation. In recent years, this division has given way to the phenomenal outgrowth of criticism surrounding the term "play," which conveniently seems to bypass the lingering stigmas surrounding games in favor of articulating a broader cultural phenomenon. However, even the more capacious concepts of play have made it difficult to posit a more explicitly environmental approach to games, one that might dethrone the reigning player- or

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

designer-centered paradigms in order to acknowledge game environments as determining components of player experience, with the potential to edify and spark curiosity about the out-of-game world.

For Morton, ecomimesis—an author's elicitation of his or her compositional environment—is perhaps counterintuitively non-natural, sharing more with the self-reflexive, self-conscious aspects of postmodern art than documentary realism. While poets, nature writers, and ecocritics like Buell find that ecologically inflected, thick descriptions of natural setting permit an escape from the confines of writing, from representation to reality, Morton concludes that "ecomimesis is not necessarily on the side of nature."[13] A similar but more polemical critique can be found in Dana Phillips's *The Truth of Ecology*, in which Phillips describes Buell as evincing "an inchoate and perhaps not fully conscious desire for a literature of presence," and accuses ecocriticism of going "well beyond the realm of the plausible in its declarations about what literature can and ought to do."[14] Phillips expresses deep skepticism over the claims of literary mimesis, dismissing them as badly veiled attempts "to do an end run around contemporary literary theory."[15] However, unlike Phillips, Morton is careful not to throw the proverbial baby out with the bathwater—although "the idea of nature is getting in the way of properly ecological forms of culture, philosophy, politics, and art" and ecomimetic projects are clearly artificial constructions, ecomimesis remains a valid and important form of poiesis. Moreover, though Morton looks to "art above all else" and Romantic literature in particular for "properly ecological forms," his theory of ambient poetics allows for the analysis of works in a range of media.[16] Ecomimesis in Morton's view presents the greatest complications in the context of the written word and its attempts to incorporate or capture ecological truth in writing itself. We can easily see, however, how the concept of ecomimesis could extend to photography, film, music, and games—both game texts and games *as* texts. In this age of aggressive graphical display—3D, high definition (HD), and computer-generated imagery (CGI)—we tend to forget that many of the earliest computer games were purely textual constructs, and thus neglected progenitors of both the modern, visually saturated computer or video game and continuing experiments in interactive fiction. We could ask ourselves, to what degree could such text-based games be said to model the kind of "writing degree zero" Phillips so readily dismisses, or the less naïve Mortonian craft of ecomimesis? As a game like *Adventure* demonstrates, game designers are recognizable cousins

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

to ecocritics and nature writers, in that all "want the world to be in the text."[17] But game texts, unlike conventional texts, demand action—games are "richly designed problem spaces" or "possibility spaces" where we come face to face with our environmental knowledge and impact.[18]

Adventure's ecomimetic qualities stem from both the game's signature descriptive brevity and the artful correlation between textual output and player language and movement. When you begin the game, for instance, should you ask for instructions, you receive the following cryptic remarks:

> SOMEWHERE NEARBY IS COLOSSAL CAVE, WHERE OTHERS HAVE FOUND FORTUNES IN TREASURE AND GOLD, THOUGH IT IS RUMORED THAT SOME WHO ENTER ARE NEVER SEEN AGAIN. MAGIC IS SAID TO WORK IN THE CAVE. I WILL BE YOUR EYES AND HANDS. DIRECT ME WITH COMMANDS OF 1 OR 2 WORDS.

Otherwise, you begin with the following description of your location:

> YOU ARE STANDING AT THE END OF A ROAD BEFORE A SMALL BRICK BUILDING. AROUND YOU IS A FOREST. A SMALL STREAM FLOWS OUT OF THE BUILDING AND DOWN A GULLY.

Exploring the surrounding forest yields little, but when you investigate the building you discover a range of objects that might help you in your search: keys, a shiny brass lamp, some food, and a bottle of water. Following the streambed south leads to an area of "bare rock," and "a 20 foot depression" at the bottom of which is "a strong steel grate." Unlocking and opening the grate allows you to lower yourself into the chamber below, and there begins your journey into the expansive underground cave system that forms the main setting of the game world.

No progress can be made without issuing recognizable one- or two-word directives to the program's mysterious narrator-actor, thus at first the game can unfold as a humorous, ELIZA-like conversation between you (the player) and it (the unknown interlocutor who presents the game), through the input mechanism of the command-line prompt.[19] Though this interlocutor supposedly serves as your "eyes and hands" and can be ordered about with simple phrases like "north" or "get keys," attempts at complex or creative workarounds are liable to earn only nonplussed responses such as

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

I DON'T KNOW HOW TO APPLY THAT WORD HERE.

or this gem,

YOU CAN'T BE SERIOUS!

At times, as you wander about lost in chamber after chamber, the computer seems as disoriented as you are, though the disorientation is verbal as much as spatial:

I AM UNSURE HOW YOU ARE FACING. USE COMPASS POINTS OR NEARBY OBJECTS.

I DON'T KNOW IN FROM OUT HERE. USE COMPASS POINTS OR NAME SOMETHING IN THE GENERAL DIRECTION YOU WANT TO GO.

Compared to current games, in which player identity is most often grafted onto a three-dimensional avatar in a curious blend of first-person belief ("I am the military operative on this mission") and third-person witnessing ("That is my character moving around on the screen"), *Adventure* is unusual in its interposing of an AI between player and environment. In a mode reminiscent of the orthodox Cartesian dualism between mind and body or philosophy's brain in a vat, the player issues commands to her physical extremities and waits patiently to see if the commands are understood and acted upon; garbled commands lead to extensive linguistic negotiations, as the player searches for objects and actions that the program can recognize. Thus, "inch forward" becomes "go down" and "hit snake with black rod" resolves simply to "strike snake." (If you err on this account, the program helpfully reminds you, "My word for hitting something with the rod is 'strike.'") Meanwhile, movement into new caverns and crawl spaces are often leaps of faith—until the program outputs the textual description of these new areas, the player is effectively blind.

Crowther's *Adventure* was, in fact, based on a real system of caves—the Bedquilt and Colossal Cave sections of the Mammoth Caves in Kentucky. Crowther, it turns out, was both an avid caver and a player of the early *Dungeons and Dragons* (1974), and *Adventure* hence effortlessly melds aspects of fantasy (axe-throwing dwarves and "magic words," like the nonsensical

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

teleportation incantation "XXZZY") with the mundane details of spelunking (Crowther and his soon-to-be ex-wife Patricia had both spent time mapping Bedquilt). That Crowther imaginatively retooled his own physical experiences within a material milieu, transforming them into the stuff of computing lore, supports the game's ecomimetic classification; the text delivers an unexpected intimacy with an alien environment that stems directly from a caver's ecological awareness and expertise. As Dennis Jerz, a chronicler of Crowther's work, informs us, "Caver terminology often employs architectural metaphors. For instance a 'room' is any discrete space, no matter the shape; a 'hall' is any long space, a 'chimney' is a pit when seen from below, and a 'dome' is the roof of a pit."[20] In a process familiar to cavers, the game therefore proceeds as the compass-guided navigation of a series of interlocking chambers or "rooms," whose descriptions sometimes forgo aesthetic detail for matters of practical judgment:

> YOU ARE ON THE BRINK OF A THIRTY FOOT PIT WITH A MASSIVE ORANGE COLUMN DOWN ONE WALL. YOU COULD CLIMB DOWN HERE BUT YOU COULD NOT GET BACK UP.

Where an untrained eye would see only undifferentiated stone and darkness, the *Adventure* player, with the aid of knowledge Crowther has embedded in the game's descriptive texture, spies evidence of previous expeditions, networks of linked passages, climbs of varying difficulty, and even the familiar results of geologic processes:

> YOU ARE IN A ROOM WHOSE WALLS RESEMBLE SWISS CHEESE. OBVIOUS PASSAGES GO WEST, EAST, NE, AND NW. PART OF THE ROOM IS OCCUPIED BY A LARGE BEDROCK BLOCK.

"Obvious" passages notwithstanding, *Adventure* also militates against player hubris, confounding would-be cartographers with the sheer scale and complexity of its natural environment. As one of the game's fan sites notes, *Adventure*'s cavernous expanses eschew the orderly, planar preferences of Euclidean geometry, instead reproducing the curved, choked, and irregular topologies of real cave systems (Figure 5).[21] Some routes are passable only in one direction, and leaving a room by its northern opening does not necessarily mean that you can return to that room by heading south from the next

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

chamber. As veteran spelunkers Roger Brucker and Richard Watson observe in *The Longest Cave*, their account of the Cave Research Foundation's involvement in Mammoth Cave National Park, caving expeditions rarely have a discernible end. The challenge is instead to discover connections between cave systems, or to find your way back to where you began (using *Adventure*'s magic word XXZZY whisks you back to the starting point), and unlike most enshrined outdoor activities, caving is less about ascent, panoramic views, and wide-open spaces than close confines, restricted vision, and plunging deep below ordinary terrestrial life:

> Caving is tactile in a way that no other contact with the inanimate can be. There is no other sport where one crawls through mud and slides through sand. One is *in* a cave, but not as a swimmer is in the water. In the cave one is clasped in solid, ever changing walls of stone that provide variegated patterns of visual and tactual delight. Caving can be almost totally sensual.[22]

Adventure grants its player the caver's quasi-mystical relationship to the nonhuman environment, bringing her into meaningful proximity with often overlooked inorganic actors and the humbling scale of geologic time.

This is not to deny *Adventure* its share of literary excellence. According to Jerz, "'Adventure' succeeds in large part due to the depth and realism of the scenery, which is rendered in concise prose that calls interesting details to the reader's attention, yet leaves much to the imagination." Jerz also points to the divergent textual styles that become apparent as one traces the changes in *Adventure* from Crowther's original to Woods's adaptation, explaining that "Where Crowther was an efficient minimalist, Woods was comparatively lavish with scenery." The economy of *Adventure*'s language allows for both the game's ecomimetic properties and its captivating ambiguity. As if to underscore this point, the most cited areas of the game seem to be its two labyrinths, which owe much of their lasting impression to their rendering in words. Nick Montfort, for instance, borrowed the title of his 2005 book on interactive fiction, *Twisty Little Passages*, from this delightfully cryptic line:[23]

> YOU ARE IN A MAZE OF TWISTY LITTLE PASSAGES, ALL ALIKE.

In one of the two mazes, this phrase appears but rearranges itself slightly at every turn, enabling attentive readers to determine the way out; in the other,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

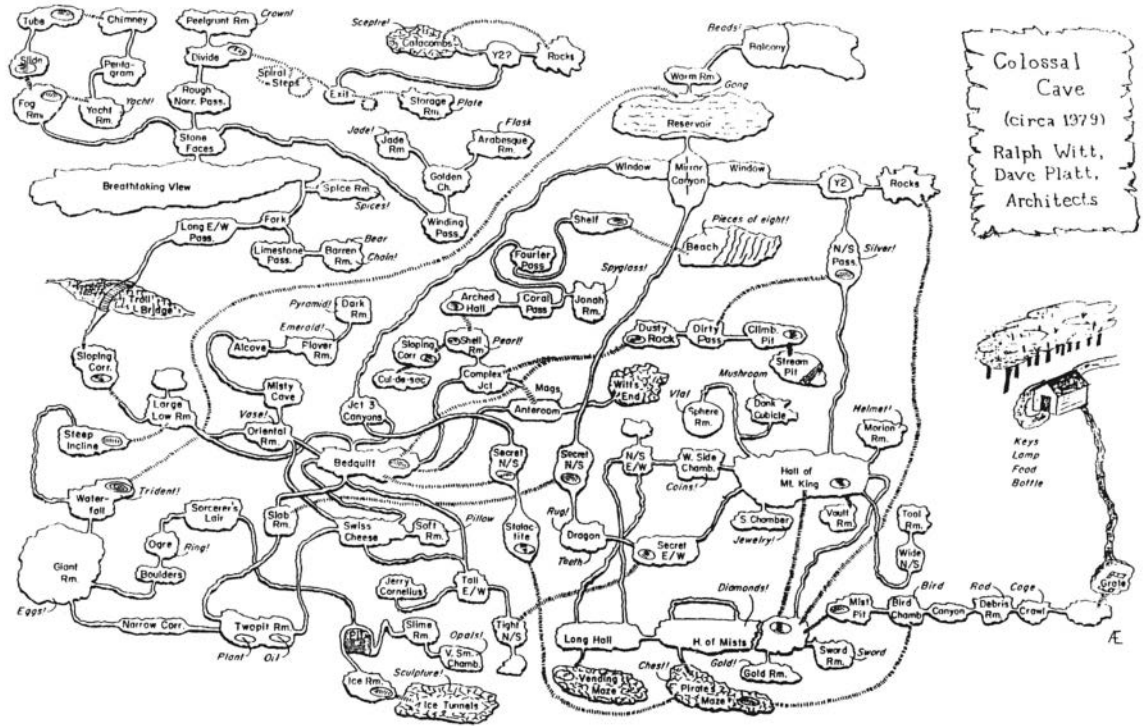

Figure 5. A map of the convoluted cave system popularized by Will Crowther's early text game *Adventure*, drawn by Bruce Beaumont and Geoffrey James Sickler. Reprinted by permission of David Platt.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

the phrase never changes. Here the game casts the player into a featureless labyrinth of stone and language, in a brilliant play on the double sense of "passages" as both literary and geologic constructs, and it is not at all clear which aspect is the more maddening.

Adventure not only returns us to a time when games were unabashedly textual, but also offers us a new model for Morton's concept of ecomimesis. Demonstrating at times both the spare elegance of poetry and the resolute matter-of-factness of prose, the text of *Adventure* generates the kind of "poetics of ambience" that Morton describes as "a sense of a circumambient, or surrounding, *world* . . . something material and physical, though somewhat intangible, as if space itself had a material aspect."[24] *Adventure* is also an example of what Henry Jenkins calls "environmental storytelling," but as a text game, it is not simply an inferior precursor to the kinds of lush, visual environments of modern games.[25] Text games remind us that game worlds are not just substitutive or compensatory simulations, but also evocative spaces in their own right. Sophisticated computer graphics do not necessarily immersive games make.

Games as Environmental Texts: thatgamecompany's *Flower*

In the spirit of comparison, we could turn to thatgamecompany's *Flower* (2009), a lyrical, largely meditative game that begins with images suggestive of urban ennui—a forlorn, potted flower drooping on an apartment windowsill, a brief cutscene portraying a breathless summer day in the city—but quickly expands into the imaginative realms of vegetal plenitude. Selecting the wilting flower carries you into *Flower*'s first level, a landscape of verdant hills and distant cliffs in which every blade of grass is lovingly rendered and curving lines of unopened flowers beckon you onward (Figure 6). You soon notice, however, that each level of *Flower* begins in an environment that is somehow marred or drained of its full vibrancy, marked by swaths of withered grass, defunct machinery, or collapsed structures. Alighting on or brushing past unopened flowers causes them to bloom and effectively rejuvenates the surrounding landscape, infusing its moribund aspects with a mysterious natural energy.

Visually stunning and replete with natural imagery, *Flower* appears to trounce *Adventure* as a game mesocosm, but the opposition is not as one-sided as it might seem. *Flower* is unquestionably beautiful, but my interest in the game stems less from its graphics than its underlying mechanics. Since most games oblige players to enter into a player-environment relationship

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Figure 6. Wind works to rejuvenate landscapes in thatgamecompany's *Flower*.

based almost wholly on extraction and utilization of natural resources that are often effectively infinite, *Flower* is daring to contemplate an alternate schema. In fact, *Flower* fulfills Lawrence Buell's criteria for an "environmental text," as presented in *The Environmental Imagination.* For Buell, an "environmentally oriented work" is one in which:

1. The nonhuman environment is present not merely as a framing device but as a presence that begins to suggest that human history is implicated in natural history.
2. The human interest is not understood to be the only legitimate interest.
3. Human accountability to the environment is part of the text's ethical orientation.
4. Some sense of the environment as a process rather than as a constant or given is at least implicit in the text.[26]

Above all, the ideal environmental text produces involvement. It brings the nonhuman world into equal prominence with the human, exposes humanity's moral responsibility to and participation in the natural world, and portrays the environment as fluid process, not static representation. While not all games can satisfy all of these criteria, games seem especially well suited to the last—

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

they are, after all, inherently processual, requiring rule-based, procedural interaction between a player or players and multiple environments. And in theory, games could use their ability to model environmental change to bring the first three criteria into play in instructive ways as well, for instance by tying environmental change to player action or inaction.

At first glance, *Flower* appears inclined to discard the human entirely in favor of the nonhuman. Human presence and activity are often suggested, but they are never directly seen, unfolding instead through abstract and disconnected images of city life. Accordingly, each level begins with a telling inversion of typical game "cutscenes," moments in which games usually showcase their most refined animation via photorealistic glimpses into key characters' lives and dramatic episodes. In contrast, *Flower*'s cutscenes are conspicuous for the absence of the human, shifting priority to the environment and establishing an elegiac tone that reads as a grim warning about urban anomie. Moreover, many of the game's reviewers have suggested that *Flower*'s levels represent the daydreams (and later nightmares) of house plants[27]—a quirky idea corroborated by the designers' decision to have the player essentially "play" wind, using the controller's SIXAXIS™ motion-sensing technology to navigate through the given landscapes, visiting unopened flowers like some kind of spiritual pollinator and causing them to bloom. Unlike most games that offer players human or at least humanoid avatars, *Flower* destabilizes not only player corporeality but also player agency and perspective. Each level is an invitation to inhabit an other-than-human consciousness, and as a gust of wind you are essentially invisible except *through* your effects on the environment: the wake left by coursing through tall grasses or the intangible suspension of multicolored flower petals gathered throughout each level (or, as the character George Orr opined in the epigraph to this chapter, "What we do is like wind blowing on the grass.").[28] The result is not lack of embodiment so much as amorphous embodiment, as the game tenders several forms of interactive feedback: the controller responds to the rotation of your hands and wrists and gently shakes at appropriate times (haptic feedback via DualShock technology), and the game's elegant sound design features music, the sound of wind, and the tonal notes triggered by coursing over and through flower nodes. A successful run of a line or group of flowers achieves a satisfying burst of sound, and while the sunnier levels employ bright, melodic tones, the darker, more disturbing levels turn to atonality in a subtly unsettling way. The geographic transition from

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

city studio to country meadow is at the same time a liberating spatial transition from flat, pictorial representation to ambient immersion. Movement formerly restricted to two axes transforms into navigable space that extends out in all directions, as the game encourages you to shed your sense of terrestrial bounding in favor of birdlike swoops and skims. Celebrating broad, open landscapes and sensations of weightlessness and speed, *Flower* melds almost photorealistic environmental detail with patently imagined elements—minimalist flowers in neon blue, pink, and yellow hues, panoramic expanses expressive of both painting and cinematic animation.

However, while *Flower* might seem at first glance a condemnation of urban blight and human encroachment on a pristine natural world, many of the levels explicitly address in an encouraging way the player's powers to ameliorate human damage or even return life to human inventions. In several levels, your actions set defunct windmills to turning, or restore power to electrical lines (evidenced by lights strung along them), or create bioluminescent haystacks; in others, you weave your way through twisted electrified metal, gently opening ghostly white flowers that render the wreckage harmless. Far from condemning human intervention, *Flower* attempts to bridge the country and the city through the player's experiential journey. Both daydream and nightmare, *Flower* brings to life both faces of environmental thinking as described by Morton in *The Ecological Thought*: the sunny optimism characteristic of "green" marketing as well as the dark underbelly of waste, despair, and the emptiness of space—the abject realities of our existence on planet Earth.[29] Like *Adventure*, *Flower* embodies a fascination with the unlit spaces beneath the surface of everyday life, and foregrounds natural environments as constitutive of, rather than supplementary to, gameplay. The game directs our attention to a nonhuman world on the margins of human society, where progress is tied to visitation and restoration rather than exploitation and strife. Its self-paced, lyrical set of stages led some traditional gamers to decry the lack of firearms and buxom women while others, including Sony executives, saw it as the vanguard of "Zen" gaming.[30]

Flower's landscapes are admittedly somewhat generic, despite creative director Jenova Chen having taken his inspiration from the windmill-blanketed hills of California, and the game is far from being biologically or ecologically accurate, but it should be celebrated for its careful decentering of human agency and its unusual lyricism, which invite both aesthetic joy and conscious reflection on the environment. Thatgamecompany's first trio

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

of games, which aside from *Flower* included a model of microbial life (*flOw*) and the desert saga *Journey* (discussed in chapter 3), demonstrates that games are not just technical but also emotional experiences; games generate anticipation, pleasure, anger, the thrills of fear and engagement, and even sadness.[31] As neuroscientist Antonio Damasio usefully reminds us, emotions are not mere decoration over the base functionality of an organism, but rather part of our congenital toolkit to navigate and respond to our environment. Moreover, that environment need not be the "real" one that surrounds us in physical, natural space. Instead, an "emotionally competent stimulus" can be "a certain object or situation actually present or recalled from memory."[32] To support this conclusion, Damasio unearths Benedict de Spinoza's statement that "A man is as much affected pleasurably or painfully by the image of a thing past or future, as by the image of a thing present," from *The Ethics* (1677), Part III, Proposition 28. Spinoza's proposition adds a new temporal dimension to our consideration of game environments—the future—as well as the language of the "image." This is key to the power of games as affective environments, particularly those concerned with environmental futures ranging from Edenic, peaceable kingdoms to ecological disaster (chapter 5).

Spinoza's theory and Damasio's research suggest that games are not hermetically sealed objects or environments, divorced from "real life" and the range of emotions and events we experience there. In addition, emotion becomes part of the player or user's learned and genetically predisposed tools for navigating virtual environments. Just as coming upon a wild bear or precipice might trigger the emotion of fear and the corresponding complex of mental and physiological responses—elevated heart rate, a surge of adrenaline, a nervous sweat, heightened senses—so might rounding a corner in *Half-Life* (1998) and encountering a legion of undead zombie scientists provoke the same fright. The emotions experienced by gamers also need not be limited to these more dramatic examples. Games like *Flower* deliberately set out to expand the emotional spectrum of games, and furthermore, to create complexes of emotions, sometimes contradictory, often subtle, that realistically reflect the conundrums of everyday life—awe and terror, bittersweet joy, poignancy and levity. One of Damasio's statements could very well be a description of Chen's games: "If anything in our existence can be revelatory of our simultaneous smallness and greatness, feelings are."[33]

Games are of course assemblages of computational processes, an approach emphasized by Ian Bogost and Noah Wardrip-Fruin, among others, but games

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

are also emotional constructs with historical underpinnings, something akin to Raymond Williams's "structures of feeling." Both *Adventure* and *Flower* literally depict natural scenes, but that alone is not sufficient to qualify them as environmental texts. What is also needed is a design attitude that somehow decenters or displaces the human agent, calls attention to the environment as more than mere staging, and introduces gameplay mechanics beyond gross assault and exploitation. In other words, Moore's Law doesn't matter, or at least not as much as most industry pundits would have you believe. (Moore's Law is named after Intel cofounder Gordon Moore, who predicted in the 1960s that integrated circuits could contain roughly double the number of transistors about every two years, really twenty months. The law is often used to predict the exponential growth of computer processing power.) While most of the game industry for the past forty odd years has been tied to the notion that better games demand higher quality graphics, lifelike settings and characters that approach the real, a few have begun to question this paradigm, among them designers aware of Japanese roboticist Masahiro Mori's notion of the uncanny valley, and *New York Times* writer Edward Rothstein, who in 2002 penned the provocative column "Realism May Be Taking the Fun Out of Games."[34] Mori famously hypothesized that lifelike humanoid robots would trigger positive emotional responses from humans only up to a point, just before true verisimilitude, after which human response would actually be less favorable because the robots would appear eerie, or uncanny. This notion of the uncanny valley has been subsequently applied to everything from digital special effects in horror films to children's toys and video game art. Similarly, while Rothstein acknowledged that "One of the major goals of video game systems has been to simulate the real, to create images so lifelike, and movements so natural that there is no sense of artifice," he also noted a curiously antitechnological streak in many of the games developed for recent generations of home gaming consoles. He gives as an example Nintendo's game *Pikmin* (2001), named for the ambiguously vegetal-animal creatures that must be marshaled to fix the player's broken spaceship and complete the game. For Rothstein, *Pikmin* and other titles demonstrate "a tension in the video game universe: technological powers are courted for their possibilities and resisted for their fetishistic demands." Ultimately, he posits a spectrum with at one end games that leverage the increased realism offered by more powerful processors and graphics engines—fighting games, racing games, and shoot-'em-ups—and at the other more "abstract"

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

games like puzzle and mystery games that rely less on visuals than on the satisfactions of exploring an at first unknown and complex set of rules. While *Adventure* would presumably fall on the abstract end of this spectrum and *Flower* on the realistic one, Rothstein's thrust is that *Adventure* need not apologize for its lack of visual pyrotechnics.

Economist Edward Castronova would probably agree with Rothstein on this point, having once concluded that "great graphics are neither necessary nor sufficient for a successful synthetic world."[35] Noting that the majority of MMORPGs are medieval in theme, Castronova jokes that there can be such a thing as too much realism—after all, what player would want the disease and filth and stench of real medieval cities in a game? Rather (and this is the way we prefer it, according to Castronova): "All in all, the synthetic environment looks rather like a very nice painting. Even a dull painting would have been sufficient, but nevertheless, the painting is getting better and better every year."[36] Some might read this as evidence of the malaise of urban modernity and nostalgia for a sanitized, pre-industrial past; however, Castronova suggests that immersion does not spring from verisimilitude, but rather from "selective fidelity" to real details. The term "selective fidelity" was coined in the 1980s by a researcher working for the Defense Advanced Research Projects Agency (DARPA), specifically on the SIMNET (Simulation Networking) tank warfare training simulation,[37] but it is also clearly reminiscent of Roland Barthes's description of the "reality effect" in literary discourse as the product less of exhaustive than telling detail.

This productive decoupling of immersion from graphics reminds us that realism is never purely the domain of the visual, and that immersion requires little more than the "magic circle" provided by games or gamelike scenarios. Early role-playing games, now quaintly referred to as "paper-and-pencil" or "tabletop" games, were conducted entirely face-to-face, using paper, writing implements, dice, and little else. Alexander Galloway has also usefully approached game realism from the standpoint of "social realism," whereby one evaluates a game's realism in terms of the conformity between the game world and the player's social, political, and other lived contexts. His primary example involves comparing the experience of a young Palestinian boy playing a Hezbollah-sponsored first-person shooter versus the American military's recruiting game *America's Army* (2002).[38] In the former case, the game achieves realism; in the latter case, realism is blocked by the player's misalignment with American military attitudes and goals. What matters here

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

for a game like *Adventure* is the unhitching of realism from crisp visual detail and other forms of postmillennial game design—polygon count (higher numbers mean less jagged edges), texture mapping (the lieutenant's suit looks like real wool), and haptic feedback (the controller shakes when you fire a gun) matter little on this account. As Microsoft, Sony, and Nintendo move to game consoles featuring body mapping, voice recognition, motion-sensitive control, and virtual-reality capabilities in the ever-present quest to break down the walls between artifice and reality, it is important to recognize the value and validity of earlier forms of environmental modeling in games. In the terms set forth by this chapter, both *Adventure* and *Flower* are successful examples of environmental realism (although *Flower* is more accurately called a form of environmental idealism), *Adventure* for its descriptive texture and navigational structure, and *Flower* for its emphasis on the nonhuman and on remedial environmental interaction. They are realistic without being real.

Game design and game studies anthologies have often acknowledged *Adventure*'s importance in the genealogy of both computer games and interactive fiction, but most have downplayed the game's unusual relationship to the Mammoth Caves in Kentucky. Likewise, players of *Flower* may not realize that the tonal progression of its landscapes was directly influenced by designer Jenova Chen's relocation from urban Shanghai to southern California.[39] But given my determination to detach a game's environmental realism from the obvious matter of its visual accuracy, why then should it matter whether or not *Adventure* was based on a real system of caves? Crowther did not intend his textual descriptions to serve what Morton calls one of the primary roles of ecomimesis—that of "authentication"—seeing as the vast majority of *Adventure* players were not cavers but gamers, and had never visited or planned to visit the Mammoth Caves. Similarly, would *Flower* be any less compelling if we knew that its environment was based on an imaginary topography, something created from whole cloth and unverifiable by direct experience?

Designers might understandably loathe subjecting game design to the strictures of physical laws and environments known to our universe, seeing them as fetters to truly imaginative world-building. Nonetheless, it is tempting to see the environmental realism present in *Adventure* and *Flower* as the basis for a defense of video games. So much of antigame rhetoric that takes the form of concern over children's time spent sequestered indoors

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

("Why are you playing games in here when you could be playing *outside*?") seems to follow the pattern of attacks on the ecocritical project ("Why write about the environment when you could just go outside?"). The same flaws characterize both avenues of questioning: not only the positing of a falsely limiting either/or but also the not altogether ridiculous supposition that the only way to experience nature is to be exposed to the elements. Though in radically different ways, literary scholars like Buell and Morton and game designers like Crowther and Chen remind us why we should bother to create literature, art, or games that portray people's relationships to their environments. Rather than seeing this as introducing a barrier to understanding, we can see the particular realization of an environment—whether textual, visual, or procedural—as a filter that helpfully selects certain aspects for consideration while excluding others, something like Max Black's discussion of linguistic metaphor or Andy Clark's replacement of the Cartesian mind-body problem with what he calls the "mind-body-*scaffolding* problem" in *Natural Born Cyborgs*.[40] Recalling Marshall McLuhan, Clark argues that what distinguishes humans is not so much some sort of innate genius but rather our capacity to use tools and our environment to complement and extend our otherwise limited powers of reasoning. This closely resembles what I have called the mesocosm in relation to video games, their playable spaces, and the places in which they are played.

Although the term "virtual reality" (VR) might seem apropos here, I much prefer the alien but intriguing "mesocosm" to VR's technological, historical, and contemporary baggage, of which there is plenty, from its lurking inferiority complex and undeserved reputation as a reality-usurping bogeyman (depicted in films like David Cronenberg's 1999 *eXistenZ*) to its present reinvigoration as the "next big thing" in gaming despite still comically clunky headsets and controllers. In this, I join a growing cadre of academics who call the very term "virtual reality" into question by underscoring the lack of a hard dividing line between its two aspects. Castronova, for instance, relegates VR to an appendix in his first book on "synthetic worlds," seeing it as a relatively inconsequential phase of technical development tangential to the kinds of player experiences found in MMOGs. He even uses the (biological) metaphor of the permeable membrane to describe the easy passage between the real and the virtual, although his paradigmatic examples are financial, as in the case of real-money trade, or the sale or purchase of virtual items and currency for actual money. A wide range of other research in the social sciences

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

and humanities also supports the observation that players do not experience virtual worlds as separate realities: Constance Steinkuehler, Nick Yee, James Paul Gee, Mia Consalvo, and many others point to games as extensive environments for learning and social bonding; anthropologist Bonnie Nardi describes play in a game like *World of Warcraft* as active aesthetic experience, in terms originally set forth by philosopher John Dewey and activity theorist Alexei Leontiev; N. Katherine Hayles considers the epigenetic changes wrought by digital media, particularly on reading and cognition;[41] and, in a conclusion particularly relevant to this book's concerns, Henry Jenkins argues that "video games constitute virtual play spaces which allow homebound children . . . to extend their reach, to explore, manipulate, and interact with a more diverse range of imaginary places than constitute the often drab, predictable, and overly familiar spaces of their everyday lives."[42] Jenkins credits video games with compensating for the loss of what was already in his generation not so much "wild" land as marginal land—areas of overgrowth or undeveloped property within or between suburban enclaves that allowed unsupervised young boys to exercise their bodies as well as their imaginations. Notably, in this he takes a position completely counter to that of Louv and those with analogous qualms concerning electronic exclusion of the natural.

Game environments necessarily exist somewhere between Jenkins's attractive idealization and Louv's worried skepticism. Though games might serve as a palliative for "latchkey" kids whose parents work long hours, or anyone without the means to adopt the "weekend warrior" mentality of the privileged, game environments are ultimately not the environments that players live in. Environmental justice activists warn us of the danger of deflecting our hopes for environmental quality onto the places other than where we live—whether those are national parks, wildlife sanctuaries, or compelling virtual realities. With Lisa Nakamura's description of online identity tourism in mind, we might advise ourselves of the risks of virtual environmental tourism: pleasant abstraction from actual environmental realities in need of our conscious attention and intervention.[43] Nevertheless, given that game and related equipment sales generated over 30 billion dollars of revenue just in the United States in 2016, we cannot turn a blind eye to the kinds of game environments that are being produced and played.[44] Games have always been subject to accusations of escapism, and acknowledging the ecomimetic and mesocosmic properties of games might begin to erode the oft-posited but

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

little-experienced divisions between the real and the virtual, the ecological and the literary, the visual and the textual. Like literary texts or artworks, games allow for a range of interpretation, but importantly, through active, exploratory play. Games offer environments that are not stable, but shifting, that react to player input, and both *Flower* and *Adventure* demonstrate that those reactions need not be of a purely instrumental kind. As we will see in the next two chapters, game environments may invite affective and ethical engagement, not only with other people, but also animals, places, and even things. Game environments, whether they are based on known places or not, are not impervious to correspondence with real-world environments. Although this perviousness could be approached in any number of ways, from literary formulations like Morton's ecomimesis and "ambient poetics" to various approaches in media and environmental aesthetics,[45] in this chapter I have suggested the ecological framing of the mesocosm because for me it best captures how game environments rely on and reimagine the world. I remain charmed by the ways in which *Adventure* and *Flower* draw inspiration from Kentucky and California, and how their emphasis on navigation and location draws our attention to basic aspects of inhabiting environments: being surrounded by and moving through them, ambience and ambulation.

Walking in Games

In his unconventional 2005 article in *Digital Humanities Quarterly*, Dennis Jerz not only recovers and analyzes *Adventure*'s original source code, comparing Crowther's version with the one Woods amended, but also embarks on an expedition to Kentucky to assess the accuracy of the game's environmental descriptions.[46] Aided by members of the Cave Research Foundation, Jerz takes pictures as he and his guides descend into the Bedquilt region of Mammoth Cave National Park. As Jerz was aware, the extensive lore around *Adventure* includes numerous testimonials from avid players who, upon visiting the real cave system, were purportedly able to use their detailed knowledge of the game to navigate underground. Although Jerz seems to rely less on his familiarity with the game than on his human companions, he does seek out and document a lengthy series of game referents. The result is an annotated "photographic walkthrough," images from the real cave system captioned with the corresponding lines of textual description from *Adventure.* Less interesting is the matter of *Adventure*'s physical accuracy; rather, Jerz's journey playfully suggests that established notions of game scholarship can

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

be expanded to include more ecocritical concerns, offering a new, more flexible methodology for approaching game environments—the walkthrough.

Walkthroughs, in common parlance, conjure images of real estate tours, theater rehearsals, or airy passageways between buildings. In the world of video games, however, the term "walkthrough" has come to mean a kind of "how-to" authored by experienced players for the purpose of guiding novice players through difficult game material. Most often textual, these walkthroughs sometimes include player-generated maps, screenshots, or lines excerpted from the games themselves. In addition, game walkthroughs typically adopt the second person, addressing the reader with the familiar "you" and thus echoing the present-tense affectation of ecomimetic writing.[47] Jerz's deliberate conflation of multiple *Adventure*s—game, text, and environment—implies that sometimes literally facing the worlds of game fantasy can produce significant exchanges. Not only are games always more than artificially isolated, ludic spaces, but we can also repurpose the game walkthrough in any number of ways, taking something conventionally designed as a cheat or guide for time-strapped or less experienced players and turning it into anything from a ranger-led interpretive walk to a Zen mindfulness exercise to performance art. Players have already, for instance, developed a subgenre of machinima that we could call machinima nature walks, where players use expansive game worlds like Bethesda Softworks' *Oblivion* (2006) and *Skyrim* (2011) to mimic a stroll outside.[48] There is artist Brent Watanabe's recent hack of *Grand Theft Auto V* (2013), the San Andreas Deer Cam, which uses a faux National Park Service web page to turn the famously violent street game into a play on the beloved animal webcam. On the more serious side, in 2008, performance artist Joe Delappe used the virtual world *Second Life* (2003) jury-rigged to a treadmill to reenact Gandhi's famous salt march, and thatgamecompany's *Journey* (2012) reverses most games' casual erasure of physical effort by forcing players to slog slowly through sand (chapter 3).

Perhaps most interesting is the rise of the so-called "walking simulator" game. Many cite the Chinese Room's 2012 release of *Dear Esther* as inaugurating the genre, along with close successors like *Gone Home* (2013), *Proteus* (2013), *30 Flights of Loving* (2012), and *The Stanley Parable* (2013). These walking games have proven intensely polarizing to game communities—while some celebrate the atmospheric quirkiness of these games, they have also excited a great deal of reactionary ire from more conservative game players.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

The games were quick to earn the lightly mocking label "walking simulators," or sometimes "first-person walkers," leading *Kill Screen* writer Miguel Penabella to wonder "Why are we so afraid to walk?"[49] The developers of such games have generally shrugged off the negativity, claiming to have no interest in debating whether or not their games are actually games. But I suspect that if we linger on the discomfort, even the threat that these games seem to represent for certain players, we may gain insight into not just how we traditionally define value in games, but also games' relationship to the quotidian world. Perversely, I suggest that the very qualities of walking simulators that upset conservative gamers—their slowness, their lack of action, the absence of people, their spatial storytelling—indirectly indicate a path forward (pun intended) for more environmentally sophisticated game design. My proposal to refashion the game walkthrough from an expert guide for struggling players to an active exploration and appreciation of game space and place is a call to inhabit different game worlds and to inhabit game worlds differently.

For fans, walking simulators capture something of the poet Wallace Stevens's lines in "Of the Surface of Things," whose rhythm and overt content suggest the expansive benefits of strolling. As Stevens writes, "In my room, the world is beyond my understanding; / But when I walk I see that it consists of three or four / hills and a cloud."[50] Although no one has completely codified their characteristics, walking simulators are often praised for their lush visuals and atmospheric environments (which leads some commentators to suggest that walking simulators are ideally suited to present horror and mystery narratives). Others have used the term "first-person explorer" to highlight what they believe is the genre's preferred mode of player-environment interaction. Eric Swain, one of the first to dedicate blog space to the walker game, concluded that *Dear Esther* reduced gameplay to just two mechanics, moving and looking; he then compared it to Andy Warhol films like *Empire* or *Vinyl* in its minimalism, which forces you to pay close attention to the smallest of details. A year later, Swain found himself wrestling with a more complex question in reference to the Japanese tsunami memorial game *9.03m* (2013)—namely, whether a minimalist first-person walker was counterintuitive, since "half of the activity in the genre of the first person walker is looking at stuff."[51] Ultimately, he concludes, "First person walkers are contemplative by nature, but they require something to spark and engage that contemplation during the time spent walking, whether that be audio diaries, frenetic editing, or mysterious happenings to discover."

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Swain is just one of many critics who have noted that first-person walkers inevitably raise questions about what constitutes gameness—are walking sims just stripped-down versions of existing game types, like point-and-click adventures or open-world games? Or are they closer to cinema or interactive art than "actual" games? In that case, what makes a game a game? Is it mechanics? Exploration? Subjectivity? Difficulty or dexterity of action? As Ed Key, the developer of the game *Proteus* (2013), has joked, the term "walking simulator" is not all that accurate, since games like his do not actually focus on the act of walking.[52] For Key, a true walking simulator would be something like the game *QWOP* (2008), which has generated its own reams of hate mail for turning the seemingly simple act of running into a nightmarish keystroke challenge. I might add the satirical game *Pussy Walk* (2015), which none too gently mocks Czech president Miloš Zeman for showing up drunk to a showing of the Czech crown jewels, challenging its players to steer an inebriated game version of Zeman across a room strewn with laughable obstacles.[53] We could also include gamified apps and devices promoting personal exercise, like Nike+, Fitbit, and Runkeeper, which overlay real walking or running with gamelike goals and rewards.

For me, the fight over whether walking simulators can rightly be called games echoes not only similar brouhahas about art games, serious games, casual games, and so forth, but also more interestingly the established debate in literature over whether science fiction is inferior literature because it generally prioritizes world design over character and plot.[54] Given my investment in developing an ecologically inflected theory of gameplay and design, in which game environments ideally do more than serve as scenic backdrop or standing reserve, it is tempting to see the hostility toward both sci-fi and walking simulators as one brand of anthropocentric elitism.

A full discussion of the scholarship on science fiction world-making is impossible here, but it is worth ending with one particular game, *Firewatch*, and the ways in which it foregrounds the physical act of walking and navigating the outdoors, and the possibilities for integrating location research into game design and development. *Firewatch* was released in February 2016 and was billed as a mystery adventure game that takes place in the Wyoming wilderness in the year 1989. You play as Henry, husband to a woman suffering from early onset dementia, and you begin the game by taking a job as a fire lookout to escape this rather complicated life. Henry develops a relationship to his supervisor and fellow fire lookout, Delilah, through scattered

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

walkie-talkie-style conversations, and the game essentially follows Henry as he tries to do his job—keep the park safe from fire—while reconciling his newfound affection for Delilah with his troubled commitment to his wife.

What interests me about *Firewatch* is in part the game itself, which lovingly reproduces the look and form of a national park (Figure 7) and arguably does for hiking what *Adventure* did for caving, and in part the research process that Campo Santo developers undertook while making the game, which recalls Crowther's process of developing *Adventure.* Prior to its acquisition by Valve in April 2018, Campo Santo was a small San Francisco–based game development studio with only about a dozen employees. According to their dev blog posts, "Over the development of *Firewatch*, members of the team have visited about a half dozen lookouts across the western United States," and Campo Santo environment artist Jane Ng even consulted Pacific Northwest forest service fire lookout schematics to get the look and feel of Henry's tower just right.[55] Thus the exterior of Henry's tower in *Firewatch* looks quite a lot like the Ute Mountain Lookout tower, in the Ashley National Forest in Utah, and the tower's cramped interior living space seems to

Figure 7. The view from Henry's lookout tower in Campo Santo's *Firewatch*, whose wilderness is modeled on the Shoshone National Forest in Wyoming.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

be modeled closely on the Huckleberry Lookout in Glacier National Park, Montana. Campo Santo's outdoorsy research could be dismissed as just another instance of Silicon Valley elites raiding nature for inspiration,[56] but it also augurs game design that is meaningfully site-specific and conscious of bodily embeddedness in the world. After all, as Rebecca Solnit reminds us in her 300-plus-page homage to walking, *Wanderlust*, "Walking . . . is how the body measures itself against the earth."[57]

Although we ought to be conscious here of the peril of an ableist inattention to other ways of moving through or with games both as player-character and player, we may still appreciate walking simulators for their mesocosmic ambitions—both outside, and in; expansive, yet bounded; and demanding inquisitive experimentation while being carefully designed. As we saw in *Walden, a game*, Tracy Fullerton's playable version of one of our most famous nature writer's footloose wanderings, walking games promote less navigational zeal than languor, and exploratory modes based less on masterful occupation than momentary visitation. Whereas Thoreau piously wondered in the posthumously published essay "Walking," "When we walk, we naturally go to the fields and woods: what would become of us, if we walked only in a garden or a mall?" *Walden, a game* resituates us mesocosmically, turning our bodies and skin into permeable membranes between world, game, and something further. What's more, when we walk in games, we walk somewhere between wild fields and woods and tended gardens and malls. Remarkably, from the Peripatetics of ancient Greece to the Situationists and their dérives, the simple act of ambling from one place to another has proven central to the development of philosophy, literature, art, and now games.

Alternate and Augmented Realities

Most of the games discussed thus far have been commercial projects designed to entertain without necessarily challenging players to consider their relationship to environments, real or virtual. That many of them have accomplished the latter while pursuing the former speaks to the potential synergy of the two objectives: creating game environments that reward diverse modes of engagement and depict nature less as dumb show than interactive theater can generate more interesting and absorbing gameplay. What happens, then, when a game takes the real world as its playable space? Or when a game takes on actual problems, for instance, health risks or the ever more elephantine carbon footprints of American consumers? Do these kinds of games

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

contradict my initial contention that a game's environmental realism does not always correlate with its fidelity to real environments, or that any game, no matter how simply rendered, may be read as an environmental text? While proponents of unmediated natural experience, like Richard Louv, David Sobel, and Lowell Monke,[58] might be tempted automatically to grant such games a crucial advantage in addressing environmental ills because they follow a paradigm based on direct, physical interaction with the real world overlaid with a gamelike scenario, I am myself reluctant to grant them an inherent superiority over exclusively digital games. Furthermore, the current industry trend toward "gamification" of everything from marketing to personal care represents a desire to co-opt the attractions and motivational efficacy of games in an indiscriminate manner that may ultimately prove detrimental to games' civic value.[59]

Before we turn to the increasingly high-profile genres of alternate- and augmented-reality games (ARGs and AR games) and their intersections with "serious" games—that is, games that render porous the usual barriers between game world and real world and those that deliberately tackle social, political, and educational content—it is worth returning for a moment to Lawrence Buell's four criteria for literary "environmental texts" and the ecomimetic conundrum posed earlier in this chapter. While writers like Dana Phillips and Timothy Morton see mediation as the central issue for the constitution of environmental literature, Buell's criteria neatly sidestep the debate by invoking the language of "interests," "accountability," and "process"—like Bruno Latour's Parliament of Things,[60] the environmental text is as much legal as literary, and its efforts at "representation" must be understood as both a signifying and a speaking for. Rather than hitch a text's environmental quality to its ability to immerse a reader in a linguistically performed natural setting, Buell assesses the rigor of the text's ethical and ecological attachments. Succinctly put, Buell suggests that the environmental text is less about personal than intersubjective experience. In it, environments are dynamic agents in their own right as well as the loci for shared human understanding.

My approach to game environments is markedly similar. I am less concerned with graphical fidelity, the kind of realism that comes with hundreds of hours of painstaking, 3D modeling work by artists using expensive software packages, than with responsiveness and responsibility—an accuracy regarding the kinds of relationships that inhere between humans and their

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

environments and between elements within those environments, whether or not humans are present. Though I am not proposing that serious games and alternate- and augmented-reality games are the most effective means to bring environmental considerations to the forefront of game design and experience, they certainly offer some promising avenues. They may also furnish important limit-cases for games' potential to cross over into more explicitly civic and political arenas. ARGs and AR games are, after all, often classified under the rubrics of locative media and pervasive play.[61] Although the growing literature on mobile media experiences is too large to summarize here, it is worth noting that games scholars recognize that mobile gaming is not a phenomenon restricted to smartphone use or other contemporary portable media devices. For instance, Espen Aarseth considers books, board games, and card games as predating modern mobile entertainment forms, and Jussi Parikka and Jaakko Suominen similarly argue that mobile games already existed in the nineteenth century, at least in the West, linking mobile games to modern experiences of travel and urban space.[62] Concurrently, it is worth acknowledging that many traditional and nontraditional nonelectronic games have sallied into the environmental arena. Artist Mary Flanagan has already usefully extended game studies both historically, back into the nineteenth and early twentieth centuries, and generically, to include everything from doll play to improvisational and situational theater.[63]

Accordingly, after providing a brief overview of the development of both alternate- and augmented-reality games, I set out a series of examples in both areas, as well as relevant nondigital or otherwise unconventional varieties of mesocosmic play. These will include environmental "what if?" games like *World without Oil* (2007); the location-sensitive health games of new media artist Greg Niemeyer, *Black Cloud* (2008) and *AirQuest* (2012); and the urban-exploration game *Play the LA River* (2014–15). Niemeyer's games and *Play the LA River* integrate players into urban environments in ways that create awareness of pollution sources and revitalization efforts, and games like *World without Oil* invite players to make present realities out of potential ecological futures. Together, these games testify to the impact that new forms of networked interaction may have on ecological instruction, from the leveraging of social networks to the incorporation of mobile, handheld, or portable devices. A further examination of analog games (the German board game *Power Grid* [2004]), installations (an interactive American museum exhibit about melting polar ice), and escape rooms (an outdoor "nature escape room"

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

designed by environmental science and management graduate students) then extends the broad range of game types and player participation models covered thus far.

Of Bees and Beasts

Although serious games can take many forms, only one of which is the alternate-reality game, I consider the two types here together because both intentionally collapse traditional barriers between real life and gameplay, or ordinary and extraordinary realms of interaction. For some, serious games' explicit handling of real-world problems automatically disqualifies them from status as games, whether because the playing is not entirely voluntary (as in the case of occupational training games) or because the games lack a strong sense of an imaginatively removed "magic circle" that demarcates play from normal life. Serious games often fit more comfortably under the auspices of art or education than recreational gaming, a classificatory quandary evident in the very paradox of the term "serious game." Examples include the scientific protein-folding game, *Foldit* (2008), developed by researchers at the University of Washington; and journalistic and political news games of the kind found at newsgaming.com, for instance the deceptively simple commentary on the war on terror implied in *September 12th* (2003).

ARGs do not necessarily engage directly with social issues, like serious games, but they do even more to blur the usual boundaries between game worlds and real world. Though the ARG genre clearly has ties to many earlier game and story forms, including tabletop and live-action role-playing, theater, scavenger hunts, and conspiracy theory, ARGs are widely considered a product of the new millennium. Many experts cite the 2001 game *The Beast* as the first of its kind, and also credit it with setting the genre's as yet unsurpassed high-water mark. Microsoft and DreamWorks commissioned the game as an innovative promotional device leading up to the June 2001 release of the Steven Spielberg film *Artificial Intelligence (A.I.).* Never officially announced as such, *The Beast* and its principal "puppetmasters" (Sean Stewart, Elan Lee, and Jordan Weisman) instead relied on clues embedded in the movie trailer and poster to bring curious players into the game itself—ludic and narrative introductory devices known as "rabbit holes," an expression that pays homage to the similarly fantastic world-crossing in Lewis Carroll's *Alice's Adventures in Wonderland* (1865). As it turned out, the film *A.I.* disappointed both critics and moviegoers while *The Beast*'s penultimate entertainment

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

was lauded as an unparalleled success, having captured the nearly undivided interest of over ten thousand players over a period of nearly two months, many of whom went on to become loyal adherents of the genre.

Now almost two decades old, the growing ARG community has witnessed a succession of failures leavened by occasional triumphs. The late ARG designer Dave Szulborski (*Chasing the Wish* [2003] and *Urban Hunt* [2004]) described the commercial entertainment landscape as littered with poorly developed attempts to leverage an ARG as transmedia mass-marketing campaign, including Electronic Arts' *Majestic* (2001) and MindQuest's *Terra-Quest* (2003). Fortunately, another highly successful ARG and touchstone for future work arrived in 2004 with 42 Entertainment's *I Love Bees*, developed in advance of Microsoft's game *Halo 2* (2004) for Xbox Live. Intended to foster "a narrative bridge" between the first *Halo* game and its sequel, *I Love Bees* presented a fragmentary story of an alien intelligence forced to express itself through human communication systems.[64] Then lead community designer, now veteran puppetmaster and game designer Jane McGonigal describes *I Love Bees* as "a Web-based interactive fiction that used websites, blogs, emails, jpegs, Mp3 recordings, and other digital artifacts to create an immersive back-story for Microsoft's sci-fi shooter videogame *Halo 2*." In a published case study, "Why *I Love Bees*," McGonigal stresses the ARG's functions as "a game-based digital learning environment," or "a kind of investigative playground," and as "a tutorial in collective intelligence."[65] This last mandate stems directly from French theoretician Pierre Lévy's writings on collective intelligence as a new, technologically driven stage in humanity's development.[66] McGonigal suggests that alternate-reality games are ideal vehicles for teaching today's youth the strategies and skills necessary for success in a networked media- and technology-saturated global communications environment.

To comprehend why ARGs have proven so compelling, we might turn again to ARG designer Dave Szulborski, who argued that the terms "alternate-reality game" or its common synonym "immersive game" are, in fact, largely misnomers.[67] Well-crafted alternate-reality games, he writes, actually do their best to disguise the fact that they are games, attempting to blend into players' real daily activities in a seamless fashion by using media and communications devices such as print, cell phones, and the World Wide Web that players already routinely use in the course of their normal lives. Referring to classic definitions of games that highlight their necessary separation from

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

the ordinary, Szulborski notes that ARGs actively work to conflate "real life" with the played universe, encouraging players to see the game as actuality rather than an alternate or immersive reality (in the sense that it transports you away from normal life or makes you lose your sense of immediately present physical reality). ARGs tap the inherent power of good storytelling along with the simultaneous instantaneity and anonymity of the internet and related communication forms—text messaging, instant messaging/live chat, email, websites, video clips, phone calls, even discoverable crafted artifacts—in order to engage participants in play that is seemingly not play, or what Szulborski identifies as the "This Is Not a Game" (TINAG) philosophy. Unlike most traditional computer or console games, ARGs at launch are often only partially scripted. In other words, ARG puppetmasters leave themselves ample room to accommodate both major and minor alterations in plot, character and puzzle design, and pacing, as players may fall short of or exceed expectations. This constant interplay between game designers (including writers, community leaders, actors and actresses, artists, and so forth) and game players, in which the emergent skills, expectations, and demands of the participant base influence game outcome and structure, Szulborski calls "interactive authoring" and McGonigal calls "real-time redesign." In their flexible capacity to evolve over time, ARGs are in one important sense close cousins to social and casual games like Zynga's *FarmVille* (chapter 4), which are often released in unfinished form or kept in perpetual beta, incorporating player feedback and distributing new content in a "just in time" fashion. Just as ARGs diminish the standard line between reality and simulation, they also trouble any hard-and-fast line between game design and gameplay.

Curiously, while many ARG purists stipulate that a true ARG can never publicly declare itself *as* a game, some ARGs, particularly commercial rather than independent enterprises, have deliberately announced their releases on sites like the Alternate Reality Gaming Network (argn.com) or in publications like *Wired.* Szulborski indicates that this may have been an attempt not only to guarantee a following but also to preempt potential legal complications in our notoriously litigious society. Some may find it quite surprising that ARGs have not encountered greater difficulties with either players or bystanders, given that such games often rely on personal contact with the player that is not predictably inscribed within a game world. In theory, problems might arise if a player mistook the game for real life, or vice versa.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Do immersive games represent the best of both worlds?[68] Or are ARG proponents sidestepping the obvious dangers of conflating real and virtual worlds, from relatively innocuous cases of mistaken identity to psychologically fraught episodes of delusion or paranoia, of the kind taken to a terrifying extent in a film like David Fincher's 1997 thriller *The Game*? ARGs lack both clear physical and temporal demarcation, of the sort provided by an on/off switch or the logon/logoff//login/logout events in a virtual world like *World of Warcraft*, so some games, like EA's *Majestic*, actually limited game progression by introducing new content according to a schedule of predictable daily doses, though with less-than-stellar results.

In an earlier essay, McGonigal discusses a particularly organized group of immersive gamers, known as the Cloudmakers, which formed in response to *The Beast.* What McGonigal notes as most interesting is the Cloudmakers' desire to apply their collective organizational and intellectual expertise to problem areas outside of the initial game—once *The Beast* was over, many Cloudmakers continued to long for engaging problems to which they could apply their "hive mind," and surprisingly, this included well-intentioned attempts to "solve" the 9/11 terrorist attacks as well as the mysterious Washington, D.C.–area sniper attacks in the fall of 2002. The Cloudmakers were not successful in either scenario, and in fact argued among themselves over the morality of treating real-world crises as gamelike puzzles; however, McGonigal suggests that the Cloudmakers' willingness to try nonetheless challenges the common stereotype of gamers as politically and socially disengaged escapists.

To return to the framing question of environmental engagement, I would emphasize that one key to the apparent draw of immersive games is their ability to put real environments at the service of a game state, an unusual but ultimately captivating meeting of physical space and virtual place. McGonigal places this juxtaposition at the heart of the alternate-reality game's absorbing qualities: "the immersive aesthetic proposed by the Beast sought to use *natural settings* as the immersive framework. Rather than creating virtual environments that were (hopefully) realistic and engaging, the Beast's producers co-opted real environments to enable a virtual engagement with reality."[69] Put another way, we could say that ARGs bypass the inherent representational limitations of virtual environments by using real environments in a virtual manner; or, we might linger just as productively on the humble "this" in the TINAG formulation as on the much-contested "game."[70] A linguist would

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

label this "this" as a proximal demonstrative pronoun, meaning that it refers to something near at hand (as opposed to the distal "that") and replaces the given noun in a deictic fashion, in effect referencing or pointing to the contextual situation. We might argue that "this" is really both "this" and "that" in the case of ARGs—both the physical, phenomenologically real experience of the player in a location and the virtual discourse networks and imaginative overlays of the storyline. Perhaps the "this" of the player's world balances or gives substance to the less tangible digital and narrative frameworks of the "game." As I will discuss momentarily, ARGs may offer one innovative approach to environmental and sociopolitical tensions between local and global scales, as they both transpire in players' home communities and leverage worldwide information and communication networks.

World without Oil

Produced by San Jose–based writer Ken Eklund and the Independent Television Service (ITVS), with support from the Corporation for Public Broadcasting, in 2007 the ARG *World without Oil* (*WWO*) simulated a thirty-two-week global oil crisis over the course of thirty-two days, challenging its players (who played themselves) to imagine an alternate reality uncomfortably close to our present times, in which demand for oil has risen 5 percent over supply. Taking as its motto the dictum "Play it—before you live it," *WWO* asked its participants, including many educators and their students, to "play" by submitting narratives of their own methods of navigating the crisis. Some planted gardens, others biked to work, some bought hybrid vehicles, others embraced biodiesel, and so on. *WWO* was never solely the stuff of bits and bytes, and that was, perhaps, the reason for its success—while players toiled endlessly on the worldwithoutoil.org website to share photos, stories, videos, and more, ultimately gameplay demanded a deliberate conflation of on- and offline social networks, environmental imagination and lived experience. A game like *WWO* encourages its players to see the real world as a problem space capable of supporting innovative environmental solutions. In a way, the game defamiliarizes the mundane, everyday character of our surroundings and our actions within them by imposing a narrative and a procedural interface that in this case highlights the follies of reliance on fossil fuels. Games need not be "serious," however, to draw on and influence "real" life. Veteran game designer Will Wright, whose whimsical game *Spore* I will discuss extensively in the next chapter, generally "sees games moving toward

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

tighter connections with a player's real-world identity, latching onto social networks and reflecting what is going on in a gamer's real life."[71]

Black Cloud

In part inspired by *World without Oil* and the *Continuous City* work of the Builders Association, *Black Cloud* began as a game proposal for the Digital Media and Learning Competition sponsored by the MacArthur Foundation. Designed for high-school students in South Central Los Angeles and downtown Cairo, Egypt, *Black Cloud* was described as "a game, where students study local air quality by searching for secret neighborhood air quality sensor stations based only [*sic*] the air quality data the sensors transmit."[72] Game organizers argued that their goal was to "bring suspense to environmental studies," adapting game mechanics and narrative devices to real-world scenarios. Participating students were challenged to try to determine the sensor locations, get to know their local neighborhoods, and contribute content to the game website, with the top contributor receiving an award that included funding for pollution abatement. University of California, Berkeley, researchers Greg Niemeyer, Ilse Mercado Ruiz, Laura Greig, and Stephanie Gerson developed the game in collaboration with two institutions in the chosen cities (Manual Arts High School and El Sawy Cultural Center, respectively). Seen as a form of "pedagogic innovation" and an intervention into traditional climate change studies, the game was billed as "an alternate reality mystery game" using "the framework of a fictional contest between green NGO's and market-driven real-estate companies." The mystery itself is climate change, notorious for being difficult to pinpoint and understand in local terms; however, the mystery is also the fictional scenario provided by the game organizers: why has the fictitious real-estate company, the Xylon Corporation, destroyed most of the sensors provided by the equally fictitious charity organization, First Breath? And who are the "sentients" or neighborhood residents that have tasked themselves with safeguarding the remaining sensors?

The wireless air-quality sensors (Figure 8) used in the game were built to detect and transmit information about ozone, carbon monoxide, and carbon dioxide levels, along with temperature, and were placed strategically at critical locations like highway ramps, gas stations, supermarkets, and construction sites.[73] The students, or "agents," in the game were then tasked with determining the sensor locations by correlating the fluctuating data with real-world

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

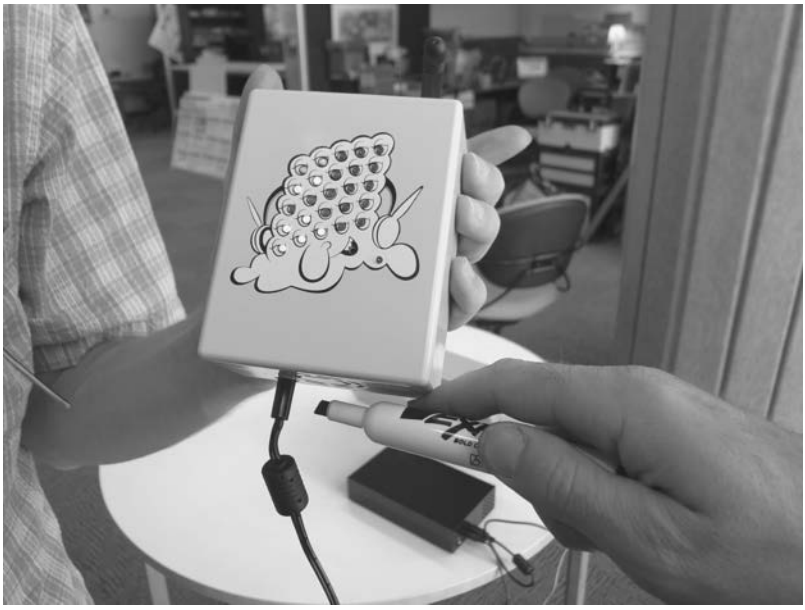

Figure 8. A sensor box created for the environmental alternate-reality game *Black Cloud*, featuring pollution-as-game-character, Cloudy McPufferson. Photograph by Greg Niemeyer.

activities. For example, a spike in sensor levels might correspond with rush-hour traffic. *Black Cloud* would influence the development of a tablet-based mobile game also concerned with air quality, initially called *Pwning Asthma Triggers*,[74] later renamed *AirQuest*.

AirQuest

While not an alternate-reality game in the usual sense, *AirQuest* shares with *World without Oil* and *Black Cloud* a concern with environmental specificity and quality. We began work on *AirQuest* in October of 2011, funded by a seed grant from the Center for Information Technology Research in the Interest of Society (CITRIS), a multicampus initiative in the University of California system. Led by professors in art, anthropology, engineering, and atmospheric science from UC Berkeley and UC Merced, including *Black Cloud*'s Greg Niemeyer, the project proposed development of a short, mobile touchscreen game aimed at educating at-risk community members about the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

causes and dangers associated with environmentally triggered asthma—in particular anthropogenic air pollution. The first game prototype was developed for the city of Fresno, California, in the heart of the San Joaquin Valley, the southern portion of California's famed Central Valley (Figure 9). The Central Valley constitutes the state's primary agricultural production region, and Fresno is a city of approximately half a million residents. Once a railroad town, it is now the county seat and a hub for agricultural processing and industry. Dubbed the "asthma capital" of the state by a local paper, the *Fresno Bee*, official surveys of the asthma problem in the area have called it an "epidemic."[75]

The game's novel take on the growing field of serious games was its incorporation and simulation of actual regional wind models and ozone and particulate-matter air-pollution data from the Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA). *AirQuest* also demonstrated innovative approaches to both game design and science education, not only through its multicampus, multidisciplinary production team, but also in its uniquely egalitarian process of

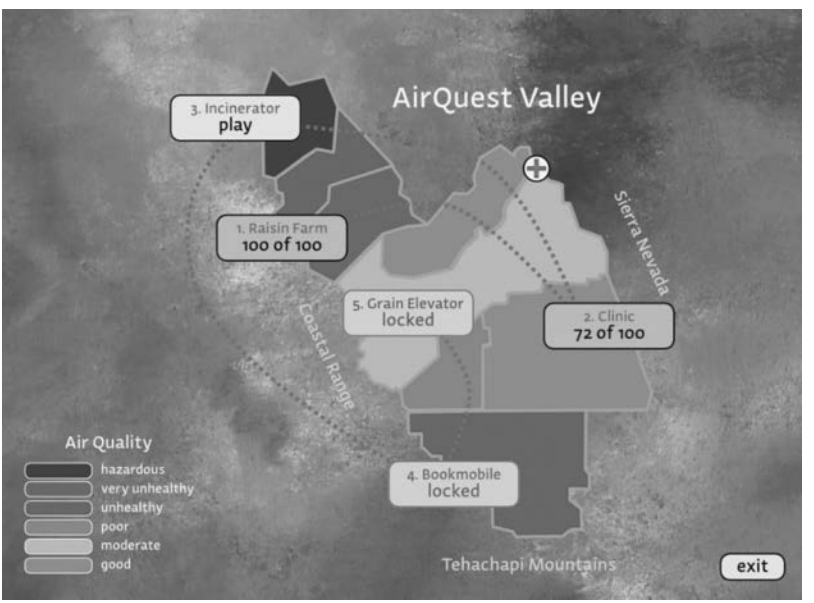

Figure 9. A fictionalized version of California's San Joaquin Valley designed for the educational asthma game *AirQuest*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

codesign that enabled a diverse network of Central Valley locals (including, most notably, thirty high-school students from Fresno High School, which boasts some of the greatest ethnic and cultural diversity in the area but a graduation rate of about 80 percent) to participate in the game's development. Information was also gathered through contact with air-board officials, air-quality advocates and activists, residents, and local agricultural workers. From a research standpoint, *AirQuest* showed that games could embed specialist knowledge (atmospheric chemistry and the dynamics of scale, for example) in simple gameplay mechanics legible to nonspecialists. *AirQuest* also suggested that game environments can be meaningfully local, faithful to the difficulties and lived experiences of a particular place and time, rather than wholly generic or fantastic in nature. The protagonist of *AirQuest* was imagined to be a young boy suffering from asthma, yet it was important to us to portray him less as a victim than as someone empowered with a unique kind of environmental intelligence, because asthmatics are indeed more sensitive than others to "triggers" of asthma symptoms, from cigarette smoke to air pollution.

Play the LA River

Organized by the art collective Project 51, *Play the LA River* offered fifty-one weeks of river-based play between September 2014 and September 2015 to parallel the fifty-one miles of the Los Angeles River, from its inland headwaters in the San Fernando Valley to its ocean mouth in downtown Los Angeles. Described as a game of "urban exploration and imagination," the game invited Angelenos to discover their local river, one that many did not even know was there or had thought lost to pavement and pollution. *Play the LA River* invited participation on three fronts: first, through a playable card deck divided into four geographical suits, with each card giving directions to a particular site on the river and suggesting activities tailored to that location (Figure 10);[76] second, through programming and collating a series of live events, ranging from cleanups and environmental-justice-oriented "toxic" bike tours to butterfly watching, yoga and meditation, and rain dances in "droughty drag"; and finally, online through a robust website and social media campaign with the hashtag #playthelariver. The card deck employed a simple "gritty-to-green" meter to forewarn players about the relative accessibility of each site, and the website also encouraged players to play safely and legally, since it is only permissible to enter the river at two locations, and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

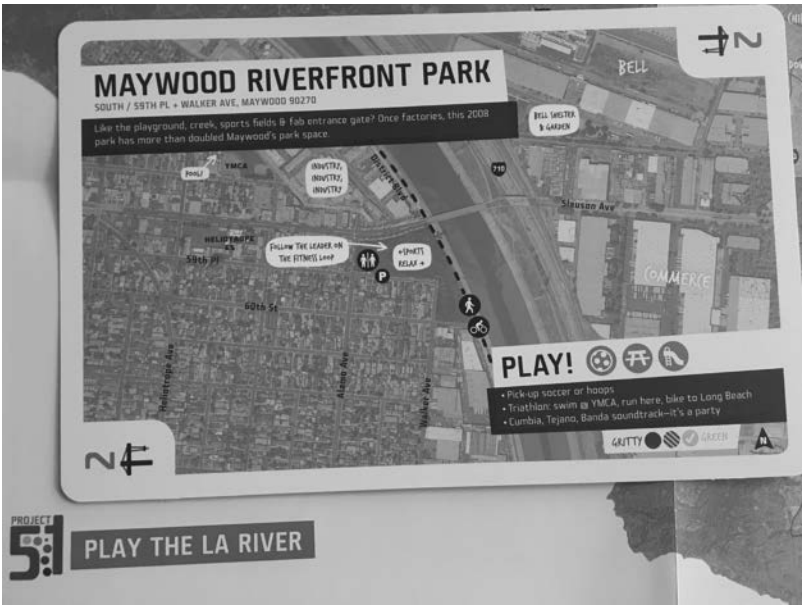

Figure 10. The *Play the LA River* card for Maywood Riverfront Park in southeastern Los Angeles County, opened in 2008 on the remediated site of the former Pemaco Maywood chemical mixing plant and part of the City of Los Angeles's LA River Revitalization Master Plan. The park serves one of the poorest and densest communities in the greater Los Angeles area.

only during the summer season. Although the alternate reality promoted by this game was less fantasy than neglected fact, *Play the LA River* aimed to restore the river both ecologically and socially, not unlike the public project of the river's revitalization recently touted by the mayor and city of Los Angeles.

Power Grid

Published by Rio Grande Games and developed in Germany, not incidentally home to one of the most active Green Parties in the world, the board game *Power Grid* invites players to become energy tycoons. Players compete to develop the largest networks by supplying the most cities with power, which requires purchasing and upgrading power plants as well as the raw materials to power them, from dirtier sources like coal, oil, and garbage to uranium and "renewable energy" sources like wind and solar. Clearly, just because a game does not use transistors or computer chips does not mean

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

that it is not procedural, as amply laid out in Ian Bogost's early work. *Power Grid* is still turn-based and rule-driven, though it may place more of the onus of execution on its human players. Moreover, *Power Grid* embeds a variety of arguments within its procedures: in its operational universe, demands for energy must be met, cities are the most valuable nodes in an energy network, and environmentalism can be profitably melded with capitalism. In *Power Grid,* power is power—success lies in the canny use of natural resources, and those living off the grid might as well be nonexistent. The game has become successful enough to support the production of numerous board expansions. The original board modeled Germany on one side and the United States on the other, but this was quickly followed by boards representing France and Italy, Central Europe, China and Korea, Japan and Russia, and most recently, Northern Europe/UK/Ireland and Australia and the Indian subcontinent.

"Altered State"

At the end of September 2008, the California Academy of Sciences in San Francisco's Golden Gate Park reopened its doors after a nearly decade-long, 500-million-dollar renovation that made the historic institution, founded in 1853, into a Platinum-rated Leadership in Energy and Environmental Design (LEED) building according to the U.S. Green Building Council. Home to a planetarium and aquarium, the building also encompasses the Kimball Natural History Museum, which greeted visitors in late 2008 with a variety of new exhibits. A large portion of the main hall was devoted to a section entitled "Altered State," which turned out to be a play not only on consciousness as a state of mind but also the implications of climate change for the state of California, already internationally known as a leader in environmental initiatives. Dr. Peter Roopnarine, an academy scientist, served as lead curator for the exhibit, and Jonathan Katz, CEO of Los Angeles–based Cinnabar Inc., worked as the executive producer for the new exhibits. According to Katz:

> Climate change doesn't have a fixed outcome—what we do as individuals and as a community will affect the next part of the story. That's why it was important to design and produce the new "Altered State" exhibits—which account for 10,000 square feet of the 35,000 square feet of exhibits we created for the new California Academy of Sciences—as a participatory guest experience. The issue becomes real in terms of people's daily lives—the choices we make—and how we perceive California.[77]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

Part of a module on "melting snow and ice," one activity was called "Polar Ice: Critical Zone" and took place within an approximately fifteen-by-ten-foot screening area. The focal wall supported the projection of a northern sea dotted with broken ice floes. In one corner stood a female polar bear, in the opposite, her cub, and rising worldwide temperatures had apparently fragmented the once contiguous ice sheet and separated the two from each other. To save the stranded cub, visitors were encouraged to use their bodies in interactive ways to "block" the sun's (projector's) rays, thereby casting cooling shadows on the image. Where a shadow fell, the sea's surface temporarily hardened, and once enough visitors worked to link their shadows, the hapless cub bounded across the restored ice to his waiting mother.

The exhibit reproduced one of the signature wounds of the contemporary environmental imagination—the idea that climate change, which has had the most dramatic effects at the Earth's poles, has had a disproportionately negative effect on the species that rely on pack ice and subfreezing temperatures in their Arctic/Antarctic zone. The polar bear drifting hopelessly on a lone berg of melting ice in the middle of a thawing sea has been popularized by Save the Earth Foundation and National Resources Defense Council campaigns, commercials for the Nissan LEAF, and a nature feature film like *Arctic Tale* (2007). But in marked distinction from helpless viewing of advertisements where a lone polar bear is shown adrift in an iceless ocean, visitors to the museum exhibit felt empowered to take action. Stretching their arms in the air or waving bags and clothing to block as much of the "sun's" rays as possible, participating visitors turned the exhibit into a kind of impromptu shadow choreography, a solution that was both playfully collaborative and active.

BranchOut: Unlock the Outdoors

Escape games may have begun in Japan as recently as 2007, before subsequently migrating to other parts of Asia, Europe, and the United States, Canada, and Australia.[78] According to the devotee blog Room Escape Artist, the number of escape rooms in the United States has leapt from not even two dozen facilities in 2014 to well over two thousand as of the summer of 2017,[79] and evidence that escape rooms have infiltrated American popular culture abounds on both network and cable television, from the short-lived game show *Race to Escape* (2015) on the Science Channel, to escape-room-themed episodes of scripted series like *The Big Bang Theory* (2007–19) or reality shows

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

like TLC's *Kate Plus 8* (2007–17). But given that a typical escape-room experience is often described as being locked in a room with other people and being forced to work together to find a way out, it may come as a surprise to learn that some have tried to repurpose the idea to teach environmental concepts through *outdoor* escape rooms. In the fall of 2016, then graduate students Nicole Poletto, Lindsay Martien, and Rick Thomas approached me as a consultant for their then nascent master's thesis project for the Bren School of Environmental Science and Management at the University of California, Santa Barbara. In their words, they wanted to foster "environmental values alongside new and creative ways to interact with the outdoors through a rotating curriculum of puzzles, games, and challenges," while using "many of the aspects of popular videogames—such as fun and engaging storylines, teamwork, and an achievement system that rewards completion of tasks—without sitting in front of a screen for hours on end." In the end, Poletto, Martien, and Thomas created several short scenarios ("The Biosphere Project," "The Great Mammoth Hunt," and so on), designed primarily for parents with children ages seven to twelve. The first playtests were conducted at the Santa Barbara Botanic Garden and Santa Barbara Museum of Natural History in February and April of 2017. Foreshadowing what may become a novel strain of the escape-room movement, the organizers carefully cordon off or otherwise demarcate the play area with caution tape and the like, while designing each module to communicate different environmental skills, from identifying edible plants to tracking animals.[80]

"Catch 'Em All in Real Life"

Released in the United States on July 6, 2016, *Pokémon Go* has been one of the most visible examples of games' increasing intersection with everyday life. The game takes a longstanding and much beloved franchise, Nintendo's *Pokémon* series (first introduced as a Game Boy game in Japan in 1996), and integrates it with the camera, location services, and health utilities of the contemporary smartphone to bring a simplified version of the Pokémon experience to the real world. Having already generated scores of handheld and console games, trading cards, manga, television cartoons, and toy lines, the basic premise of the Pokémon series—catching wild creatures and teaching them to battle other tamed Pokémon—has reinvented itself through its translation to an augmented-reality form. In other words, *Pokémon Go* superimposes the fiction of Pokémon onto the real geography and built

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

environments of players' lives, turning natural landscapes and cultural and historical landmarks into Pokémon habitat and infrastructure for player-trainer development.

Definitions of augmented reality vary, but most agree that in order for AR to be AR it must (a) overlay the real world with a computer-generated display or interface, in which (b) the two must be aligned (or registered) to each other and (c) real-time interaction is possible.[81] Unlike immersive virtual environments, augmented-reality technology supplements reality rather than replacing it.[82] Augmented-reality technology has been around for decades and used in a number of areas including entertainment, military, manufacturing, and medical visualization applications, but a dramatic increase in the quality and ubiquity of AR tech has taken place since the turn of the

Figure 11. In the mobile augmented-reality game *Pokémon Go*, a wild Numel pops up on bluffs overlooking the Pacific Ocean in Santa Barbara (left: with the augmented-reality feature turned off; right: with the augmented-reality feature turned on).

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

millennium, perhaps most infamously in the case of Google Glass, and more incrementally with game systems. Early camera-based peripherals like the PlayStation's EyeToy and Move and Microsoft's Kinect, and various handheld game devices like the PS Vita and Nintendo's 3DS, have all made augmented-reality gaming fairly commonplace in the console and handheld gaming markets, while other companies like LyteShot have developed their own custom hardware for outdoor run-and-gun games like *Assassin* (2015).

Developed by Niantic, formerly a part of Google and developer of the augmented-reality massively multiplayer online (MMO) location-based exergame *Ingress* (2013), *Pokémon Go* imbues the world with the fiction that wild Pokémon are all around us, awaiting discovery and capture. The game uses Google Maps and GPS technology to overlay players, Pokémon, supply points (PokéStops), and gyms (places where trainers may battle other teams' trainers or train their own creatures) on players' actual locations, and the optional AR feature lets you see Pokémon as they spring up around you (Figure 11).

Journalistic coverage of the game has centered largely on sensational incidents produced by *Pokémon Go*'s intrusion into ordinary space and activity, from players stumbling on dead bodies and drug deals to car accidents caused by distracted players and criminals using the game to lure victims. But even those who missed the ample buzz over the game were made aware of the game's popularity in the form of preoccupied, smartphone-wielding Pokémon trainers, with their signature (some would say erratic) movement and behavior patterns—namely, walking, running, skateboarding, sometimes even driving while periodically consulting the phone and stopping to intently swipe or tap it. For nonplayers, players might seem odd or menacing, assisted by the fact that Pokémon spawn points are commonly found in little-used urban and suburban places. Yet dismissing the game as mere childish novelty or security threat misses *Pokémon Go*'s many attractions as an exemplar of playable nature. Not only does the game integrate virtual and visceral experience, but also, as I will discuss in chapters 3 and 4, caring for digital animal and plant life has its own modest rewards. Not surprisingly, People for the Ethical Treatment of Animals (PETA) has produced several biting parodies of Nintendo's *Pokémon* franchise, for instance the game *Pokémon Black & Blue* (2012), with the tagline "Gotta free 'em all!" in which abused and battered Pokémon rise up against their former trainers. Fortunately, we may choose a middle course between animal liberation and domination, turning instead to animal trainers like Temple Grandin and feminist-socialist science

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

and technology scholar Donna Haraway, whose deep affection and respect for companion species animates my thinking.

One noteworthy source of disappointment with *Pokémon Go* stems from its ongoing neglect of rural environments. In a twist I find especially ironic given the game's ostensible premise of finding and catching wild animals, Pokémon rarely spawn in uninhabited or lightly inhabited areas, since the game uses landmarks submitted by players of Niantic's previous game in conjunction with frequently geo-tagged or posted attractions from the volunteer-driven Historical Marker Database (HMdb.org). In fact, players in less urban areas have consistently complained about the relative dearth of Pokéstops and gyms in their areas,[83] highlighting a backend lack of natural data and continuing digital divides based quite literally on geography and the topography of cellular data coverage networks.[84]

Environmental Realism: Translating Play to Action and Transmediality

Can games really promote learning, activism, and lifestyle change? The designers of educational games and the broader category of serious games, as discussed in this chapter, would certainly answer in the affirmative. As Henry Jenkins and Alexander Galloway have pointed out, however, granting games this ability also renders them susceptible to the criticism of media-effects theories, most prominent among them what Galloway calls the "Columbine theory" of video game violence. While some studies have cast doubt over the constructive permeability of games and the real world—for instance, the 2008 Pew Internet and American Life Project report on "Teens, Video Games and Civics," which essentially concluded that while almost all young people today play games, their game-playing did not necessarily correlate with higher or lower civic participation rates—others have shown that virtual environments can have salutary health benefits and that action taken in immersive environments has greater lasting impact on environmental behavior than messages imparted by print or video.[85] In the latter University of Georgia and Stanford University study, researchers essentially compared the impact of cutting down a virtual tree (using VR gear) to reading a print description or watching a video of cutting down a tree on participants' paper conservation and perception of environmental efficacy.[86] And while many studies have demonstrated the restorative benefits of spending time outdoors or having natural views, coverage of these findings often fails to mention that simply being shown representations of natural environments also has a

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

significant, if not as large, positive impact on stress levels, attention and task performance, and physical recovery.[87] In other words, all those well-meaning nature triumphalists and simultaneous technology denigrators may have jumped prematurely to their conclusions, and those of us conditioned to see games as gadgets-plus-geeks risk losing sight of the growing vitality and variety of game worlds.

Thankfully, Galloway moves past previous media-effects discourses on video game violence in a multipronged fashion: first, by stressing that gaming is active and participatory, that is, that video games as an action-based mass medium have displaced the primacy of vision. Like Ian Bogost, Galloway recognizes that interaction is fundamental to gameplay, and notably allows agency in terms of both machine and operator, that is, the computer and its user, explaining that "games are fundamentally cybernetic software systems involving both organic and nonorganic actors."[88] Additionally, Galloway's attention to social realism, or the nonrepresentational realism of player action and its congruence with one's social life, helps to shift discussion to games' potential to spark social, political, and of course I would add, environmental action. Bogost similarly acknowledges that the effectiveness of a game's procedural rhetoric depends on the preconceptions that a player brings to the game.[89] Though at times he argues that there is no necessary correlation between a player's experiences in-game to that player's experiences out-of-game (for instance, in denigrating dynamic in-game advertising), Bogost grants that some games can be truly persuasive, even potentially empowering (for instance, when a nonfarmer plays *John Deere: American Farmer* [2004] and thereby gains a better appreciation of agriculture). Most important, perhaps, Galloway demonstrates that a new hermeneutics regarding video game interpretation is needed, summed up in his own appropriation of "deep play" from Clifford Geertz: "Because play is a cultural act and because action is textual, play is subject to interpretation just like any other text."[90] The analysis of a game requires an understanding of not only the unique affordances of the game itself, but also the contributions made by the player and her cultural milieu. Galloway thus ends *Gaming* with the concept of countergaming and the desire to align gaming more closely with glitch art and tactical media or hacktivist interventions.[91]

Games, then, are transmedial in more ways than typically imagined by critics and industry thought leaders. Games are usually seen as transmedia when they blend or overlap with content in other areas: films, music, literature, and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

so forth.[92] This kind of transmediality is symptomatic of much of the mainstream media's vertical integration tactics—every film or TV franchise seems to be accompanied by its own website, video game, stuffed toys, books, and even lunchboxes and towels. However, I think the concept of transmedia can be fruitfully pushed further to explore the correlation between the real and the virtual, lived life and played life. Transmediality might usefully apply to games that model ecology and the environment, especially if we are willing to see social life as a medium with its own aesthetics and proceduralism. For many, this has already been enacted in the current rise of serious games and alternate- and augmented-reality games, which implicitly define themselves in opposition to more traditional games, regarded perhaps unfairly as frivolous or unrealistic. In transmedia, someone takes interests from other areas and brings them to games; in serious and other-reality games, someone first and foremost interested in games winds up learning something unexpected, be it about pollution, policy, or animal husbandry.

In the end, no few scholars and designers suggest that games may be the ideal training ground for knowledgeable consumers and politically active citizens. Speaking of *I Love Bees* and collective intelligence work, Jane McGonigal writes: "I am suggesting with this case study that for young students learning about CI for the first time, popular culture and online entertainment will remain the most effective spaces for learning how real-world massively collaborative participation works."[93] Similarly, Henry Jenkins implies that we may naturally migrate from entertainment-oriented, pop-culture applications toward more mindful ones.[94] In this vein, perhaps, McGonigal has dubbed the grandiose scale of modern games "epic environments." Likening them to ancient stone cathedrals that reflected the handiwork of thousands, McGonigal explains that "Our experience of these epic game environments isn't physical, but it is real in one crucial sense. The engineering of the virtual environment represents, today, a collaborative feat on an extreme scale." The purpose of an epic environment is "to create a space that completely absorbs and envelops the player in a sense of awe and wonder."[95] McGonigal also praises what gamers term "epic wins"—successes so dramatic and hard-won that they live on in shared memory—and she goes on to suggest that epic wins are not only feasible in epic digital environments, but also that large-scale, playful cooperation will make a difference in the world beyond.

The many games surveyed in this chapter constitute less a comprehensive typology than a sortie into certain liminal categories of games and gamelike

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

experiences that exemplify the kind of game/world imbrication that I have heretofore celebrated. In addition to alternate-reality games like *World without Oil* and *Black Cloud*, augmented-reality games like *Pokémon Go*, and other location-sensitive games like *Play the LA River*, the growing variety of analog and nontraditional games (board games, installations, escape rooms) shows how environmental gameplay also permeates offline, educational, and built environments. Although hardly exhaustive of the many possible permutations of existing games and game types, this chapter's broad consideration of the mesocosmic qualities of games has prepared us to think carefully about games as scalar experiments (chapter 2), games' engagement with the nonhuman (chapter 3), and the critical antithesis to augmented-reality games, what I would call diminished- or depleted-reality games (chapters 4 and 5), in which game environments reflect on the already troubling ecological status quo or project future crises and their evitable aftermaths.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:34 UTC
All use subject to https://about.jstor.org/terms

2

Scale

Some of my earliest and fondest memories of playing computer games involved measuring myself against game environments: hurrying across a field of bright green and blue—forest and water—in *Realm of Nauga* (1982) for the TRS-80, patiently pacing from screen to screen in *King's Quest* (1984) on the Tandy 1000, and, much later, daring to cross the seemingly endless, bandit-infested plains of West Karana in the original *EverQuest* (1999). Although players and game characters have always been the subject of intense scrutiny, these early games linger in my memories less because of their character development than their sprawling worlds. Within them, the player character was a small, even negligible entity, in part a convenient narrative focus (escape the Nauga!) as well as a familiar way to gauge game distance and time. Even in the case of *EverQuest*, which as one of the first MMORPGs took avatar creation to new heights of narcissistic detail, the game world had grown in proportion, becoming not only more immense but simultaneously more thick with possibility.

Mark J. P. Wolf, Michael Nitsche, Henry Jenkins, and others have written compellingly about game space,[1] but my aim here is to look less at game environments or players in terms of their own merits than to look more closely at the relationship *between* the player and the game space, or to think about relative scale as the operative framework for describing player environmental experience. Embedded in a scalar approach to games is an implicit commitment to environmental ethics, something I will return to again and again in considering the political and social consequences of world design in games. In short, it matters whether we play as small, middling, or large entities, whether we crawl, swim, or swoop, and whether our horizons seem to hem us in or invite us onward. It matters, as well, that the devices on which we play our games are products of the global shuttling of natural resources and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

factory work, and an unsustainable faith in Moore's Law of exponential growth in transistor density (chapter 4).

From the technology industry's less-than-reassuring projections of the "scalability" of their products to science journalist Elizabeth Kolbert's conclusion that "for better or (mostly) for worse, global warming is all about scale,"[2] scale works to enmesh both the technical and environmental parameters of games. Although we shall see that as a term, scale has no neutral or stable value, we humans inevitably organize our thoughts and actions by degree, magnitude, or extent. Furthermore, our media cannot escape this abiding structuring. This work deliberately straddles the nexus between media and ecology, and in doing so, questions of dimension invariably arise. Ursula Heise has noted, for instance, how media theorists have historically deployed media ecology at different scalar levels depending on their intellectual dispositions: globally, as represented by Harold Innis, Marshall McLuhan, and Neil Postman, and locally, as represented by Bonnie Nardi and Vicki O'Day.[3]

Environmental thinking has always been an exercise in scalar understanding. How much is too much, and when is enough enough? Acting in an ecologically responsible fashion calls for suprapersonal awareness of the impact and extent of one's actions. Green bumper stickers thus urge us to think globally, while acting locally, and even household cleaning products invoke the Native American creed of the seventh generation to align themselves with a less polluted distant future. Hand in hand with this feel-good expansive awareness comes the terror of disproportion. Scale has served as environmentalism's convenient bogeyman in rhetoric dating back to at least Thomas Malthus's *An Essay on the Principle of Population*, with its bleak pitting of an arithmetical food supply progression against geometrical population growth. Yet impersonal scale also obliges less environmental agendas. As I will discuss further in chapter 4, on entropy, venture capitalists and titans of industry are generally obsessed with economies of scale—roughly speaking, the benefits that accrue from a larger company size or volume of production. They are notably less interested in diseconomies of scale, even though one classic evasion of responsibility for ecological damage, by designating it an externality to the system of production and consumption, largely depends on scalar spin-doctoring: are you sure the current spike in global temperature is out of proportion to what has come before or merely a result of normal cyclical

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

variation (climates change, as the climate deniers say)? So, too, one cannot be held accountable for pollution assessed below "significant" thresholds of concentration (in parts per million), for injuries occurring too far in the past (the statute of limitations), for damages originating upstream, not-in-my-backyard, or held in common. Sometimes to our advantage but more often to our detriment, so much of our perception of environmental risk and reward hinges on scalar framing, in this case creating and policing measurements of toxicity, time, and distance.

In games, scale is equally central and just as two-faced. The presentation and experience of scale is a major yet neglected factor underlying a game's ability to provoke player feelings of mastery and its converse, awe. In the first case, one often remarked in critical writing about games as cybernetic systems, the illusion of control stems from not only games' "interactive" responsiveness but also interfaces and abilities that mimic the cartographer and surveyor in bestowing an information-laden satellite vision,[4] one in which the game environment exists to be mapped and measured. But at the same time, in the place of action, speed, and god's-eye surveillance, games may also invite you to feel small, do little, and take your time doing so. Awe, what some might call the sublime, accompanies a humbling realization of one's relative insignificance before or within the presence of an other in some way vastly more capacious, be it an ocean, mountain, or mathematical infinity. That both mastery and awe may coincide in the playing of a single game is a curious phenomenon, worthy of exploration—what is the attraction of playing a primitive aquatic microorganism, swimming about in the primordial soup of an alien world (as in *flOw* [2007])? What am I doing when I use the plus and minus buttons on the overhead mini-map in *World of Warcraft* to zoom in and out? Or in *Spore*, when I scroll the mouse wheel to peer closer at a planet, or withdraw from the scene at hand?

In what follows, I will argue that games are tailor-made to develop scalar environmental consciousness, for instance by bridging local and global, micro and macro domains. While thinking in this way about environmental representation in games inevitably confronts calcified ideals of realism and transparency, I prefer to treat games as simplifications that allow patterns to emerge more readily rather than militate for a verisimilitude that demands one-to-one mapping. In fact, as the following brief review of the scientific literature on scale in ecological journals will suggest, video games share certain

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

fundamental qualities with field and laboratory experiments, and both players and scientists exercise their creative and rational faculties to make sense of the worlds around them. Gameplay and scientific work are, it turns out, closely related enterprises.

First, several caveats are in order. Foremost, scale means many things to many people. Groups as diverse as mapmakers, geographers, field ecologists, and computer scientists use the term but seldom agree on its definition, in part because scale is inherently relational. As Willard McCarty has said of models, scale implies at minimum a ternary structure between measure-taker, that which is being measured, and the measure itself.[5] In practice, this has meant that scale serves equally well as an instrument of revelation and distortion. Scalar arguments have accordingly been both the clarion call and the bête noire of environmental movements—picture the Leonardo DiCaprio–narrated *The 11th Hour* (dir. Leila Connors-Peterson and Nadia Connors, 2007) and again the bumper-sticker mantra "think globally, act locally" alongside Malthusian warnings about population growth and the unapologetic rhetoric of globalization.[6] For my purposes, scale is less significant as a graded system of measurement than as an acknowledgment of interspecies and Latourian interobjective relativity. That is to say, scale connotes dependence as well as magnitude. The word may conjure the undue tidiness of architectural miniatures and the conformation of environments to users, but it also makes possible a thinking through of excess, a thinking *beyond* in the realm of hyperobjects.[7]

Along the way, I hope to reveal some of ecology's potential affinities with digital interactive media.[8] At the same time, this chapter is intended as an initial inquiry into the variations in scalar representation across media. While I want to resist characterizing the transition from print and photography to the moving image (*Powers of Ten*) to the sandbox simulation game (*Spore*) as progressive teleology, I will argue that contemporary games offer quantitatively and qualitatively distinctive opportunities for the representation of pressing ecological quandaries. Where Ralph Waldo Emerson once described poetry as possessing a rare ability to "magnify the small" and "micrify the great," thereby transforming our perception of the material world, I present games as both an aesthetic and an ethical means to engage in world design and management, one especially well suited to exploring questions of sustainable action and scope.[9] Understanding how scale is defined and instantiated in our media culture should be of paramount importance in an age vexed

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

by parochialism, transnational corporate ambitions, and borderless phenomena of minute and massive proportions, from toxic contamination of living tissue to ocean eddies and extreme weather.

Leveling Up

Apart from a relatively short-lived experiment with experience loss and "de-leveling" in the first *EverQuest*, games in which players control and develop characters generally encourage a one-way progression. Be it inventory, skill, cash, or level, much of the supposed lizard-brain satisfaction of playing depends on this "blissful" accumulation of points, stats, sums, and items.[10] Setting aside early coin-operated arcade games and a recent, experimental run of new "permadeath" games, to be discussed in chapter 5, games today revel in the kind of consequence-free play that often reigns in toddlers' rooms—build, destroy, rebuild, destroy, start over yet again or just leave things where they lay. Someone else will pick up the mess (we hope). As many a detractor has noticed, games lure us to play with the unspoken promise that we will always gain, and the reassurance that we can only ever level up.

For an environmental thinker, there is something fundamentally disturbing about this paradigm. Perhaps it has something to do with the inevitable conflict between capitalist growth and sustainable reimagination that journalist Naomi Klein documents in *This Changes Everything: Capitalism vs. the Climate.*[11] Video games surely share some of the blame for the mega-growth fantasies perpetuated on Wall Street, at quarterly stockholder meetings, and in the councils of transnational trade organizations, not to mention the grocery store and the mall.[12] The problem is not just a cavalier attitude toward growth, but the absence of equal attention to the constraints on growth and inverse processes of decline, the murky shadows on the other side of the axis. How do we retain the freedom of replay and creative exploration that makes games so delightful, knowing that our safety net is also a false bottom, conveniently hiding the depths of our indifference? If games have a saving grace in this regard, it is their patent agnosticism in regard to scale—digital play embraces the minute and the massive, empire and apocalypse, with equal aplomb, enabling us to inhabit different perceptual worlds and toy with space and time. It is time for games to wrest scaling from corporate boardrooms and technical specifications and to think more in terms of humanistic environmental studies. Magnitude with direction.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

Granted, experts across the disciplinary spectrum express mixed feelings about scalar models, seeing them as necessary and illuminating frameworks, on the one hand, and falsely subordinating constructs, on the other.[13] We might expect scientists to have fewer qualms, but lately many have been at pains to historicize and disambiguate the notion of scale. A case in point: though today, references to ecology routinely evoke local communities, regions, and an entire planet in crisis, the concept of scale did not become popular in scientific circles until the 1970s.[14] Biologist John Wiens could write in the late 1980s that "'Scale' is rapidly becoming a new ecological buzzword," even while chiding fellow ecologists for being slow to adopt scalar thinking (relative to colleagues in physics, math, geography, and atmospheric and earth science).[15] Two decades later, a literature review conducted by Brody Sandel and Adam Smith demonstrated that scale remains both poorly understood and applied as a variable in experimental design.[16] As early as 2002, NASA researcher Jennifer Dungan and her coauthors recommended avoiding the word scale completely, in favor of more specific and universally agreed-upon terms.[17]

These scientific misgivings about scale are summarized in the following five cautionary principles, which in turn imply why games may embody a desirable alternative to actual experiments.

1. Scale Operates at Both Spatial and Temporal Levels

As Wiens notes in his early article in *Functional Ecology*, the inclination is to favor the spatial over the temporal or to examine the two aspects in isolation, rather than in tandem. Of course, such reduction flies in the face of the equally spatial and temporal complexity of human-wrought environmental change—from disrupted patterns of animal migration and biotic homogenization through globalization to Stoermer and Crutzen's dubbing of the current geological epoch as the Anthropocene. Human agency is dramatically altering the very scale of events even as human perception has proven itself blind to catastrophic change that occurs in geologic time.[18]

Scientists also generally parse scale into grain or resolution (unit size) and extent (range). Notably, as geographer Nathan Sayre writes, the difficulties of perceiving and addressing climate change are in large part due to the unique combination of fine grain and large extent, in both space and time: "One might venture the thought that humans can barely think at the scale of global warming—after all, we have never had to do so before."[19]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

2. Multiscalar Analysis Is Better Than Monoscalar Analysis

Scientists also tend to design experiments confined to only one spatial scale, even though this limits the validity and generality of their findings. According to Sandel and Smith, scale is a "lurking factor" that frequently is not acknowledged or studied due to logistical constraints and the field ecologist's traditional reliance on the quadrat.[20] More resources must be expended to collect data at multiple scales, so restricting the grain and extent of one's experiment is always tempting because it reduces the number and impact of confounding variables.

3. We Design Experiments on Anthropocentric Rather Than "Effective" Scales

It probably comes as no great surprise that scientists usually design ecological studies on scales appropriate to human experience and perception, rather than to the species or subjects in question. Yet ecologists Göran Englund and Scott Cooper, among others, explicitly warn against arbitrary and anthropocentric selection of scale. Instead, ideally, experimental design should involve "matching the scale attributes of organisms, processes, and the abiotic environment. Often this amounts to preserving the 'effective scale,' which describes the scale of the system as experienced by the organisms."[21]

4. We Favor Biotic, Rather Than Abiotic, Explanations

Wiens suggests another problem directly related to anthropocentric design, namely ecologists' penchant for focusing on biological rather than physical processes. At smaller scales, we might reasonably expect biological interaction to dominate results, but, at larger scales, factors such as atmospheric and geological effects could loom larger.

5. We Assume Continuity When Discontinuity, or Nonlinearity, Is Actually the Norm

Perhaps the most important lesson from this survey of the ecological literature on scale is scientists' acknowledgment of nonlinearity or discontinuity as the governing principle of many natural states and processes. Essentially, one can never assume that what holds true at one scale will hold at another. Sometimes faulty statistical extrapolation and aggregation error are to blame, but, in general, Wiens reminds us, "the continuous linear scales we use to

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

measure space and time may not be appropriate for organisms or processes whose dynamics or rates vary discontinuously."[22] He gives the example of insect diapause, diapause describing one kind of animal dormancy in which certain species go into a period of growthless inactivity in response to unfavorable external conditions.

Why do these five, closely linked observations regarding complex scale-dependence matter? In short, our tendency to select and measure at terrestrial, biological, and human scales and to describe phenomena as orderly and continuous series severely limits our understanding of nonhuman agency and experience. Depending on the scale of observation, too, the same factors may have differing "explanatory power."[23] The challenge then becomes moving past recognition of these issues to more responsible kinds of evaluation and engagement. As some ecologists have put it, how do we match large-scale questions and small-scale data, or "scale up" from "experimentally tractable scales" to the realities of expansive natural environments?[24]

Among the options available to us, those kinds of overzealous cartography intent on creating a one-to-one map of the world are the least appealing.[25] Far more intriguing are the varied media forms that dramatize scalar dependencies without sacrificing the capacity for wonder. Consider the whimsical

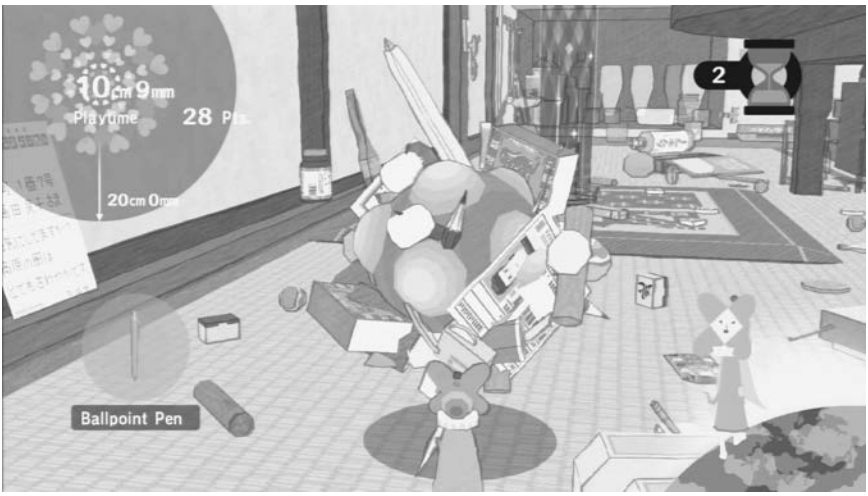

Figure 12. Rolling right along in *Katamari Forever* for the PlayStation 3, one of many games in the *Katamari Damacy* series. *Katamari Damacy* translates to English as "clump soul."

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

Japanese game *Katamari Forever* (2009), in which you play a tiny cosmic prince charged with rebuilding the universe by rolling up matter (Figure 12). Using a sticky "katamari" ball to pick up mass, you start with relatively small items but soon progress to larger and larger ones as the ball swells in size. Each shift in effective scale is signaled by a visual blurring, as the playable world stretches to new dimensions, and obstacles at one scale—hedges, pylons, and parking structures, to name just a few—become katamari fodder at another. Along these lines, *Katamari Forever* cheekily invites us to raise our scalar consciousness to absurd heights, while literalizing the interconnectedness of all things.

Yet whether or not games like *Katamari Forever* make available novel ways of conceptualizing the world and our place within it remains to be seen. Historically, other works have attempted to leverage new technologies of visualization to take the universe's measure with the same trademark curiosity, albeit with a good deal more sobriety.

Exponential Vision and the Powers of Ten

In 1977, Charles and Ray Eames released the short film *Powers of Ten*, an approximately nine-and-a-half-minute educational journey through space and the human body that uses the distinguishing framing device of an expanding and contracting white square, whose sides are determined by a power of ten, to demonstrate the differences in scale between astronomic and atomic levels of inquiry.[26] In its iconic opening scene, the film begins from a vantage point just a few feet above a man and woman picnicking by Lake Michigan in Chicago.[27] Looking down at the couple, as if pinned to the airy nothingness above them, the film gradually expands out to the then known boundaries of the universe (10^{24} meters), then returns at accelerated speed to the blanket, only to plunge deep into the cells of the man's resting hand. Eventually, the film reaches the inverse magnitude of 10^{-16} meters, or the scale of an individual proton. As enticing as it may be to dismiss the film as propaganda for the triumphal march of science, with its obsessively tidy vision and authoritative male narrator (the voice of physicist Philip Morrison), the bulk of the film notably takes place beyond the limits of unassisted sight, venturing deep into both conceptual and pictorial speculation. As such, the film testifies to not only a centuries-old scientific desire for all-encompassing observation but also the fundamentally imaginative character of scientific epistemology. Alex Funke, a key contributor to the 1977 film, described the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

production staff's creative protocol for dealing with the twin limits to knowledge and imaging as follows:

> In preparing for the film, we first sought out at every power the very best pictures available, then asked workers in that particular realm what we might see if the imaging were a hundred, a thousand times better. We had the raw material. . . . Then in each case *we made the imaging more than real* through adding, by hand, the details of what might (or should) be there.[28]

Like the atomic landscapes or topographical maps now produced by nonoptical technologies like the scanning tunneling microscope, many of the images used in *Powers of Ten* are less direct imprints of actuality than mediated constructions, or enhanced renderings of the real. At the macrocosmic scales, the film dissolves between artful composites of satellite and observatory photos and visualizations of data garnered outside the visible spectrum via radio, ultraviolet, and infrared astronomy; at the microcosmic scales, the film relies heavily on scanning electron and transmission electron microscopy, but also takes representational liberties. "When there were only mental models, we made physical ones," explains Funke. Thus the film's pointillist depiction of a proton at the interior of a nucleus "is no photo but an abstract symbol of the physics we just begin to comprehend."[29]

Based on an illustrated, young-adult book by Kees Boeke called *Cosmic View: The Universe in Forty Jumps* (1957), and itself the model for numerous later adaptations, among them games and online applications,[30] *Powers of Ten* and its rapid history of permutation in many respects recapitulates the longer account of scientific vision outlined by historians of science Lorraine Daston and Peter Galison. The film attests to the idiosyncrasy and inventiveness of scientific vision, and within the relatively brief span of fifty years, the film, its immediate source, and its many successors make evident the decisive effects of medium and time period on scientific visualization. Any such film, made today, would have to cope with the increased scale of astronomical and biological observation, and would also have to contend with images of city, planet, and cell that have since proliferated and grown more fraught. The original *Powers of Ten* is an unapologetic paean to the scientific imagination, depicting a world where couples lounge contentedly near "bustling" freeways, seemingly sandwiched between two wondrous worlds of undiscovered matter, but the intervening decades have borne witness to growing

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

environmental concerns and fears. A modern audience shown aerial views of Lake Michigan, Chicago highways, and the troposphere might be more likely to associate them with the invasive zebra mussel, traffic congestion, and greenhouse gases than with idyllic summer relaxation. Similarly, peering into the recesses of the cell and the atom today is likely to conjure debates over genetic modification, cloning, and nuclear energy—the common litany of post–World War II anxieties over the nature and extent of scientific progress.

Furthermore, given the pace of scientific and technological innovation since the film's original release, *Powers of Ten* belongs to a now bygone era of exceptional visualization. In the late 1960s and early 1970s, when astronauts on various NASA *Apollo* missions took some of the first full-view pictures of our planet from outer space, several of the resulting images, most famously the "Blue Marble," became icons of the nascent environmental movement.[31] In that historical period, one noticeably less saturated by satellite imagery, the sight of Earth suspended in the void of space highlighted the planet's singular fragility. Since 2005, however, satellite imagery of the Google Earth variety has become a staple of daily media use, moving beyond government, particularly military usage, to become the quotidian basis for everything from driving routes to weather monitoring. In the contemporary moment, *Powers of Ten* loses much of its initial novelty, for now anyone with a smartphone or broadband-enabled computer can replicate the film's visual maneuvering from the terrestrial to the atmospheric.[32]

Yet *Powers of Ten* captures a pivotal moment in the history of scientific visualization in its bypassing of traditional print media in favor of cinematic animation. In the volume that followed the film, Eames supporters Philip and Phylis Morrison emphasized the superiority of the moving over the still image:

> No visual model can convey unaided the full content of our scientific understanding, the less if it is restricted to the static. . . . The limitation of the static image is not simply that it lacks the flow that marks our visual perception of motion: Real change in the universe is often too slow or too fast for any responses of the visual system. The deeper lack is one of content. A single take belies the manifold event.[33]

For the Morrisons, the advantages of film and its fledgling companion video derive from their capacity to present not only movement, but also change

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

over time, leading them to conclude in this same passage that "Film and the video processes together constitute the most characteristic form of art in this changeful period of human history."

From our vantage point in the new millennium, we might well wonder what the Morrisons (not to mention the Eameses, who were well known for their interest in toys) would have made of video games, a medium that was still in its infancy at the time of the film's 1977 release. Could a game capture "the manifold event" even more readily than the conventional moving image? If so, would games then constitute the most characteristic form of art in this changeful period of human history?

"Your Personal Universe in a Box"

Developed by game luminary Will Wright and the studio Maxis, and published by Electronic Arts (EA) in 2008, *Spore* was ambitiously touted as an evolution-simulation game featuring five stages of species development: cell, creature, tribe, civilization, and space. Historically speaking, *Spore* represents the culmination of nearly two decades of Wright's work in the game industry, most of it on *Sim* games like *SimCity* (1989) and *The Sims* (2000). The collective *Sim* games conveniently suggest something of Wright's broad-ranging fascination with environmental modeling in their unresolved tension between environmental or biocentric concerns—how to manage a planet, an ant colony, an urban landscape—and an equal anthropocentric fascination with how the agents within those landscapes carry out their lives. In visual and experiential terms, the various *Sim* games also represent different points on a scale of magnification, from the global perspective of *SimEarth: The Living Planet* (1990) and the metropolitan perspective of *SimCity* to the neighborhoods and single-family dwellings of *The Sims* and the backyard dirt colonies of *SimAnt* (1991). However, *Spore*'s clearest predecessor in the *Sim* franchise is *SimEarth*, which invites players to supervise evolutionary scenarios running the gamut between open-ended experiments and theoretically prescripted paradigms like the "daisyworld" proposed by Andrew Watson and James Lovelock.[34]

Graced with all the computational and graphical advantages of the intervening nearly twenty years, *Spore* appears to offer an unprecedented level of virtual ecological detail. One could easily spend hours within the game's Creature Creator, shaping one's image of the ideal species, and the game unobtrusively enfolds aspects of sciences ranging from geology, zoology,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

and ecology to climatology and astrobiology. Gameplay in the space stage, in particular, touches on long cherished environmental principles like ecosystem stability and habitat renewal. For instance, one of the primary tasks of the stage is to render environmentally challenged planetoids hospitable to colonization, which requires substantial attention to both climate and species diversity (Figure 13). Players also carry out missions, some of which deal overtly with environmental crises, such as the alarming directive "Save planet *X* from ecological disaster!"

On the one hand, these tasks entreat the player to take on the mantle of environmental steward for colonized worlds; on the other, the espoused version of ecological care drastically oversimplifies life's complexity and threatens to perpetuate the myth that humans can exercise surgical precision in diagnosing and addressing environmental ills. Saving a planet, it turns out, often means hunting down and violently exterminating "infected" organisms using your spaceship's onboard laser. Restoring balance to an ecosystem translates into filling vacant animal or plant niches in a planet's food chain via the indiscriminate abduction of species from other planets. Even planetary climate correction becomes almost trivial given the ready availability of futuristic tools. Not enough atmosphere? Not a problem—toss an atmosphere generator at the planet surface and watch clouds of reassuring-looking

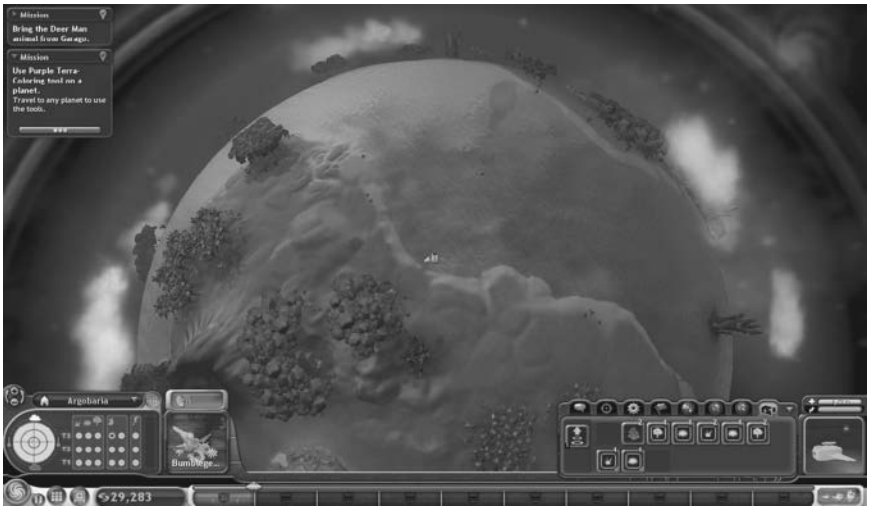

Figure 13. A spaceship (center) hovers over a planet's surface in *Spore*'s final stage.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

gases drift into the troposphere. Climate too chilly? Rain a toasty meteor shower down on the world or apply a heat ray to begin a warming trend. Using weapons-grade lasers, high-tech rays, and elaborate mechanical gizmos to bludgeon a planet's climate into shape makes a mockery of the delicate "butterfly effects" espoused by chaos theoreticians. In sum, *Spore* does pose ecological lessons, but those lessons verge on environmental slapstick.

Not surprisingly, after the game's much-heralded release scientists quickly realized that *Spore* had fallen short of its advertised marks. *Science* magazine's John Bohannon called the game a massive disappointment in terms of its potential for science education, even after granting that its primary aim was to please rather than inform. After playing *Spore* with a team of scientists to evaluate its scientific merits, Bohannon ultimately flunked the game, lamenting that it got "most of biology badly, needlessly, and often bizarrely wrong," particularly in its treatment of evolution.[35] Two of the scientists who helped to assess the game, evolutionary biologists Ryan Gregory and Niles Eldredge, similarly concluded that "*Spore* is essentially a very impressive, entertaining, and elaborate Mr. Potato Head that uses the language of evolution but none of the major principles."[36] Foremost among *Spore*'s many evolutionary inaccuracies is the complete lack of consequence for player death. *Spore*'s much-ballyhooed version of evolution is, in fact, closer to the long discredited theory of Lamarckian evolution (in which an individual organism can develop and pass on adaptations during its lifetime) or evolution's creationist-tending nemesis, intelligent design (where players are the universe's unseen architects). In the eyes of scientists, *Spore* deploys evolution primarily as a marketing gimmick; the theories of genetic succession are less the guiding force for actual game mechanics than rhetorical trimming around the digital dollhouse play for which Wright is famous.

In comparing *Spore* to a glorified Mr. Potato Head, Gregory and Eldredge acknowledge that the protracted, random nature of real evolution is noticeably at odds with the logic of immediate customization that makes *Spore* so attractive. The game's versatile Creature Creator software has arguably proven more popular than the game itself; it is a feature, or a subgame, that threatens to render the rest of the game a mere showcase for the well-crafted avatar. In a similar fashion, the bulk of the game's command interface attends to matters of aesthetic preference. Should you find yourself displeased by the lumpy contours of your planet or its dull sandy color, you can use special tools to level terrain, form "cute" canyons and crystalline mountains, or turn

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

the sea purple, the atmosphere red, and the land cyan. Incredibly, none of these changes seems to affect life on the planet, implying at some fundamental level that cosmetic alteration and environmental health need not be mutually exclusive aims. Like the Creature Creator, which essentially equates evolution with deliberate customization in a digitally enhanced production mentality at odds with the vagaries of actual evolution, *Spore*'s building-, vehicle-, and planet-design menus emphasize the malleability of matter, not so much its ontological essentialism as its receptivity to the expression of individual preference.

Criticisms like these reveal an unavoidable tension in using games to model environmental processes—the necessary give-and-take between player freedom, or agency, and ecological constraint. The worlds that Wright creates tend to be sandboxes more than slides, that is, open-ended systems inviting experimentation rather than goal-oriented spaces centered on measurable achievement. Reviewers and players disappointed by *Spore*'s lackluster gameplay have therefore sometimes generously allowed that *Spore* is less a game than a software toy, and Wright himself has called *Spore* a "philosophy toy," designed to lead younger generations to insights via self-directed investigation.[37] At the same time, *Spore*, like most of Wright's games, is recognizably a "god game," meaning that players act as omnipotent beings whose every action influences the universe in which they operate. Tellingly, Wright has said that he wanted players of *Spore* to feel like George Lucas, not Luke Skywalker—that is, the architect of fantastic worlds rather than an individual within them. *Spore* accordingly reflects Wright's valorization of human agency and intentionality. From an environmental standpoint, *Spore* models the strain between envisioning nature as either a design space or a problem space, or a place of invention and expression versus an arena fitted with recognizable troubles and solutions.

In its defense, other critics have praised *Spore* as a trendsetter, both within the game industry and in related realms of networked collaboration. In contrast to the massively multiplayer online role-playing games prevalent in game studies, among them *EverQuest* and *World of Warcraft*, Wright has touted *Spore* as the first "massively single-user" game. In other words, though the game itself follows a single-player trajectory, the creatures, plants, and structures that populate the universe one explores are drawn from the so-called Sporepedia, which amasses and makes available not only the creations of Maxis employees but also other *Spore* players. Creatively challenged or

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

time-strapped players can peruse the Sporepedia to find and use the inventions of others, and in return, it is quite possible that their own creations will find their way into other players' games. While this content-sharing scheme promotes its share of impish pranks, from expletive-labeled species to phallus-shaped monsters, it also leads to a delightful cross-pollination of imaginative worlds. You can, of course, choose to play the game entirely offline, protecting your universe from the intrusions of other designers, but *Spore* players are encouraged upon log-in to play the game online, in a mode of free exchange.

Steven Jones, who devoted the final chapter of his book *The Meaning of Video Games* to *Spore*'s anticipated release, has suggested that the game's player-interaction and content-creation interfaces should be imitated by the digital humanities—"today's digital environments," he writes, are "potential models for digital scholarship."[38] *Spore* in particular presents a highly developed example of "distributed and time-shifted content creation and content sharing."[39]

> What we can learn from a game such as *Spore* is how to imagine a research infrastructure that encourages asynchronous content-creation and -sharing by many users on different schedules, with different agendas—one that allows for the continual reediting of content objects, which can be experienced as if they existed in parallel universes but at the same time remained entangled and linked together for collaborative activity.[40]

For Jones, an improved approach to new textual scholarship lies in an emphasis on improvisation and performance within the productive restrictions offered by digital environments like the *Spore* universe. The ideal infrastructure for such activity would provide "interpretive consequences, as a set of constraints and affordances within which to perform textual meanings":

> I would compare texts and video games not in terms of their supposedly shared narrative content (not in terms of their content at all, really) but formally—in terms of how they model complex systems, how they construct networked environments for the (re)production, transmission, reception, and continual reediting of their respective content-objects. In this sense, both texts and video games are best understood as systems of prompts for various possible performances.[41]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

Like Jones, I clearly believe that games can be usefully related to "texts" both in the capacious manner of poststructuralist analysis and in terms of their formal elements; this kind of unexpected melding of literary interpretation and game studies was already explored in chapter 1. Jones's argument that "textual and digital humanities cyberinfrastructure needs to be more like games" is an important one. However, *Spore*'s massively single-user paradigm also suggests that world creation and maintenance can be the work of both the one and the many. As I will discuss momentarily in relation to Ursula Heise's work on the frictions between local and global framings of environmental issues, *Spore*'s hybrid realization as a local (stored on the player's hard drive) single-player game with global (networked) multiplayer content models one method of bringing together the oft-cited boundaries of ecological thinking.

Although it might be tempting to read *Spore* as an exercise in frivolous and, in the end, noncommittal play, Wright has publicly vaunted the game's potential to underscore environmental objectives. During his demo of *Spore* to TED Conference participants in March 2007, Wright used his in-game spaceship to pump huge amounts of carbon dioxide gases into a planet's atmosphere, thereby raising its ocean levels, swamping his own cities, and increasing the temperature of the planet to a point where the oceans evaporated and the surface burst into flame—clearly not a winning strategy so much as a curiosity-driven experiment. Having done this, Wright casually remarked:

> What's interesting to me about games in some sense is that I think we can take a lot of long-term dynamics and compress them into very short-term kind of experiences, because it's so hard for people to think fifty or a hundred years out, but when you can give them a toy and they can experience these long-term dynamics in just a few minutes, I think it's an entirely different kind of point of view, where we're actually mapping, using the game to remap our intuition. It's almost like in the same way that a telescope or microscope recalibrates your eyesight. I think computer simulations can recalibrate your instinct across vast scales of both space and time.[42]

Wright thus asserts that games can act as intellectual and spatiotemporal prostheses, in language arguably reminiscent of Marshall McLuhan's contention that media act as extensions to humankind, or agent-based computational

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

modeling expert Joshua Epstein's rationales for scientific and social scientific modeling.[43] *Spore* evidently has the power to reveal to us the dramatic consequences of our current follies, here the overproduction of greenhouse gases that trap the heat of the sun's rays and lead to global warming. But what may be more important is the residual impression that environmental catastrophe of this sort is neither unforeseeable nor inevitable.

Unlike the iterations of a purely scientific model or the preset narratives of film or science fiction, a game like *Spore* offers both repetition and difference, as directed by the personal choices of the player—what gamers would call replay value. *Spore*, which by design has been freed from the constraint of a single "win state," opens up an ethically unencumbered space in which players can spool out countless environmental futures, from pastoral empires to admittedly morbid fantasies of ecological disaster. Put more broadly, what *Spore* perhaps does best is give players the ability to experience and affect procedural change at scales ranging from the microscopic to the galactic and from the short to the long term, effectively heeding the scalar warnings of ecologists. The game's deliberate open-endedness forces players to ponder the benefits and drawbacks of interaction at each level. Like scientists who study and model real-world environments, players in virtual worlds may find themselves struggling with a similar set of questions: what is the value of remaining at one scale, and when is it necessary to move beyond that scale to examine the relations or transgressions that occur across the artificially imposed boundaries of hierarchical thinking?

The effective visualization of ecological states at a range of scales has become crucial, given contemporary environmentalism's trouble with representing largely intangible linkages and its internal frictions between what we could call the micro- and macroenvironmental approaches to pressing ecological problems. Many artists, activists, and environmental educators remain deeply committed to local and embodied forms of ecological knowledge, including the artists' collective Futurefarmers, led by Amy Franceschini and Michael Swaine, who reinterpreted *Powers of Ten* in a way that draws attention to these very questions of appropriate scalar engagement. Known for dozens of previous projects ranging from the revival of urban victory gardens and the launching of community soil and seed banks to street-level planting interventions, it is perhaps no surprise that the Futurefarmers' novel take on the film limits the audience's perspective to the terrestrial scale—visually, at least, their project refrains from swooping off into outer space or

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

delving down to quantum particles. Instead, Franceschini and Swaine retain only the one square meter of picnic blanket as a familiar framing, treating it not only as visual device but also as event, restoring to the occasion the sense of lived duration and opportunity for relation lost or barely present in the original image. In the Futurefarmers' *A Variation on the Powers of Ten*, the picnic is less a convenient narrative premise or mathematical anchoring point for interstellar and intracellular journeys than it is the very model for human dialogue and connection to place. While the Eameses' film could not help but downplay the human scale in comparison to the wide expanses of scientific inquiry, the Futurefarmers' version forces us to reconsider at close quarters what we think we know, through intimate conversation and shared presence.

Rather than literally depicting the expanding boundaries of scientific investigation, the Futurefarmers invited ten scholars involved in a diverse range of sciences to join them for a series of personalized picnics. Each researcher demonstrates a special affinity for a particular power of ten: Ignacio Chapela, known in many circles for his near dismissal after publishing evidence of rogue transgenic elements in Mexican corn, represents the world of microbial ecology; Ananya Roy, a professor in city and regional planning, ponders urban systems and international development (Figure 14); premier lepidopterist Arthur Shapiro ruminates on insects, weather, evolution, and ecology; and so on.[44] The Futurefarmers allowed each interviewee to choose the site for his or her own picnic, as well as the array of accompanying foods, publications, and special objects. For example, Shapiro brought a butterfly net and index cards, as well as Pabst Blue Ribbon (a nod to his annual Butterflies for Beer competition in northern California); Roy asked for whole foods ("philanthropy through grocery shopping"); and Chapela requested local, microbial food (cheese, bread, and wine). The outcome has been a dispersed network of documentation, not a single cinematic product—the picnics were not only filmed but photographed, audio recordings were made, conversations transcribed, and diverse materials displayed on the Futurefarmers' website and selected for exhibition (the work was briefly previewed at the Berkeley Art Museum in 2010 and shown again in Sweden in 2012).

In their outwardly simple decision to restrict *A Variation on the Powers of Ten* to the modest area between 10^0 to 10^1 meters, the Futurefarmers demonstrated a preference for local, even site-specific knowledge. Although they work across online, print, and gallery spaces, their true media are air, soil, and water. They would probably dispute McLuhan's dismissal of the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 01 Jan 1976 12:34:56 UTC
All use subject to https://about.jstor.org/terms

Figure 14. The Futurefarmers picnic with Professor Ananya Roy (10^5) on the University of California, Berkeley, campus, as part of *A Variation on the Powers of Ten.* Photograph by Jeff Warrin, 2011, copyright Futurefarmers 2011.

"human scale" sought by urban planners as "irrelevant" to the new forms of electric media.[45] In this, they are joined by many an environmental educator. Environmental scientist Mitchell Thomashow speaks for many in advocating place-based environmental learning and a return to natural history curricula. Thomashow stresses that the nature of the challenge is largely perceptual—learning to perceive the effects of global environmental change in our local places by recovering the "naturalist's gaze," a patient, meditative, observant demeanor, to be joined with the analytic knowledge provided by science and the spiritual guidance provided by religious or other moral and ethical reflection. For Thomashow, new media are always double-edged

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UT6 12:34:56 UTC
All use subject to https://about.jstor.org/terms

swords. The internet, like television, presents "seductions" and "traps": "Every hour spent in front of the computer screen comes at the expense of your time observing natural history directly."[46] While far from condemning technology wholesale, Thomashow remains wary of its tendency to hasten conclusions, manipulate our attention, and collapse space and time in ways that encourage us to overlook the world around us. For Thomashow, the internet and related technologies crowd out sensuous experience of the natural world in favor of virtual intellectual engagement. Moreover, their routine daily use blinds us to their simultaneously broadening and limiting perceptual effects.

Yet Thomashow also acknowledges that "the permeability of the visceral and virtual is the hallmark of our age"[47]—where visceral should be taken in the sense of bodily. "Despite the best efforts of environmental educators," he admits, "millions of people mainly observe nature through windows and screens."[48] At other times, Thomashow less abashedly celebrates the sampling power of contemporary technologies, its ability to connect people and locations from all over the world and to translate otherwise abstract situations into readily graspable simulations and data visualizations. Both excited and dubious about the possible meetings of the biological and virtual worlds, Thomashow at first hesitates—"Maybe the prospect of cultivating biospheric perception via the Internet is an illusion"—but then ultimately grants that "crawling on your knees through a wetland on a humid summer morning, watching warblers on their spring migration, or observing biogeographic patterns on a series of computer overlays" are "all so many means of learning how to affiliate with life."[49] Inadvertently recalling both Dana Phillips's critique of literary ecomimesis and Daston and Galison's appreciation for relative dimensions of vision, Thomashow allows that "Each pace reveals some patterns and conceals others. Taken together as perceptual tools, various paces allow for the juxtaposition of scale."[50] As an example, he cites the "emergence of a coherent, ecosystem monitoring function—the blending of the Internet, GIS systems, satellite images, and field-based natural history research" as "an indispensable tool for interpreting global environmental change."[51] In sum, our approach to environmental realities need not militate wholly for or against new media; they are one part of a larger arsenal for combating ecological damage and scientific ignorance.

In the burgeoning worlds of the environmental humanities and ecological philosophy, both Ursula Heise and Timothy Morton have debunked

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

provincial localisms, but in conspicuously different manners. Heise wonders about the aesthetic possibilities of a deterritorialized environmental vision, carefully tackling the thorny paradox of such mantras as "think globally, act locally," while Morton loosely exhorts us toward expansive, even cosmological thinking.[52] On the one hand, Morton writes eloquently on topics ranging from queer and dark ecology to Buddhism and hyperobjects, attending to cross-scalar possibilities and both intimacy and impersonality at the extremes of the very small and very large. On the other hand, Heise's work provides a vastly more grounded working-through of culture, media, and matter. Notably, Thomashow's writing on biospheric perception in *Bringing the Biosphere Home* was one of many intellectual precursors to Heise's *Sense of Place and Sense of Planet*, which takes up the question of technology's right relation to environmental thought in even more direct ways. Arguing that recent years have been characterized by "an excessive investment in the local," Heise makes the case for "an ideal of 'eco-cosmopolitanism,' or environmental world citizenship," one that acknowledges but offers a clear alternative to liberal skepticism toward globalization.[53] Though it has become second nature among environmental devotees to minimize carbon footprint through eating, traveling, and purchasing within as compressed a radius as possible, and globalization has become something of a watchword for transnational corporate ambitions, Heise suggests that environmentalists have lost sight of the large-scale nature of environmental challenges in their well-intentioned espousal of the local. In response, Heise turns to a range of works across fiction, poetry, and installation art that are collectively "meant to point to ways of imagining the global that frame localism from a globalist environmental perspective."[54] Though she does not explicitly invoke games, Heise wonders "what aesthetic forms might be most appropriate for articulating [a deterritorialized environmental vision]," or "what new possibilities for ecological awareness inhere in cultural forms that are increasingly detached from their anchoring in particular geographies."[55] Her recognition that Google Earth presents conceptual opportunities unavailable to the *Apollo 17* image of the "Blue Marble" implies the promise of other recent media, even if games are never mentioned directly.

Although games inevitably participate in flows of material and capital and so-called attention economies that place them squarely within the ongoing debate over local, as opposed to global, modes of thinking and living,[56] games, especially digital ones, can obviate the perceived choice through multiscalar

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

play. The local and the global are, after all, only imagined extremes, beyond which lie countless microorganisms, elementary particles, and most of the known universe. If we could, like a Sporovian spacecraft, escape the anthropomorphic drag of the local–global dualism, perhaps our Earth-friendly bumper stickers would urge us to "think galactically, act microscopically."

Playing the Game of Nature

As unorthodox as the thought may be, video games may be even better suited to scientific visualization than the conventional moving, but non-interactive, image, and support for such a proposition may be found well outside the bailiwicks of game scholars and educational software developers. Daston and Galison and Colin Milburn, for example, have independently identified the same trend in scientific imaging—away from depiction toward fabrication, at a point where the formerly distinct boundaries between recording and producing have been breached. For my purposes, the value of what Milburn and Daston and Galison believe to be a recent paradigm shift from ocular to tactile science, or perhaps the unexpected convergence of visual and haptic epistemologies, lies in its evident recapitulation in less rarefied media contexts. Well outside the elite research laboratory, in millions of ordinary living rooms and home offices, computer and video games have popularized the same qualitative shift beyond vision toward interactivity, in roughly the same period (as Milburn chronicles, nanotechnology flourished from the 1980s onward). The player of a game like *Spore* is thus kin to the archetypal scientist of the latest representational epoch described by these authors—one who melds creativity and intuition with the efforts of instrumental science.[57]

Even ecologists, often stereotyped as outdoorsy, loner types, are not immune to the increasing computerization of our world and the enticements of "big data," evident in the host of new journals at the intersections of ecology, informatics, and computer science. Ask any ecologist working today where the biggest trends are in his or her field or subfield, and he or she is likely to say that the discipline has moved radically toward mathematical and statistical modeling via the computer—witness newer journals like *Environmental Modelling and Software* (1997–), *Ecological Informatics* (2006–), and *Remote Sensing* (2009–). Some ecological research no longer takes place in the field, but rather uses satellite measurements and advanced statistical algorithms like machine learning to crunch large quantities of

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

remotely gathered data, which may be as important as the patient and methodical observation of natural habitats and species. This may sound similar to the digital humanities' use of topic modeling algorithms or data-visualization software to process concordances, databases, or library corpora, and just as scholars who cling to romantic notions of literary work, lodged purely in the text itself, may feel threatened by the advance of digital humanities approaches, ecologists committed to research outdoors may experience an existential crisis in this age of "big history" and "big science." Some have already announced that big data is the future of ecology and that one day, ecologists will no longer need to work in the field, while others indicate that ecology's culture of individualism is still robust.[58] The growing volume of critiques of big data, including Mary Gray's anthropological attachment to people and danah boyd and Kate Crawford's specter of apophenia, or "seeing patterns where none actually exist,"[59] also means that even in ecology, remote sensing and machine learning will continue to be complemented by traditional ethnographic and ethological methods.

Games are not easy solutions to vexing scientific problems or palliative alternatives to real-world action, but there are felicitous similarities between gameplay and ecological work. In fact, the same ecological literature that earlier outlined the difficulties with scalar modeling also reveals some of the following foundational correspondences.

A. Perturbation Experiments

First and foremost, the vast majority of ecological experiments are what ecologists call "perturbation experiments," meaning that "some environmental factor, such as the density of competitors, predators, or resources, is manipulated in experimental units and unmanipulated units are used as controls."[60] As Englund and Cooper explain, "The approach has gained high status in ecology because it allows us to test mechanistic hypotheses under realistic conditions." All games are at some level perturbation experiments, then, though the conditions may be more or less realistic and the variable factors more or less explicit depending on the game's design.

Simulation-style sandbox games, or resource-management games, for instance, tend to wear their experimental factors on their sleeves. To give just one example, the sustainable town-building game *Banished* (2014) features both seasonal weather variation and copious tables, logs, and graphs that make it abundantly clear what resources are being produced, traded, and sold. But

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

of course, even games without obvious toggles, sliders, levers, and buttons are by definition exercises in controlled experimentation—a game would not be a game if it had a predetermined outcome. In other words, we must wonder, *"What happens if I do this?"*

B. Scaling Models and Dimensional Analysis

A second sympathy between ludic and ecological approaches to scale can be found in modeling and dimensional analysis. By necessity, both ecologists and game designers must distill the richness of real-world systems into manageable experimental structures, though perhaps only ecologists feel they must account for the effects of the reduction in complexity. Englund and Cooper recommend using scaling models "that describe how experimental results change with arena size and which, thus, can be used to extrapolate small-scale results to larger scales,"[61] as well as dimensional analysis, a method borrowed from engineering and mathematics, "which can be used to construct small experimental systems that respond to manipulations in the same way as their natural counterparts."[62] The goal is to produce models that align the so-called prototype with the physical model while anticipating the impact of experimental design artifacts like induced "edge effects" (introduction), such as the effects of enclosures like fences or aquarium glass on species distribution or predator–prey relationships.

To say games are models is hardly the stuff of controversy—after all, games not only aspire to a certain level of realism by modeling people, animals, and natural phenomena like movement, collision, and water flow, but also model less tangible ideologies and assumptions, from heteronormativity to American military exceptionalism. And the power to model does not reside only with designers. Players, too, through their activity in the game world, derive and construct physical and mental models, including ideal ways to navigate zones, handle difficult opponents, and interact socially or antisocially with other players. But while games may be models, those models are still, by and large, far from ecological. In the days of the first *EverQuest*, for instance, I distinctly remember the practice of "zoning," or running to the load point for the next segment of the massively multiplayer world, in order to escape monsters too powerful for my fledgling avatar. This was well before the capabilities of contemporary MMOGs, with their relatively seamless experience of geography. In *Everquest*'s in-game world, no zone lines or dividing walls were visible in order to maintain the illusion of contiguity,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

but players quickly learned where the game's *effective* zone lines were, often hopping back and forth across them despite onerous load times.

C. Ground-Truthing

Another method that scientists within and beyond ecology use to reconcile scales is called, rather poetically, ground-truthing. It refers to observations made, usually at ground level, which are then applied to calibrate remote-sensing devices like satellites through confirmation or denial of the measurements made by such devices.[63] An example of ground-truthing via citizen science can be found on NASA's project site for "S'COOL," which stands for Students' Cloud Observations On-Line.[64] For S'COOL, students at over five hundred schools helped "ground truth" CERES, or the Clouds and the Earth's Radiant Energy System, a series of climate-monitoring instruments that have orbited the Earth on NASA satellites since 1997 in order to help scientists study environmental change on our planet.

In my mind, players of games regularly engage in a kind of ground-truthing when they consult overhead mini-maps or other navigational aids as guides for their "on-the-ground" experience. And a growing number of alternate-reality games, such as the *Halo 2* ARG *I Love Bees*, and GPS/GIS-based activities like geocaching, explicitly meld game fiction with investigations at actual coordinates, in a different kind of half-reality than Jesper Juul's real rules plus fictional worlds.

D. Environmental Failure

In one final area, games seem far better suited to ecological modeling and experimentation than actual scientific studies—namely, system breakdown. Working ecologists can't destroy or arbitrarily change real-world environments without very good reason, and often they must opportunistically wait for events like fires and oil spills to study things like ecosystem response to extreme conditions. But in games, the ludic impulse encourages sometimes methodical, sometimes rambunctious trial and error, building and breaking, striving and failing, and in some games, disasters, both natural and human-made, are only a click away, as in the classic *SimCity*.

In some ways, I am extending the insights in Juul's later volume on the art of failure in video games to suggest that failure can be seen not just in the sense of personal fault that Juul dwells on ("failing to effect one's purpose" or "a failing to occur, be performed, or be produced; an omitting to perform

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

something due or required"), but also the kind of systemic failure we invoke when speaking of unhealthy bodies or ecological units ("the fact of becoming exhausted or running short, giving way under trial, breaking down in health, declining in strength or activity, etc.").[65] For Juul, the possibility of failure is a necessary component of meaningful gameplay. Juul reflects, "When I play video games, I do experience something important, profound. Video games are for me a space of reflection, a constant measuring of my abilities, a mirror in which I can see my everyday behavior reflected, amplified, distorted, and revealed, a place where I deal with failure and learn how to rise to a challenge."[66]

At the same time, Juul also consistently describes gameplay as emotional gambling, and identifies self-defeating behavior and spectacular failure as two less constructive forms of game failure, citing the ability to unleash environmental disasters in the original *SimCity* as an example. Both are "strategies through which we can make failure feel less negative by actively seeking it out."[67] This raises the question of whether the prominent trope of ecological calamity in games allows us to exorcise, or at least shrug off, some of our besetting environmental demons (chapter 5). Yet whether or not these catastrophic scenarios are tinged with absurdity, deliberately unleashed or patiently suffered, games clearly give us a less ethically restricted space within which we can take part in manifold environmental futures. Take Ubisoft's game *From Dust* (2011), which I will revisit in chapter 5. Although the game exhorts players to exercise their godlike abilities responsibly, with subtle reminders like "You have all of the powers to make the world in your image. Use them wisely," inevitably some players choose to wreak havoc on their villagers instead. But rather than lament the callousness of some players or strive to avoid failure, we might consider the value of learning to deal with catastrophe, a dynamic that plays out in the debate between climate mitigation and climate adaptation approaches. Here we could usefully compare *Spore*'s vision of global environmental change to that portrayed in science-fiction writer Kim Stanley Robinson's Science in the Capital series (*Forty Signs of Rain*, *Fifty Degrees Below*, and *Sixty Days and Counting*),[68] which takes as its cast members of the elite scientific bureaucracy in and around Washington, D.C., and at research universities around the country. Following the work of National Science Foundation employees and environmental political lobbyists, the series explores the "what if?" scenario presented by irreversible global warming, including rising sea levels, greater

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

temperature fluctuations, and increased storm activity. The nation's capital is flooded, then alternately baked and frozen, and as civil society braces for the worst nature has to offer, the scientist heroes do their best to increase funding for science and to develop realistic alternatives for addressing climate change. Unlike *Spore*, or for that matter, Robinson's *Mars* trilogy, solutions do not come at the other end of stupendously sophisticated technological apparatuses like orbiting solar mirrors or heat rays. Instead, the scientists in the *40/50/60* trilogy consider genetically modifying a fast-growing tree lichen to sequester carbon, marshaling the world's ocean liners to pour tons of salt into the North Atlantic Ocean in an attempt to restart the stalled current, and, when all else fails, airlifting people away from drowning land masses. Much of the series is also devoted less to damage prevention than damage control, implying that *some* fallout is inevitable. In *40/50/60*, environmental crisis is not simply an ominous future, but an inescapable present—the solutions will no longer arrive via tepid political and social initiatives for hybrid cars and tankless water heaters. Robinson dares to imagine catastrophic call and response, and for him resolution is an odd admixture of technocracy, spirituality, and primitivistic, anarchic impulses.

For now, we might tentatively call these four modes of ecology-game crossover experimentation, modeling, verification, and failure, and then map them to the axes once used by Alexander Galloway to describe games' social (rather than ecological) realism (Figure 15). In his original classification system from *Gaming*, Galloway proposed one axis to describe the spectrum of agency between computer and player, and another between a game's story world and its player's worldly context. This allowed him to point out that many scholars and players tended to focus on only one quadrant of the resulting diagram—a player's activity in a game world—without accounting for other experiences equally constitutive of what we call gameplay: server lag and mechanical glitches, pausing and configuring ("menu acts"), interaction with nonplayer characters, and, crucially, what Galloway calls ambient acts, or moments when a game world appears to operate independently of player action, from manifestations of virtual weather to the programmed pathing of computer-run townsfolk. Galloway's model thus anticipates my modifications, in that it could already be used to evaluate the environmental quality of games by identifying those that more evenly distribute agency between the machine and operator poles, or that draw necessary connections between the diegetic world of play and the nondiegetic world of the player.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

However, this amplified diagram better conveys the latent interplay between real and virtual worlds, players and designers, and environmental experience and speculation. When we reframe each quadrant in terms of gerunds, much like Stephanie Boluk and Patrick LeMieux reoriented games as processes in *Metagaming*,[69] we begin to glimpse how the scientific practices discussed earlier (experimenting, modeling, verifying/ground-truthing, and failing) might correspond to a wide range of ludic actions and situations.

Spore's modest successes in these areas owe much to the influence of *Powers of Ten*, not least because *Spore* embeds its player in neatly nested experimental domains, treating developing life at successive orders of magnitude, from the microscopic to the macrocosmic. Wright also pays unmistakable homage to the film in the game's culminating space stage, by allowing players to control in-game perspective through the use of their mouse wheels—scroll the wheel forward and your spaceship descends from orbit through layers of atmosphere to the chosen planet's surface, where you can skim the ground to search for native flora and fauna or engage city populations. Scroll the wheel backward and your spaceship lifts off and returns to the microgravity of outer space. Keep scrolling, and the game perspective widens from planet to solar system and finally to the entire galaxy, where in much-accelerated time, you can watch spinning celestial arms crammed with the

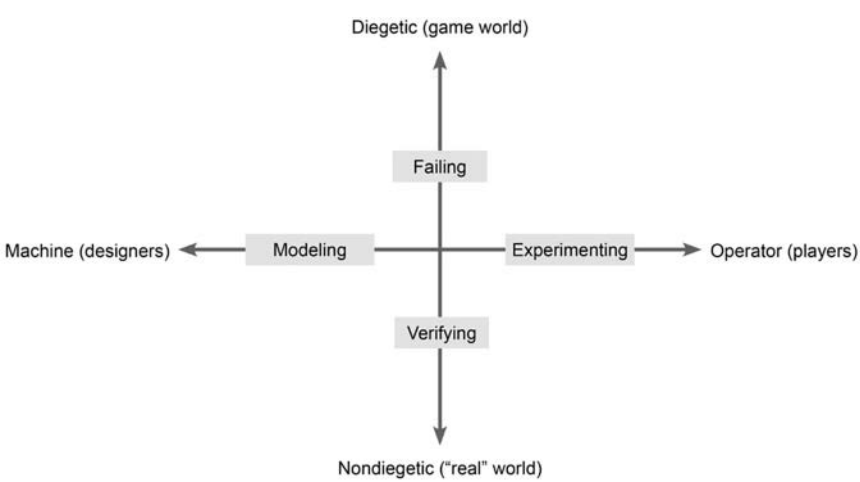

Figure 15. Mapping the intersection of games and ecology, using Alexander Galloway's original classification system from *Gaming*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

twinkling lights of dying stars. Unlike viewers of *Powers of Ten*, however, *Spore* players may navigate between these different scales at will, guided by such sundry motivations as curiosity, goal-oriented achievement, aesthetic preference, or perhaps even morbid or whimsical brands of environmental schadenfreude, as when Wright nonchalantly destroyed a game planet for his TED conference audience. The name *Spore* is itself indicative of this expected diffusion of paths and terminuses. In its biological contexts, a spore may refer to mechanism and thing, animal and plant. Spores describe reproductive and dispersive methods across multiple kingdoms in the Linnaean taxonomic system (animals, plants, fungi, protozoa, etc.): in zoology, a spore refers to "a very minute germ or organism," and in botany the spore becomes "one of the minute reproductive bodies characteristic of flowerless plants."[70] Unlike seeds, spores carry very little in the way of nourishing resource, yet they are designed to survive for long periods of time under unfavorable conditions. The word itself derives from the Greek word *σπορά*, meaning "sowing, seed," a rather fitting description of the *Spore* player's ultimate role as a kind of cosmic disseminator, spreading species across a distant galaxy.

Games need only a little encouragement to grow. Already, they are inherently multiscalar—melding the quantitative and the qualitative, the experiential and the analytic, the computational and the graphical—and a universe of questions awaits.

"An Infinite Canvas in Time" and Space

Indeed, one could argue that game designers, historians, scientists, and the authors of speculative or science-fiction worlds face similar occupational challenges. As the range and depth of specialized knowledge expands, they have to articulate the nature, scale, and complexity of phenomena ranging from stellar evolution to climate change, and render those articulations compelling for nonexpert audiences. As a case in point, three recent, very different projects all attempt to straddle aesthetic and scientific imperatives while making grand swaths of space and time accessible: the interactive timeline ChronoZoom, dedicated to "visualizing the history of everything,"[71] the highly anticipated *No Man's Sky* (2016), billed as a "science-fiction game set in an infinite procedurally generated galaxy,"[72] and Chinese science-fiction author Cixin Liu's prescriptions for his chosen genre.

How does each of these projects approach infinitude, either as a spatial or temporal phenomenon, and do they productively demonstrate media's

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

potential to bridge different scales and domains of knowing? ChronoZoom began in 2009 as an idea within UC Berkeley's Department of Earth and Planetary Science, but later expanded to include partner Microsoft Research, and through them development partners at Moscow State University and the University of Washington. ChronoZoom is essentially a fancy interactive timeline,[73] one tightly allied to the recent academic project of "Big History." Unfortunately named big historians like Macquarie University's David Christian, University of Michigan's Bob Bain, and Berkeley's Walter Alvarez aim to show students the very big picture of life on Earth, well beyond the confines of the present and narrow professional specializations. Thus, the International Big History Association (IBHA), founded in 2010, "promotes the unified and interdisciplinary study and teaching of the history of Cosmos, Earth, Life, and Humanity," and ChronoZoom's documentation explains that big historians typically divide history not only by chronology but also by component epistemological regimes, including "cosmology, astronomy, geology, paleontology, evolutionary biology, archaeology and historiography."[74] Perhaps not surprisingly, big history has attracted the attention of none other than Microsoft billionaire Bill Gates, whose support ultimately undergirds both the Big History Project (at bighistoryproject.com), which offers free, online coursework for middle and high-school students, as well as a six-hour "journey through 14 billion years" for lifelong learners, and ChronoZoom, which as an open-source community-development project has nevertheless long been shepherded by Microsoft Research.

Putting any potential skepticism about Bill Gates's involvement aside, it is worth noting that big history supposedly teaches students to examine "the authority, evidence, and logic of claims across disciplines and scales," and that ChronoZoom, which is now marketed as a dynamic, interactive cloud-based data visualization tool for Big History, often cites similar principles of interdisciplinarity and the unification and organization of information. In fact, David Christian, the historian who coined the term "big history," sees it as a way of explaining the visible complexity of the world in spite of the pull of entropy. One promotional video shows UC Santa Barbara professor Jeff Dozier using ChronoZoom as part of his introductory graduate earth systems science course in the Bren School of Environmental Science & Management. What strikes me about this clip is Dozier's statement that "the struggle we have in communicating science is how to present information based on data." Without directly engaging the standard arguments against

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

anthropogenic climate change, Dozier suggests that ChronoZoom not only facilitates teaching the long history of climate change, but also makes it visible in an undeniable way.

My second case study, the game *No Man's Sky*, is in its own way attempting to make the complexity of infinite worlds accessible (Figure 16). The game, finally released in the summer of 2016, generated an extraordinary amount of prerelease hype (and postrelease ire)—it was not uncommon to see it described as "one of the most anticipated games in game history," or as not merely an open-world game, but an "open universe" game, and no doubt this hyperbole followed directly from one of the game's developers making the claim at the 2015 Game Developers Conference (GDC) that there would be some 18 quintillion possible worlds for players to explore. *No Man's Sky* is the brainchild of indie developer Sean Murray and the British studio Hello Games, and although initially released on the PS4 and PCs, VR support was later added. The game is technically multiplayer, but because the universe is so vast, players may not encounter each other for some time, if at all. Players begin on any number of randomly selected planets and tend to be preoccupied by gathering resources in order to stay alive. This new state of affairs, where the size of the game world sidelines social interaction, calls for a reinterpretation of the massively multiplayer online game—what is massive

Figure 16. A landed spaceship on the toxic, fungi-dominated surface of the planet Pext Tau in the expansive, sci-fi universe of *No Man's Sky*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

here is less a Leviathan-esque body politic composed of players than a world in which player interaction is incidental.[75]

Deep Zoom and Procedural Generation

For ChronoZoom and *No Man's Sky*, what is arguably more important than their forms are the processes that allow us to experience them—in the case of ChronoZoom, what is known as "deep zoom" technology, and in the case of *No Man's Sky*, what is known as procedural generation. ChronoZoom's interface involves extreme zooming and dilation, somewhat like the slideshow software Prezi, except movement is always tied to all of past time as a navigational backbone. Specifically, ChronoZoom uses Microsoft Seadragon Deep Zoom technology, a tool that was initially used to explore large quantities of high-resolution images in a manner highly reminiscent of scanning microfiche. (Seadragon is used in Microsoft products like Silverlight, Photosynth, and Pivot, and has spawned open-source projects like Open Seadragon and Zoom.it.) As described on its Microsoft Research site suggestively entitled "An Infinite Canvas in Time," ChronoZoom offers "a zoom factor of nearly 5 trillion."

For Walter Alvarez, one of the creators of ChronoZoom, "zoomability" is what makes ChronoZoom distinctive. As he explains in the ChronoZoom 2 beta tour, people have been making visual timelines of history for a very long time, but ChronoZoom allows you to take a "visual voyage" anywhere from the Big Bang to today. Deep zoom seems to suit the big historical project of unifying and organizing knowledge across many domains, even attempting to "bridge the gap" between the humanities and the sciences. ChronoZoom's timeline, called the "master timeline," is designed to fold in a variety of multimedia online resources, although today it is still limited to gallery-like "exhibits." The timeline/deep zoom structure also supposedly facilitates "self-discovery" and pattern recognition and association as opposed to targeted search, which requires that you know what you are looking for at the outset. According to its literature, ChronoZoom thus aims to move beyond search to a "browsing" model of knowledge and broad historical connection, something more "intuitive" and "visual" than the dominant text search engine.

No Man's Sky, meanwhile, has become one of the latest poster children for procedural generation, in other words using a limited set of algorithms to create nearly unlimited game assets or content, an approach made both famous and infamous in game titles like *Dwarf Fortress* (2006), *Minecraft*,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

Spore, and *Everything* (2017). Procedural generation is what allowed that flabbergasting boast about 18 quintillion possible worlds, as once the game's developers set the mathematically based physical and behavioral rules for geological and biological construction, the outcomes were essentially infinite due to random variation. Yet despite the fanfare over *No Man's Sky*, procedural generation may have more naysayers than supporters. As even a cursory glance at game forums shows, gamers often argue that procedural generation is "lazy development" by another name, since most of the game's art assets and behavioral systems have not been meticulously handcrafted. Others remain agnostic, watching and waiting to see whether the game's procedural generation leads to the best-case scenario of organized complexity, or the worst-case scenario of nonsensical chaos. However, one of the more useful definitions of procedural generation that I have seen reminds us that even though procedural or algorithmic generation is typically differentiated from traditional authorship, it is not necessarily exclusive of it.[76] Furthermore, procedural generation clearly allows a small team of independent developers to tackle a project that normally only a large, AAA ("triple-A") game studio would undertake.

Why put ChronoZoom together with *No Man's Sky*? Although one is an educational application and the other a game, clearly, the two projects are united by hyperbole. One touts itself as an infinite canvas in time, the other an infinite procedurally generated galaxy. It would be easy enough to invoke Jean-François Lyotard's *The Postmodern Condition* here, and its classic definition of postmodernity as an "incredulity toward metanarratives," or its conclusion that "science has always been in conflict with narratives," to look askance at ChronoZoom's rather teleological bent, its model of increasing complexity of the universe.[77] And no doubt part of *No Man's Sky*'s appeal comes from its blatant frontierism, its manly, classic science-fictional challenge to explore where no man has gone before. A more nuanced critique of ChronoZoom might invoke cinematography to remind us that zoom as a cinematic technique does not come without distortion. Or we could apply the caveats designed for Big Data to Big History.[78] I myself would return to scientists' own warnings about the difficulties and the necessity of depicting both space and time simultaneously in media's scalar portrayals.

But even if these projects suffer from a questionable enthusiasm for master narratives and sweeping views, with their talk of master timelines, regimes, and infinite worlds, and even if ChronoZoom and *No Man's Sky* are inevitably

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

asymptotic enterprises, always approaching but never reaching total coverage, what makes them so intriguing is not the rhetoric of absolute scale, but the way they invite us to craft media experiences at effective or relative scales, set against the field of inexhaustible time and space. Perhaps ChronoZoom's model of visual browsing really does promote a different way of learning and knowing, while procedural generation represents an exciting way to create playable experiences and game worlds that escape the drag of oversimplification. Both suggest novel techno-aesthetic systems predicated on eliminating the perceived boundaries of existing media—one, a visual epistemology based on "deep zoom" image technology, and the other an alternative method of producing playable content using algorithm-driven procedural generation rather than manual design.

While granularity or particularity is likely to suffer when broad connection is emphasized, both projects demonstrate the potential for media to provide the intellectual and aesthetic interface between widely separated scales of activity and domains of knowledge.

Speculative Fiction

Given all this, it seems appropriate to end with another brief nod to the world of science fiction, and in particular Cixin Liu's remarks on sci-fi world-building. Liu's recently translated *Three Body* trilogy uses the classic problem of the motion of celestial bodies to frame Earth's response to the threat of alien extermination, seen largely through the eyes of model scientists and one deadbeat cosmic sociologist. But rather than analyze Liu's novels, let us enjoy Liu's contribution to an issue of *Science Fiction Studies*, provocatively entitled "Beyond Narcissism: What Science Fiction Can Offer Literature," which offers tangential insight into both ChronoZoom and *No Man's Sky*.[79]

For Liu, mainstream literature has always been guilty of "indulging an intense anthropocentric narcissism," and as a result has typically excelled at what he calls "micro details"—social niceties, the nuances of characterization, like the way a Jane Austen heroine can read a drawing room full of visitors. In contrast, science fiction delivers best on the "macro-details." Liu praises Arthur C. Clarke's *2001: A Space Odyssey* (1968) for revealing to him literature's potential for macro-detail, saying, "I had on countless occasions imagined a type of literature that would reveal the vastness and profundity of the universe to me, that would allow me to experience the shivers brought

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

on by the countless possibilities of worlds beyond number."[80] Discussing science fiction in particular, Liu says that "the widespread appearance of macro-details marked a sign of the genre's maturity. They are the narrative technique that, for me, best embodies the particularities and advantages of science fiction."[81]

Yet discussing Leo Tolstoy's *War and Peace* (1869) and Herman Wouk's *The Winds of War* (1971), Liu contends that "macro-descriptions of historical events cannot form the main body of a mainstream literary work, for then the novel ceases being fiction and becomes a work of history."[82] Science fiction, however, can tackle macro-portrayals of history because that history is invented. Reminiscent of Timothy Morton's suggestion that ecological thought should be cosmological and darkly ecological, rather than locally oriented and sunny in disposition, Liu argues that science fiction expands post-Renaissance literature's anthropocentric narcissism by deemphasizing the importance of character and emphasizing the importance of world—while many have seen this as science fiction's generic failing, for Liu it is undeniably an asset that sci-fi characterization goes beyond the individual to "species portrayal" and beyond that to world/environment portrayal. "Mainstream literature is limited to describing a single species (humanity) and a single world (Earth)," says Liu, dismissively.[83] Liu remarks that his own career has seen a parallel shift from hard or pure sf, rooted in hard science, to an increased reconciliation and focus on the human relationship to the natural world. For Liu, science fiction manages to do what both ChronoZoom and *No Man's Sky* set out to do, with mixed results, and in a much older medium:

> Science fiction is precipitously expanding the descriptive space occupied by literature, giving us the potential more vividly and profoundly to show Earth and humanity from the vantage point of the entire universe. It can also show the several thousand years that make up the traditional world of literature in a new light: watching Romeo beneath Juliet's window is certainly more interesting when viewed from a telescope in the Perseus Cloud than from a nearby bush.[84]

Liu's words make me wonder whether we could imagine a ChronoZoom where the timeline does not end precipitously in the upper right-hand corner, where imagined and speculative timelines coexist alongside "real"

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

events. Would these not serve an equally pedagogical function? Or could we take *No Man's Sky* at face value and play as if we were, indeed, no man—as alien, or nonhuman, in a universe far too large to accommodate fantasies of individual possession and knowledge? As it turns out, games have already begun to experiment with offering play at the "effective" scales of organisms well above and below our usual levels of perception, and sometimes even on the border of life itself.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:36 UTC
All use subject to https://about.jstor.org/terms

3

Nonhuman

> Computer programs, complex lists of formal instructions written in specially designed, artificial languages, can be seen as a new type of the rhetorical figure apostrophe, the addressing of inanimate or abstract objects, with the magical difference that it actually provokes a response.
>
> —ESPEN J. AARSETH, *Cybertext*

> The figure of an intrinsically inanimate matter may be one of the impediments to the emergence of more ecological and more materially sustainable modes of production and consumption.
>
> —JANE BENNETT, *Vibrant Matter: A Political Ecology of Things*

Standing naked before his watching cat, Jacques Derrida once famously experienced a kind of shy unease, later chronicled in the lecture and publication of "The Animal That Therefore I Am (More to Follow)."[1] We might wonder what Derrida would have made of *Neko Atsume*, a free Japanese kitty-collecting game released in 2014 that took the iOS and Android app stores by storm (Figure 17). Labeled by writers at the game journalism site Kotaku as "The Japanese Cat Game We Can't Stop Playing" and regularly described by its chroniclers as "addicting" and "obsessing," the game allows you to feed and entertain stray cats who happily cavort in your home and yard once it has been populated with extravagant cat toys. The over fifty cats that appear from time to time often peer out at you from containers or scratching posts; a few are stoic, but most return your gaze with affection.

Derrida's essay inadvertently speaks to the peculiar attractions of *Neko Atsume* (which means "cat gathering") for the same reasons that it has become a cornerstone of animal studies criticism—its impatience with hubristic

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Figure 17. “How can an animal look you in the face?” The cats of *Neko Atsume*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

anthropocentrism, the willingness to grant an unknowable consciousness to the observing animal, and a marked modesty toward the achievements of domestication. While Derrida's repeated assurances that the cat of his speech is real, and not just a convenient allegory, might suggest his distrust of feline icons, Derrida simultaneously toys with the possibility that his cat reference is, after all, a literary allusion to Lewis Carroll's *Through the Looking-Glass* (1871).[2] Derrida's awareness of the specular relationship between human and animal, waking and dreaming, prefigures the experience of staring through the aluminosilicate glass of an Apple device at *Neko Atsume*, itself a game that reflects the longstanding Japanese preoccupation with cats as a companion species enshrined in temples, figurines, and innumerable "kawaii" or cute forms of popular culture, from cat cafés and *maneki neko* to the ubiquitous Hello Kitty.[3]

Of course, many are far less sanguine about mediated, particularly digitally mediated animal–human relations, from the late art critic John Berger to the autistic animal scientist Temple Grandin,[4] and it may be especially instructive to look at the conversion charted by one prominent theorist of technology and its psychological effects. Although less commonly associated with animal studies because of her career-long emphasis on human–computer interaction, Sherry Turkle has nonetheless written extensively about our relationships to machine others, including sociable robots designed at MIT; Paro, the robotic baby seal created in Japan to keep lonely elders company; and more widely accessible "virtual" pets like Furbies and Tamagotchis. Turkle's initial work, for instance in *The Second Self*, found promising communion between people and early computing devices, and elaborated at length the latter's unique and inevitably anthropomorphized "holding power."[5] However, recent books like *Alone Together* and *Reclaiming Conversation* testify to Turkle's growing worry that such computational companions have become undesirable substitutes for more genuine, face-to-face, and thus tacitly human-to-human interaction. Yet I remain sympathetic to the legions of charismatic and not-so-charismatic fauna and flora who litter the playful worlds of games.[6] As Katherine Isbister has regularly stressed in her research on the emotional force of games, the design of nonplayer characters (NPCs) significantly impacts player investment and identification.[7] Animals as NPCs have been integral to many games and game genres, whether as hunting trophies (*Duck Hunt* [1984]), domesticated livestock (*Hay Day* [2012]), mounts (*World of Warcraft*), or breeding pets (*Faunasphere* [2009]). These days, many

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

young people fondly remember childhood hours spent either on the virtual pet website Neopets or several versions of *Pokémon* on Nintendo handheld gaming devices.

More and more, games are offering a first- or second-person/animal perspective, in which as players we are joined with other species in a kind of deterritorialized becoming-animal.[8] Here, Derrida's *l'animal que donc je suis* might be irreverently revised to *l'animal que donc je joue*—"the animal that therefore I play," or perhaps "play with." We might consider that, as a noun, *joue* also describes the jowl meat of the face, as in a recipe for braised beef cheeks (*joues de boeuf confites*), a pendant fleshiness that seems appropriate to our taking animal form in games. A list of animal protagonists in games could obviously include *Frogger* (1981), *Sonic the Hedgehog* (1991), and *Ecco the Dolphin* (1992), as well as the marsupial hero of the *Crash Bandicoot* series (1996–) and the white wolf-goddess of *Ōkami* (2006). However, my aim here is less to provide an exhaustive historical accounting than to point to some thought-provoking, recent experiments in animal gameplay. First, in the Swedish game company Might and Delight's *Shelter* (2013) and its sequel, *Shelter 2* (2015), one finds a counter to the indulgent sentimentalism of many a pet-loving game. In *Shelter*, you play as a badger mother to five cubs, and in *Shelter 2* as a mother lynx to four kittens; yet despite the maternal narrative, both games present a nature noticeably "red in tooth and claw" (a phrase often attributed to Alfred, Lord Tennyson, but likely predating his poem "In Memoriam A.H.H"). While there are a few tender moments in the safety of one's den, neither game permits an idyllic tour of animal existence. Instead, they stress the tenuousness of life. In *Shelter*, for instance, the badger cubs are alternately threatened by starvation, forest fire, flash flood, and terrestrial and airborne predators (Figure 18), and even should you see them safely to the final stage, you yourself will meet an untimely end. At the very beginning of *Shelter 2*, a gravid "Mother Lynx" must survive the pursuit of a pack of hungry wolves. She enjoys the ability to sprint and sense prey from afar, but she and her kittens must still contend with wolves, floods, and constant hunger. Online, players of *Shelter* and *Shelter 2* regularly deprecate themselves for being "terrible" badger or lynx "moms," and their grief at the death of any member of the animal family echoes other games where a beloved animal companion was lost, for example, the fall of the horse Agro in Team Ico's *Shadow of the Colossus* (2005). Although the games' muted, woodcut-style art and general lack of instruction make it difficult to parent successfully,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Figure 18. The path of a family of badgers is partially blocked by fire in Might and Delight's game *Shelter*.

many players nevertheless seem to feel personally accountable for their "babies."

Other games that clearly invite a melding of human and animal perspectives are Giant Squid Studio's *Abzû* (2016), an underwater exploration game in which you play as a diver who, among other things, may ride along with whales and meditatively project her consciousness into any of the species of fish, reptiles, invertebrates, and mammals surrounding her. *Never Alone* (2014), produced in collaboration with Iñupiat Alaskan Native people, distributes play equally between the Iñupiat girl Nuna and her companion arctic fox. Playing alone, you must toggle back and forth between the two to solve certain puzzles; ideally, you would play with another person, thereby forming a multispecies quadrumvirate of paired avatars and players. Additionally, several more open-ended experiments in animal gameplay bear mentioning, among them the VR head-mounted display (HMD) flight simulator Birdly®, which promises its prostrate, fan-blown users "the ultimate freedom of a bird,"[9] and the *Euglena* light-barrier games featured at the beginning of chapter 1. Although protists are technically neither animal nor plant, despite behaving in some ways like both,[10] their mobility and consumption of food mark them as animal-like. When researchers at the Riedel-Kruse lab tested

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

the *Trap It!* (2015) game at the Tech Museum in San Jose, California, they later concluded that two of the primary appeals of such "human-biology interactions" are what they call tangibility (or sometimes the tactile) and the value of perceived interaction with real organisms. In their words, "Dealing with real organisms seemed to be a unique and rare experience for the users."[11] A few forays have also been made into what could be called animal or more-than-human MMOGs, which are distinctive not only for their use of non-human avatars, but also their dedication to noncompetitive gameplay and nonverbal forms of communication. Typically, MMOGs have been studied as sites of human social interaction and identity performance, yet more-than-human multiplayer games like Big Fish Games' short-lived *Faunasphere* (2009–11) and ongoing experiments like Tale of Tales' *The Endless Forest* (2005–) and Might and Delight's *Meadow* (2016–) generally restrict player interaction to subtle cries or physical emoting, akin to what Espen Aarseth terms "the pose" in relation to text-based multiuser dungeons (MUDs).[12] In *The Endless Forest*, my deer with a vaguely humanoid face may prance or paw the air before another deer, or even shake her head in a yes/no fashion, should the other manage to model a question. In *Meadow*, animals that in the previous *Shelter* games would have adhered to a strict predator–prey relationship are now free to frolic alongside one another, suggesting that on an internet increasingly characterized by verbal abuse and trolling, constrained forms of sociality are paradoxically quite liberating.

A final animal gameplay experiment removes player agency altogether, namely artist Brent Watanabe's 2016 Twitch.tv live-streaming experiment for which he hacked the open game world of *Grand Theft Auto V* to prioritize a deer's perspective. Watanabe once described the experiment as follows:

> The mod creates a deer and follows it as it wanders throughout the 100 square miles of San Andreas, a fictional state in *GTA V* based on California. The deer has been programmed to control itself and make its own decisions, with no one actually playing the video game. The deer is 'playing itself,' with all activity unscripted . . . and unexpected. In the past 48 hours, the deer has wandered along a moonlit beach, caused a traffic jam on a major freeway, been caught in a gangland gun battle, and been chased by the police.[13]

Viewers of the virally distributed project delighted in its playful similarity to genuine park-service fare and its inversion of the game's usual attractions,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

given that Rockstar Games and the entire *Grand Theft Auto* series have conventionally been studied, celebrated, or vilified precisely for their human vices—among them violence, sex, racial stereotyping, and sensationalist pandering. With Watanabe's fake deer cam, two constituencies arguably briefly aligned that are rarely seen together—hardcore gamers and nature enthusiasts. Fans who watched the cam footage, some for hours, replicated the behavior of citizen-scientists and curious onlookers who devotedly follow real animal webcams.[14] The deer cam pokes equal fun at connoisseurs of the *GTA* franchise and overly invested animal cam watchers, as in the case of the now infamous Woods Hole Osprey Cam, which had to be taken down because of viewers' irate behavior over a perceived "bad animal mom." Whether or not Watanabe intended to gently lambast our tendency to project human morals onto animals, donations to the project ostensibly went to support the Humane Society.

Even these select examples of animal gameplay invite new critical perspectives from within and beyond the pale of conventional game scholarship, from the many varieties of posthumanist and multispecies thinking, prominent among them Donna Haraway's work on the cyborg and companion species and Anna Tsing's "more-than-human sociality,"[15] to the feminist ethics of care and its application to animal welfare. Caring for something, whether a toy creature, potted plant, or pet rock, is a potent and evolutionarily hardwired behavior, one which Turkle reminds us leads children to feel compunction, even grief, over abusing a Furby or forgetting to feed a Tamagotchi. That game animals occupy a liminal space between animal and thing also conveniently propels us into our next consideration—nonhuman others that are not animals. In a move similar to that performed by Michel Callon, Bruno Latour, John Law, and the actants of actor-network theory, we might expand this identification with the animal to something even broader, to plants, say, or the secret life of things.

The Problem of Modeling (and Rendering) Trees

Chapter 4 will look more closely at farming games, but it is worth noting here that game nurturing is hardly limited to animal companions. As a case in point, when I have a few moments to myself, I sometimes open the *Viridi* (2015) app on my smartphone, in which you tend a planter full of slow-growing succulents (Figure 19). There is very little to do besides infrequent watering and weeding, and accordingly the game's minimalist design mimics

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Figure 19. A thirsty plant in the succulent-tending game *Viridi,* from Ice Water Games.

many entries in this growing category of "Zen" games, which like *The Endless Forest* deliberately straddle the border between game and screensaver. Like *Flower*, *Viridi* promises a kind of plant thinking,[16] and at the very least, gardening describes one thing we can "do" with games, as Ian Bogost has noted in his discussion of Japanese rock gardens, or *karesansui*.[17]

Along with this conscious tending, I have grown increasingly concerned with the provenance of the largely unconsciously assimilated scenery that we experience while playing games—what in chapter 1 I referred to as the environmental backdrop, at times lionized in moments of graphic spectacle but most often compressed into the *coulisses* of a theatrical margin. This has only become more important as designers experiment with less muscular modes of gameplay that thereby foreground a player's surroundings, as in the rising genre of "first-person walkers," "walk-'em-ups," or "walking simulators," also discussed in chapter 1. My thoughts about walking as a constructive and construing act in video game environments are here complemented by an attempt to understand the technical and scientific preconditions for the production of those environments, through the necessarily limited lens of vegetation. In a way, I want to reverse the progression found at the beginning of Gary Snyder's poem, "Walking the New York Bedrock," to step out of the "sea of information" and return to actual, virtual trees.[18] In what follows,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

I examine the ways in which catalogs of vegetable readymades, or what could be called "plant-and-play" models, have been developed both historically and contemporaneously by several leading companies (SpeedTree, Xfrog, Laubwerk), including a brief look at the proportion of "natural" to "built" environmental assets in game development model libraries. Before proceeding, I should clarify that in computer science, terms like "asset" and "library" typically refer to templates or models created and then made available in digital repositories for later use in production. To give an analogy, if you have ever used a piece of clip art or a stock photo, you have relied on a kind of generic archive in the same way that many game companies, even AAA ones, make use of game engines, middleware, third-party products, and outsourcing rather than building everything in-house from the ground up.

Although some questions seemed clear from the outset—who makes these assets, and how? What range of species is currently available to designers, and why? Are these plants pictures, or processes? And, why on earth does a tree need to be speedy?—quickly, conceptual sticking points arose. First among them is the tension between computational power or graphics capabilities and botanical accuracy. There are many ways to generate individual plants, some of which try to simulate natural patterns of growth and development while others simply attempt to generate plants in toto. Trees in particular are still computationally intensive for most computers to render, so from the computer graphics or game development perspective, it is often necessary to sacrifice accuracy or detail for speed and efficiency. A modest rhododendron, for instance, could require about 30,000 triangles, while a single maple tree demands several million polygons.[19] Industry solutions to this include LOD (level of detail) rendering, where distant or occluded objects are simplified into low-detail versions of themselves or approximated by what are called, tellingly, billboards, instead of full geometric models. A second, but related problem has to do with the difference between models of the node and edge variety (for trees, knots and edges), familiar to us from computer network diagrams, and models that add layers of volumetric and visual detail. Dealing with a digitally generated plant as a topological model or as a geometric and animated entity makes an enormous difference not only to the computer that must render the plant, but also to our perceptual understanding of that plant. One final concern is the relationship between individual plants and landscapes, whether it is interactions within a population or between species, or between vegetation and terrain or environmental

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

conditions such as light and moisture. Some of the more botanically inclined modeling methods do attempt to model both positive influences, like light for phototropic plants, and negative ones, like spatial interference from competing branches, but most digital vegetation today still employs an illusionistic sleight-of-hand, with careful attention paid only to the look of either individual plants or plant masses, rather than realistic midlevel interactions, for example between trees, as when two trees grow together into a shared crown. A game's grassy meadow is likely to feature a reduplicated throng of just a handful of plant models, with a few unique individuals—a broken stem, a gnarled piece of deadfall—added to diminish the sense of uniformity. In other words, there is little risk of being unable to see the digital forest for its trees, because the two are essentially interchangeable.

Several companies have made a name for themselves in digital plant creation, prominent among them Interactive Data Visualization, Inc. (IDV) and its SpeedTree product line. IDV caters to customers in cinema, games, and architecture, although its role is often hidden under the auspices of visual effects houses like Industrial Light & Magic. SpeedTrees have been featured in such high-profile films as James Cameron's *Avatar* (2009) and games like the *Dragon Age* (2009–) titles, *Fallout 3* (2008), *Grand Theft Auto IV* (2008), *Smite* (2014), and *Battlefield 4* (2013). By now, IDV confidently asserts that SpeedTree for Games is the video game industry's premier vegetation solution, "Whether you're looking to create serious games ecosystems, video game forests or any other real-time application tree or plant." The SpeedTree catalog *is* impressive, containing broadleaves, conifers, palms, cacti, shrubs, and flowers from all over the world, and even a few marine specimens. And on one of my many visits to the catalog, I was amused to see that one of the featured plants was *Cannabis sativa*, jestingly marketed as SpeedWeed (Figure 20).

To give some sense of SpeedTree's impact on a single, high-profile game, we could turn to Bethesda's *The Elder Scrolls IV: Oblivion*. In "A Brief History of Cyrodiil," one of Bethesda's artists, Noah Berry, describes the challenges of creating the green world of *Oblivion*: "Buildings and swords are one matter—we've tackled these types of models pretty successfully before, but lush, moving vegetation? High detail trees that sway and interact with dynamic wind? These are no small undertakings in 3D worlds that are generally constructed out of straight lines and hard angles."[20] In his post, Berry adds that players can encounter any of 35,544 shrubs and bushes, 67,730 plants and mushrooms, 94,013 trees and fallen logs, and 395,696 rocks during their adventures in the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

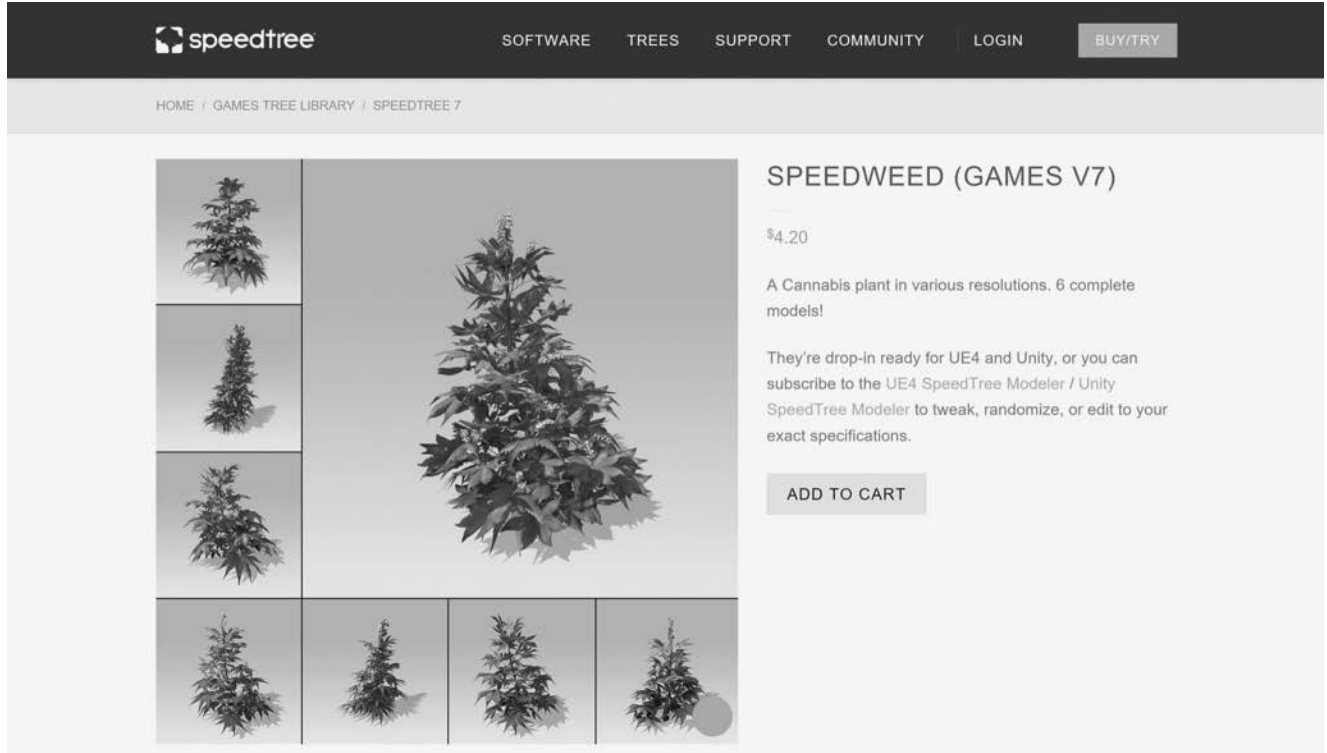

Figure 20. Digitally modeled *Cannabis sativa*, or SpeedWeed, is one of the many plant species available in the SpeedTree online store.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

open world of *Oblivion*—put this way, the scale of virtual biosphere production is staggering.

Competitors to SpeedTree include PixelSquid, Laubwerk (Figure 21), and Xfrog, the last of which boasts over six hundred plant species in its library. SpeedTree's off-the-shelf models contrast with Xfrog's more complicated suite of tools, guided by their devotion to what they call "botanical rules." In Xfrog's marketing literature, they patiently explain that nature is not about points, lines, and polygons, emphasizing that their procedural approach is superior because Xfrog plants "have no triangles, no quads, of Euclidean geometry. Polygons exist to represent man-made objects." Xfrog dismisses the common but deceptively simple question "Are plants fractals?" by forestalling it: "And no, before you say it, the world is not made out of fractals"[21]—an exasperation that becomes clear after one plunges down the long, dark rabbit hole of mathematical biology, algorithmic botany, and what I now call *digital morphogenesis*, or the science and math of pattern development in computer-generated plants and animals.

Pioneers in this area include the Scottish biologist D'Arcy Wentworth Thompson and the Biological Modeling and Visualization research group in the Department of Computer Science at the University of Calgary led by

Figure 21. A weeping willow created by the German 3D plant modeling company Laubwerk, associated with Professor Oliver Deussen and his computer graphics research group at the University of Konstanz.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Przemyslaw Prusinkiewicz. Prusinkiewicz's Algorithmic Botany lab continues work done by Prusinkiewicz with Aristid Lindenmeyer before Lindenmeyer's passing, and together they were the primary authors of the foundational 1990 textbook *The Algorithmic Beauty of Plants.* Lindenmeyer was known for introducing Lindenmeyer-systems, or L-systems, in 1968, which now form the basis of Xfrog's distinctive software. L-systems were originally proposed as a theoretical method to study the development of simple, multicellular organisms, but were later applied to higher plants and plant organs. As Prusinkiewicz and Lindenmeyer explain, "After the incorporation of geometric features, plant models expressed using L-systems became detailed enough to allow the use of computer graphics for the realistic visualization of plant structures and developmental processes."[22] Or, as Oliver Deussen and Bernd Lintermann, the authors of a more recent textbook and incidentally the cofounders of Xfrog, point out, "The complexity of digital design and the visual quality of synthetically produced images has reached a point at which it is rather difficult to differentiate between computer simulations and actual photographs."[23]

In the digital design of plants, then, we have the convergence of centuries of mathematical interest in the apparent symmetry and self-similarity of natural forms; biological interest in morphogenesis, defined as the development of an organism's form through growth and differentiation of tissue; and trends in computer science. Deussen and Lintermann describe two broad categories of approaches to "computer-assisted methods for the production of plants," namely procedural and rule-based methods: "Procedural plant creation processes are parameterized algorithms that are designed for the production of a certain type of plant, though often solely for a single specie [*sic*]. Rule-based procedures are based on a rule system, which, using the application of rules, produces from a simple initial state a complex final state."[24] Procedural methods include von Neumann cellular automata, modeling of branching structures, particle systems, fractals, geometrical models, approaches based on budding, combinatorial approaches, voxels (square volume boxes, sometimes used for climbing plants), and approximate models. Rule-based methods include L-systems, object instancing, iterative function systems, and graph systems. Today high-quality images can be generated with both methods. Rule-based methods are attractive for their formal compactness and their ability to produce all types of trees, but they are difficult to implement, requiring high conversancy with the underlying systems. With Xfrog, Deussen and Lintermann developed a graph-based or more

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

visual version of L-systems and combined that with procedural methods to make a more user-friendly product. Xfrog's compromise thus seems to be some combination of procedural generation and hand modeling.

Granted, what matters here is less an exact understanding of these methods than the question of ideal form. In *The Posthuman*, Rosi Braidotti playfully shares adaptations of Da Vinci's famous, perfectly proportioned Vitruvian man, first in the form of a Vitruvian woman and then later, a dog.[25] In that spirit, I find it telling that the designers of digital plants often validate their work by going back not only to early biologists but also Da Vinci himself, who apparently divined one of the "golden rules" of plant structure by noticing that in tree branching, the diameter of a parent branch matches the combined widths of its "sons." Presuppositions ramify depending on whether we think of digitally modeled plants in the neat terms of graph theory or network topology; as branching structures with trunks, limbs, and so on; as the product of a number of probabilistic or parameterized fields influenced by attractors and inhibitors; or, as Da Vinci would have it, as volumes akin to bundles of strings, which is arguably closer to a tree's functioning (at least the transportation of nutrients and water via xylem and phloem).

Digital flora also raises the question of how closely aligned new media and the natural are, given the nagging ease of fractally generating convincing plants. Well before Benoît Mandelbrot's *The Fractal Geometry of Nature*, many noted a certain beautiful self-similarity in nature. Lev Manovich includes the principle of modularity in his well-known definition of new media, which he himself says could be called "the fractal structure of new media." "Just as a fractal has the same structure on different scales," writes Manovich, "a new media object has the same modular structure throughout."[26] Although it turns out that plants are not, in fact, fractals, fractals remain a convenient way to simulate nature's patterns. Once again, new media are not so new, and ultimately, it matters whether these plant-generation methods cleave to the messier, but correspondingly more complex world of real plants. It matters whether the plant is generated as a growing form that can evolve, change through seasons, grow old, and even die, or is merely the result of blatant cookie-cutting. As Thompson opined in his 1917 book *On Growth and Form*, which set the stage for mathematical biology and studies of morphogenesis, "Organic form itself is found, mathematically speaking, to be a function of time. . . . We might call the form of an organism an event in space-time, and not merely a configuration in space."[27] Thus, although names like SpeedTree imply that realistic vegetation is only a few quick

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

clicks away, something like Xfrog's developmental algorithms and L-systems may be fundamentally more interesting in their approach to plant generation. In Lindenmeyer systems, rules are executed in parallel; they are designed to mimic the natural occurrence of parallel processes in the development of organisms. L-systems are instances of classic rewriting systems that use text or string-based logic, like the well-known Koch or snowflake curve.

As computer processing power increases, computer scientists will probably start to incorporate more and more sophisticated parameters in digital plant design, so we can foresee fewer billboards and level-of-detail cheats and more attention to ecosystem design in the form of plant interactions and community associations. For instance, Prusinkiewicz already divides approaches into structural and space-based models, where the former use endogenous growth mechanisms inherent to the plant structure and the latter take into account external influences, like wind. This takes us out of the realm of visual effects and into broader discussions of scale, relation, and digital fidelity to ecological reality, as discussed throughout the preceding chapters. What will happen when the clean lines of mathematical topologies are replaced by the messy edges of actual topography and environmental coexistence? Fortunately, these highly technical subjects prove accessible from a variety of perspectives, among them formal or aesthetic concerns and attention to media industries and production cultures. After all, what makes a digital landscape look real? What makes it beautiful? A computer scientist might answer that realism corresponds to a high amount of natural data, and beauty to self-similarity. Yet our perceptual apparatus somehow registers excessive uniformity as artificial. Take the following product review of SpeedTree, from *Gamasutra*:

> The resulting trees are a perfect balance between speed and quality. Seen up close, the trees are remarkably believable: you can look up at the treetop when your character is standing directly below the tree, and the illusion of volume and parallax between the leaves is properly maintained. Additionally, as SpeedTree uses billboards to represent distant trees, creating large vistas with forests is a breeze. *Some individual trees do look a bit algorithmic and fractal at certain moments*, but when placed in a grove or forest, the results are strikingly realistic.[28]

This reviewer's hesitation in an otherwise heady torrent of praise reminds us of how much our "advanced" technologies, from biological computing

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

to materials-science engineering to computer graphics, are still asymptotic enterprises questing after the complexity and elegance of the natural. In work on sustainable architecture, biomimicry in materials science, and the use of natural sensors, many already look to nature for superior design techniques, among them the BIOMS group (Bio Input onto Material Systems) and the Hybrid Ecologies Lab at UC Berkeley. Eugene Thacker similarly describes biomedia as a circuit between the human body and genome and the lab.[29]

Trying to fathom how game trees come to be also exposes the relative invisibility of these preconditions for game production. In game studies, despite laudable attempts at detailing the inner workings of the game industry,[30] and continuing interest in platform and software histories,[31] very little attention has been given to the "middleware" realm of game tools, engines, software development kits (SDKs), and asset libraries. This is surprising, given that their costs are far from negligible. If you wish to buy digital trees from the French company Bionatics, for instance, expect to spend hundreds, if not thousands of dollars: "RealFX retails for $1,350 with ten plants of your choice, and a version with fifty trees retails at just $3,350. NatFX starts at $990 (ten trees) and climbs up to $2,990 in the fifty-tree version. Additional trees are sold on per-tree payment model."[32] However, the real danger is that digital asset libraries will not only replicate the sorry anthropocentric bias of most of our cultural production but also sacrifice science for speed. Even specialists in the digital design of nature freely admit to giant gaps in the procedural and animated representation of natural environments, and my preliminary research on the Unity Asset Store, launched in 2010 and later billed as the leading global asset marketplace for developers,[33] suggests that avatars, guns, cars, and buildings vastly outnumber plants, animals, and landscapes in model libraries. In a sort of obverse content analysis, we can learn a great deal from the categorization and relative lack of availability of "natural" objects in these digital asset libraries, which media creators rely on to shorten their product development time.

Evoking Martin Heidegger on the standing reserve and my own criticism of games that idealize resource extraction, author Paul Frosh meditates in a related fashion on the character of "stock" photography:

> In fact, the very word 'stock' refers us to the systemic nature of cultural production *and* to semiotic questions of appearance and meaning. A stock image is literally kept 'in stock' in real agency archives, stored—ready for distribution—

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

> like a manufactured product in a warehouse; the word 'stock' also connotes, however, the predominant appearance of these images: instantly recognizable iconographic combinations which rely upon, and reinforce, 'clichéd' visual motifs and stereotypes that are drawn from a far broader cultural archive or image-repertoire.[34]

Like stock photos or even cell phone antenna trees,[35] digital plants are for the most part mass-produced clichés that are simultaneously hypervisible and invisible, ubiquitous enough to pass beneath notice, designed to be seen and ignored. Yet this is the nature we increasingly consume on our screens, that is praised by industry elites, and in some cases, as with *Avatar*'s Pandora, found preferable to our own world. Meanwhile only a little digging reveals that, as with much game technology, SpeedTree has partial roots in the military, since its founders developed their expertise while serving in the navy.

At the same time, SpeedTree and products like it give us a valuable way to understand the increasing convergence of visual media forms and the progressively more porous boundaries between human labor and artistry and automated computer techniques. Originally developed for an architectural visualization, SpeedTree has since crossed platforms from exclusive use in games to cinema, as well. Computer scientists working on plant modeling envision additional functions with more tangible impacts: "Prospective applications also include computer-assisted landscape architecture, design of new varieties of plants, and crop yield prediction."[36] Xfrog also advertises an oxymoronic but pleasingly cyborgian method of modeling their plants "by hand" using their proprietary software. The combination of procedural generation and hand tweaking invites a more nuanced understanding of visual effects work and virtual world-building that goes beyond standard discourses of immaterial labor and knowledge work or my own critiques of the shortcomings of digital environments. One writer even compares the developers that do this kind of work to real-world arborists, leading me to wonder whether workers like these are really arborists, who tend to individual trees; foresters, who care for entire forests with the aim of harvesting; or silviculturists (silvology being the science of forest management).[37] While plant models often use scanned textures from real plants, in the case of Xfrog, users have already extensively experimented with more abstract and impressionistic applications. In fact, the authors of *Digital Design of Nature* expressly reference media art like Bill Viola's *Tree of Life* as inspiration for their work.[38]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UT6 12:34:56 UTC
All use subject to https://about.jstor.org/terms

The latest developments in virtual reality also foretell a day when players' entire bodies will move as if in game space and gestures will easily terraform and cultivate virtual landscapes.[39]

In due course, perhaps we can aim at an understanding, recalling both the legal definition of standing put forth in Christopher Stone's influential "Should Trees Have Standing?" as well as understories, alluding to both narratives and layers of vegetation beneath the forest canopy (as employed by cultural geographer Jake Kosek).[40] We also ought to consider what poet Robert Hass long ago called the problem of describing trees.[41] To walk, to garden, to grow, and to prune—all of these are meaning-making and potentially counter-ludic acts that settle us with and as biomass.

The Adventures of a Binary Digit, or Bit-Narratives

Thus far, I have examined attempts to move past anthropocentric play through animal- and plant-based nonhuman representation. Should we move down the hierarchy of Heideggerian worldliness, however dubious, from human to animal to stone, we might usefully stumble upon recent literary scholarship on eighteenth- and early nineteenth-century "it-narratives," defined as a kind of "nonhuman autobiography" whose "defining feature . . . is that they are told from the perspective of an object or (less commonly) an animal."[42] In the remainder of this chapter, I linger on the nonliving stuff of games, while proposing the newer, but complementary category of "bit-narratives," which typically either feature computers or digital objects as protagonists or meditate on themselves as digital creations. Just as it-narratives—for example, *Adventures of a Black Coat* (1760) or *Memoirs of a Wig* (1814)—have lately been reconsidered using the material emphases of textual and bibliographic studies, I argue that bit-narratives provide a convenient platform from which to expand materialist approaches to games, from historical media-archaeological studies to potential crossovers between game studies and actor-network theory, posthumanism, animal studies, and new materialism. Akin to Leah Price's contention that nineteenth-century it-narratives were books about themselves *as* books,[43] bit-narrative games like *The Novelist* (2013), *Mountain* (2014), and Paolo Pedercini's satirical *Phone Story* (2011) offer metaphysical speculation about the lives of inanimate objects, while also being material entities at the interface of fiction and reality that enact the increasing centrality of digital objects and processes to our everyday lives. Moreover, as playable experiments in nonhuman alterity and agency, bit-narratives often

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

manifest an environmental edge. Taking forms like the commodity exposé or survivalist drama, they may remind us that "its" and "bits" are no longer simply nonhumans but also humans we treat like objects.

For the recent focus on the recountable life of objects in "it-narratives," we may thank the bibliophilic fancies of literary scholars of the eighteenth and nineteenth centuries. Their textual and bibliographic study of texts from this era is, I would argue, media studies *avant la lettre*. According to Christina Lupton, English it-narratives were popular in the second half of the eighteenth century and into the 1810s, and included tales like *The History and Adventures of a Lady's Slippers and Shoes* (1754), the aforementioned *Adventures of a Black Coat*, and the century's most successful it-narrative, *Chrysal; or, The Adventures of a Guinea* (1760). "The common explanation for the emergence of this literary form," she continues, "has been that eighteenth-century Britons were interested in the new autonomy of artifacts, and that writers seized on the speaking object as a way to reflect the mobility and power of commodities in the booming mid-century colonial marketplace."[44] Other dominant readings of it-narratives have been given by Christopher Flint and Mark Blackwell,[45] who see them as displaying writers' anxieties about the precarity of their profession. For them, it-narratives body forth their authors' alienation and commodification in the new era of print capitalism. Lupton deliberately pursues a less symbolic or symptomatic approach to the it-narrative, resisting the tendency to see the objects as stand-ins for their authors. Like Price, who is interested less in poststructuralist texts than actual, physical books, Lupton tries to approach the "its" of it-narratives matter-of-factly, even superficially, as "thinking things." For Price, it-narratives survive into the nineteenth century mostly as moral stories about books and their owners (so often about The Book, with a capital B), and can be productively examined with the material emphases of contemporary bibliographic and textual studies.[46]

In my view, it-narratives linger to this day, though modern equivalents have largely shed the original conceit of being told from the perspective of the object, or animal, itself. In the late twentieth and early twenty-first centuries, perhaps the most salient form of it-narrative has been the commodity exposé, stories about the hidden or overlooked life cycles of everyday products. In what amounts to a kind of environmental or environmentalist literary subgenre, these stories display a solicitous anxiety about globalized systems of capital exchange, from the sourcing of raw materials to the disposal of

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

used goods, from transnational labor markets and conditions for workers to ecological impact and gross carbon footprint. From our cushy but increasingly uncomfortable vantage as the Anthropos in the newly dubbed Anthropocene, tales of thingness have become parables of human folly through excess production and consumption. "Its" are no longer just nonhumans but also humans reduced to intentionless labor, as Taylorist cogs in the global "free" market.[47] Though Lupton has notably resisted reading traditional, eighteenth-century it-narratives as discourses about commodification and alienation in the Marxist senses, since they preceded those terms, modern it-narratives have no such exemption. We could look at any number of examples, from the food journalism of Michael Pollan and Eric Schlosser to epigenetic theories of Jared Diamond's *Guns, Germs, and Steel* (1997) variety, but for now let us look at just two, which we could shorthand *Tales of a Neoliberal T-shirt* and *If Rubber Ducks Could Talk.*

In December 2013, NPR's *Planet Money* aired a story years in the making about how an ordinary, non-organic cotton T-shirt gets made.[48] Divided into segments called Cotton, Machines, People, Boxes, and You, the series tracked a shipment of custom-order shirts from start to finish, meaning from a Mississippi cotton farm, to factories in Indonesia, Colombia, and Bangladesh, across oceans on a cargo vessel, to Brooklyn for design printing, and finally to the T-shirt buyers, over twenty thousand of them who pledged money during the series's Kickstarter campaign. The story was itself inspired by a book called *The Travels of a T-Shirt in the Global Economy: An Economist Examines the Markets, Power, and Politics of the World Trade* by Georgetown business professor Pietra Rivoli.[49] Initially, *Planet Money* tried for years to make the shirts from scratch, but ended up negotiating a commission with Jockey, which agreed to let them follow the shirts through their life cycle. *Planet Money*'s report and its accompanying website weave together standard human-interest stories with a less typical focus on things—from cotton fields filmed via drones to the giant metal shipping container (roughly 40 × 8 × 9.5 feet) used to transport the series's shirts. Though the report clearly aims to shed light on the little-known practices behind garment production, at times its approach to the world of things borders on all-out object crush. Thus the cargo box becomes the "humble hero of the global economy" or "the unsung innovation at the heart of the global economy," while the machines that do the majority of the work of turning cotton into thread become stars of a bizarre kind of techsploitation film. Though it seems to

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

be the humble story of a T-shirt, lurking behind all of this is another "it" of questionable contours, an abstraction paradoxically composed of people and things—namely, the market. It seems strangely appropriate, then, that the *Planet Money* T-shirts were emblazoned with the image of a squirrel holding a martini glass, a punny reference to economist John Maynard Keynes's phrase "animal spirits" from *The General Theory of Employment, Interest, and Money* (1936). The phrase makes room for human emotions and preferences to shape markets, not just pure numbers.

A second example of a modern it-narrative is Donovan Hohn's journalistic opus *Moby-Duck*, helpfully subtitled *The True Story of 28,800 Bath Toys Lost at Sea and of the Beachcombers, Oceanographers, Environmentalists, and Fools, Including the Author, Who Went in Search of Them*.[50] Hohn's account follows in the wake of the following event: on January 10, 1992, a Taiwanese container ship called the *Ever Laurel* traveling from Hong Kong to the Port of Tacoma encountered rough weather near the international date line, in the process losing several stacks of cargo. Among these was a shipping container carrying thousands of kids' bath toys in the form of red beavers, green frogs, blue turtles, and yellow ducks. Not surprisingly, this story, once reported, captured the popular imagination, even spurring Hohn to quit his day job as a high-school English teacher to find out what really happened to those toys once overboard. True to form, in the book Hohn keeps up a running patter of seafaring quotes from Melville's classic and Joseph Conrad's *The Mirror of the Sea* (1906), while using the lost toys to ruminate on childhood, fatherhood, plastic pollution, environmentalism, and ocean science. To get his scoop, Hohn crisscrosses the globe, volunteering himself as a mediocre deckhand, garbage collector, merchant-marine tourist, and scientific assistant, traveling by land and air but most often by sea to Alaska; Hawaii; factories in Guangzhou, China; Korea; the North Pacific Subtropical Gyre; and even multiple outposts in the Canadian Arctic, all in an effort to trace the possible circulation and dispersal of the bath toys after they left the North Pacific Subpolar Gyre somewhere south of the Bering Sea. Of course, the only lost toys that Hohn encounters have already been found by others, washed up on distant shores, usually bleached and brittle. Unlike *Planet Money*'s carefully shepherded T-shirts, the Floatee brand toys are elusive creatures; in other words, "its" are not always easy to trace.

Besides these modern pseudo-environmental versions of the it-narrative,[51] today we also have stories and forms that I have labeled "bit-narratives." Bits

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

are not only small pieces of any given material, but "bit" is also shorthand for "binary digit," one of the fundamental units of electronically stored computer information.[52] Bits thus capture both the radical scalar reductions of contemporary science and its visualization, from quantum physics and nanotechnology to molecular biology and biochemistry, and the increasing ubiquity of digital objects and processes in our everyday routines. Provisionally, I am defining bit-narratives as stories that either feature computers or digital objects as protagonists, or that are themselves digital creations. In the former category, I place something like Neal Stephenson's 1995 novel *The Diamond Age*, which is to nanotechnology what his 1992 *Snow Crash* was to the internet. As its title suggests, *The Diamond Age* takes place in a near-future in which the fabrication of matter is trivial. Component atoms and data arrive via Feeds, allowing even the poorest citizens to compile basic food and clothing. Though the novel's plot and story world are too intricate to elaborate here, I describe the book to my students as a digital bildungsroman, centered on a little girl by the name of Nell. And though Nell is the poster-child for latchkey poverty, a swirl of circumstances conspires to place an extraordinarily sophisticated piece of nanotechnology in her hands. Modeled on Victorian grade-school primers, the *Young Lady's Illustrated Primer* outwardly resembles an old technology, but within its covers it is endlessly adaptive and interactive, eventually teaching Nell everything from how to read and how to defend herself against physical assault to how to think in binary and write computer programs.

The *Primer* is originally commissioned as an educational gift for a neo-Victorian aristocrat's granddaughter, but the *Primer*'s designer, John Percival Hackworth, decides to compile a bootleg copy for his own daughter. This necessitates Hackworth's excursion into Shanghai's underworld, but on his return home Hackworth is set upon by a gang of street urchins that includes Nell's older brother Harv. In this manner, the newly minted *Primer* has a chaotic infancy, passing from Hackworth's hands through the hong of Dr. X to Harv, who recognizes the book's value and takes it to give to Nell. Thus, although Nell is ostensibly the protagonist of *The Diamond Age*, the *Primer* is arguably even more central to the novel's many, dispersed narratives. Like the items foregrounded in eighteenth- and nineteenth-century it-narratives, the *Primer* travels through a quick succession of "owners," its mobility as an object revealing systems of exchange and the persistence of racial and class-based social and economic divisions. As Price notes, later it-narratives

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

describing the lives of papers and tomes invited their readers to see their reading material as the very documents in question, enfolding readers into the documents' ongoing story. In that vein, *The Diamond Age* is cleverly subtitled, "Or, A Young Lady's Illustrated Primer," which might suggest that it is simply the tale of a little girl's schoolbook, or, more interestingly, that one's edition of *The Diamond Age* is the primer itself. It's documents all the way down.

Though Stephenson is best known for his trendsetting cyberpunk, post-cyberpunk, science-fiction, or speculative fiction novels (the genre depending on who you ask), he has also notably written for *Wired*, the tech-happy magazine brainchild of, among others, Stewart Brand and Nicholas Negroponte, which featured science-fiction writers like Bruce Sterling and William Gibson among its earliest authors. For its December 1996 issue, Stephenson wrote a hefty reflection on the business and geography of undersea cabling in the piece "Mother Earth Mother Board."[53] Dubbing his journalistic enterprise "hacker tourism," by which he meant touring the world with an eye to what only geeks would find interesting, Stephenson and a photographer traced the laying of the then state-of-the-art submarine communications cable FLAG, which stands for Fiber-Optic Link Around the Globe. The Europe-to-Asia segment Stephenson documented was laid in the mid-1990s, beginning in the United Kingdom and ending in Japan. Since then, FLAG has grown to over 28,000 kilometers long, its FA-1 Atlantic segment now connecting the East Coast of the United States to England and France.

For me, "Mother Earth Mother Board" is another bit-narrative, one that approaches the environmental it-narrative in its concern with the materiality of networks and the nonmetaphorical paths upon which our data travels. Too often, digital transmission and memory are invisible processes, a problem exacerbated by the recent move toward wireless and cloud storage. Given the massive environmental impact of the technology industry, I see bit-narratives like these as beneficial reminders of the materiality of the bit, which again refers to both the abstract conception of a computational unit and its physical instantiation as the presence or absence of an electrical charge (or two distinct levels or poles of magnetization). Although Stephenson in this article seems little concerned with FLAG's environmental impact, and more intent on the motley cast of colorful individuals who work in the cable-laying industry, from time to time he pauses to consider the sheer arrogance and susceptibility of these massive infrastructural projects. In a section entitled "Hazards" he writes, "It sometimes seems as though every

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

force of nature, every flaw in the human character, and every biological organism on the planet is engaged in a competition to see which can sever the most cables."[54] And in an admittedly speculative explanation of U.S. dominance of the global network, based on the country's being "large, free, and made of dirt," he elaborates on the article's central metaphor and the fundamental alienness of aquatic environments: "If the network is The Computer, then its motherboard is the crust of Planet Earth. This may be the single biggest drag on the growth of The Computer, because Mother Earth was not designed to be a motherboard. There is too much water and not enough dirt."[55] For Stephenson, perhaps, this is a disappointment, a frustration of the scientific and technocratic meritocracy he celebrates; for environmentalists, this may be, instead, a reassuring testament to nature's unyieldingness in the face of human hubris. In fact, ten years later to the month, the 2006 Hengchun earthquake with an epicenter in southern Taiwan severed a host of undersea telecommunications cables, including the FLAG segment between Hong Kong and Pusan, South Korea, severely reducing or disabling much of Asia's regional and international telecom capacity.

The second category of bit-narratives involves those narratives that are themselves digital objects. To avoid turning the phrase into a catch-all, I would add a second criterion that turns again to the dual meanings of bit and my preoccupation with ecology and the status and agency accorded to nonhuman things. Perhaps for a bit-narrative to properly *be* a bit-narrative, it must be both composed of bits, and attentive to those bits' material realization and effects. Consider, for instance, Molleindustria's 2011 mobile game *Phone Story*, which took the glib rhetoric of "there's an app for that" to new ironic extremes by using its four playable levels to enact the following exploitations: coltan mining in the Democratic Republic of the Congo, Chinese sweatshop labor, U.S. export of toxic e-waste to "less developed" nations, and the tech industry's manufacturing of obsolescence to keep consumers clamoring for the latest and greatest devices. To play *Phone Story* is to use one's smartphone and the familiar swipe of a finger to play armed Congolese overseers, FoxConn-style factory agents using nets to catch suicidal workers, an Apple employee lobbing nextgen handhelds to customers storming the store, and the global poor salvaging used, noxious electronic components.[56]

Like historical it-narratives, *Phone Story* is indeed the story of your phone, both the story you play on your particular phone and its backstory and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

projected future as a commodity. The game also wittily reinvents the casual game's typical story and endless modes (Figure 22). Rather than offering a flimsy, escapist narrative, *Phone Story* implicates you whether or not you meet its goals. In Story Mode, failure or refusal to play leads to the same reproach: "Don't pretend you are not complicit." In Obsolescence Mode, *Phone Story* reinvents endlessness by linking it to corporate marketing—the game now begins with a Kubrickian dawn of man sequence where the dark, monolithic outline of a smartphone, dubbed iThing, rises into space. Play the game through and it starts over, but this time you have graduated from iThing beta to iThing 2.0. Keep going, and you achieve iThing 3GS, and so on. Of course, the gameplay never changes, just the labels. This time, when you fail or deliberately stop playing, the game snarkily informs you that "You didn't meet the goal. Don't try to stop the progress."

A less obvious but equally interesting bit-narrative can be found in *The Novelist*, an indie game developed by former AAA developer Kent Hudson and released online in December 2013. The game is an interactive drama that chronicles one family's summer on the Oregon coast, as revealed by the things around them. Dan Kaplan is a writer struggling to complete his latest book.

Figure 22. Parodying the industrial logic of planned obsolescence in *Phone Story*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Linda, his wife, is an aspiring painter. Their son, Tommy, is a good sort but has trouble reading and making friends. As you quickly learn, Dan has brought the family to this beautiful but secluded location in order to dislodge his writer's block, so as each chapter of the game unfolds, he must make difficult, often heartbreaking choices between the demands of his career, his marriage, and his child. You discover all of this as a voyeuristic player-spirit that inhabits the Kaplans' vacation rental home, roaming around the house either by "possessing" lights or choosing to emerge from the nearest incandescent bulb to creep about. Not just an impartial observer, you shape Dan's choices by whispering into his ear while he sleeps.

While it is easy enough to be swept along by the game's dramatic content, I found myself most intrigued by its use of matter and environment. Ordinary objects take on numinous significance, including images, personal belongings, and a whole host of documents, among them diary entries, typewritten pages, letters, shopping lists, Post-it notes, magazines, and books (Figure 23). Some of these are manifestations of the creative process, like Dan's scrawled ideas for plot points or Linda's half-finished canvases. Others are prized possessions, like Tommy's favorite toys. Some are conduits for particular activities, like firewood for a campout on the beach; and still others are evidently threats, like the whiskey Dan begins to overindulge in

Figure 23. Objects and documents lead ghostly lives in Kent Hudson's game *The Novelist*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

as his deadline draws closer. Many of these are actionable, their glowing or flickering forms indicating to the player that they may be read or otherwise inspected. Often, the window of their narrative efficacy is short—a single chapter—so at all other times they lurk in the background as evidence of decisions already made or still-to-come. The story advances when, in each section, after exploring all the available options and discovering each character's preferred outcome, you select an object that will set in motion the outcome you deem best, for example, Dan's jogging shoes, instead of the whiskey bottle, if you want him to lay off drinking and revert to a healthier lifestyle.

Although *The Novelist* is not an ecological game, since the player-as-spirit stays resolutely bound to the home, it is arguably an environmental one. Beyond the clear metaphorical importance of the game's isolated forest setting and spectacular but also eerie coastal bluff views, it is because the game emerges through the hidden lives of objects, rather than explicit conversation, that it seems to celebrate the nonhuman. The characters' default verbal exchanges verge on the inane, but their unspoken memories and thoughts, their textual baggage, and the emotional and historical residues of the property allow surprisingly profound situations to unfold. *The Novelist* conveniently allows me to make the point that games as a form of mediation are not necessarily poor substitutes for external reality, as they would be under a logic of simulation or representation or an eco-logic of scientific accuracy. Instead, they are fitting vehicles for attempts "to think with or through the physical object world," as Bill Brown has put it.[57]

Ian Bogost, a prominent video game theorist and designer and more recently a philosopher of so-called object-oriented ontology (OOO), has argued that video games and the platforms they run on are as ontologically interesting as any other thing in our universe, with human beings deserving no particularly special status.[58] Wielding leveling concepts like "flat ontology" and his own "alien phenomenology," Bogost implies that although we can never really know what it's like to be a mollusk, a PlayStation 4, or a padron pepper, we owe it to ourselves and to them to speculate about the contours of their experiences. Usefully, in this worldview, video games, computers, and consoles and the silicon, plastic, and rare metals that compose them are no longer definitively on the cultural side of the moth-eaten nature–culture divide, but instead curiosity-provoking things among uncountable other things. Such radical equivalency (not in the sense of all things being equal

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

but rather nonhierarchically related) in theory renders terms like "natural" nonsensical, as such a categorization is only meaningful from a human perspective. Yet in its plucky attempt to break from centuries of philosophical tradition characterized by the valorization of human subjectivity, OOO can bear a confusing resemblance to more established paradigms in actor-network theory, posthumanism, animal studies, and the process philosophy of Alfred North Whitehead. Critics might argue that object-oriented philosophies neatly sidestep problems like the game industry's complicity in the creation of toxic byproducts. OOO and speculative realism more generally have also faced substantial and important criticism from feminists and other theorists of bodily difference that are rightly concerned about these philosophies' potential erasure of histories of objectification of people.[59] Recognizing OOO's tremendous uptake in art and design circles, architectural theorist Neil Leach has nevertheless sharply criticized the school of thought's return to Heidegger through the work of Graham Harman.[60] Leach productively charts the differences between Harman's object-oriented ontology and Manuel DeLanda's new materialism, recognizing in the latter a more appropriate—namely, less technophobic and less essentializing—philosophy for digital design.

While Bogost's independent forays into OOO suggest that some strains of object-oriented thinking may still pertain to the study of games, more generative alternatives may be found in both "new" and by-now venerable modes of materialist thinking, among them Jane Bennett's vital materialism.[61] Inflected by feminism, political ecology, and science studies, these materialisms give us a way to approach games without the knee-jerk, reflexive branding of them as non-natural objects. Put in terms of other potentially more familiar discourses, we could say that games and game platforms perform the fundamental tension between the machinic and the organic, the computational and the artistic, or, as Jesper Juul has written, real rules and fictional worlds. What interests me from an ecocritical perspective is games' potential to marry both subjective and objective features of experience, and to render the nonhuman accessible, and only peripherally to realize philosophical trends in animal, game, and science studies. Like Katherine Isbister's work on nonplayer characters and their vital function in creating players' feeling of involvement and emotion in games, materialist ludology would attend to the nonhuman, or more-than-human, elements of games in order to decenter the player as the crux of game understanding.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

Mountain-Water-Game

While the mundane objects of *Phone Story* and *The Novelist* work to make ordinary things seem alien, both games nevertheless reassuringly orbit the human world. Dan rarely strays from the confines of his summer house, and most of *Phone Story*'s levels play out before windows and screens. Accordingly, in this final section I turn to forms of nonliving matter that seem animate yet aloof, and that have excited aesthetic and colonialist impulses from the very first—high peaks and flowing waters. Far from complete, these initial musings on the mountains and rivers of game worlds take for comparison exploration narratives, Asian art traditions, cultural geography, biosemiotics, and landscape aesthetics, in the hopes of generating a rich array of options with which to approach game scenery as more than inert backgrounds.

In Richard Bartle's well-known typology of player types, based on his experience running one of the first multiuser dungeons, killers (clubs) are the "griefers" of the social play universe, while explorers (spades) are portrayed as geeky, curious types, less motivated by competition or achievement than by wonder.[62] But as histories of settler colonialism might remind us, exploration is not just a driving reason for play, but also a frequent euphemism for imperialistic expansion. The legendary British mountaineer George Leigh Mallory, when asked "Why did you want to climb Mount Everest?" reportedly quipped "Because it's there."[63] When pressed to answer more constructively, with a mention of the scientific information gained from his first attempted ascents in the early 1920s, Mallory responded, "Sometimes science is the excuse for exploration. I think it is rarely the reason," linking his personal drive to summit Everest with "man's desire to conquer the universe." All this is to say that perhaps we should not let Bartle's explorers off the hook entirely. Along with the scopophilic and instrumental environmental relations characteristic of games of graphical spectacle and resource extraction, we might add another, upon which the others are in part predicated: the cartographic impulse. Whether or not a map is actually created, the explorer sets about penetrating the unknown and testing personal and geographical limits—in a real-time strategy game, she feels satisfaction in dispelling the fog of war as she advances into new territory; in the seemingly open-world game, she seeks out the inevitable zone walls in a bid to peek or sneak past bounding game structures.

Journey, released in 2012 by the same game studio that produced *Flower* (chapter 1), both adopts and contests this mode of terrain mastery. With little

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

preamble, you begin the game in a desert landscape dominated by a distant mountain, and its strangely lit peak immediately suggests itself as the objective. Along the way, you may uncover ruins and ancient artifacts, murals and visions, which depict a harmonious agricultural way of life replaced by intensive industrialization and war. Collectively, these intimate that players are trudging over the bones of a once powerful civilization annihilated by overreliance on energy and technology. (Sound familiar?) For someone interested in how games and other virtual environments both replicate and reimagine real-world industrial and postindustrial environmental logics, *Journey* presents a valuable case study on several levels. As a narrative, there is its understated postapocalyptic flavor; as an experience, *Journey* takes some unusual but very appealing risks with gameplay.

Thatgamecompany is known for experimental, artistically stunning games that foreground natural environments and invite atypical modes of player experience. Creative director Jenova Chen intended *Journey* to invert many of the canonical tenets of "good" game design—among them mastery, legibility, and convenience (in other words, players should feel empowered, goals and controls should be clear and unambiguous, and it should be relatively easy to get from here to there, save one's progress, and so forth). Instead, *Journey*, as its title suggests, actually celebrates duration, distance, and insignificance, promoting precisely those qualities of a desertified world that minimize player agency while provoking feelings of wonder and humility. The mountain, while the obvious goal, signifies less than we think—it barely draws closer after many minutes spent slogging in its direction, and even after we have reached its icy slopes, we apparently perish, at least physically, in the ascent. In fact, players who complete the game are rewarded by a speedy return journey in shooting star form. Deposited once more at the start, they may simply begin the journey again. While it might be tempting to invoke Joseph Campbell to describe the player of *Journey* as a mythic hero on an archetypal quest, it is worth adding that although *Journey* can be played alone offline, as a networked game it is secretly multiplayer. Only one other player may join you at any given time, and even then the game denies standard verbal or visual distinction to its players. For instance, you cannot customize your avatar (although more experienced players have white robes, not red), and you can only communicate with the other player through physical arrangement and tonal emotes. Accordingly, *Journey* is officially described as "an interactive parable, an anonymous online adventure

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

to experience a person's life passage and their intersections with other's [*sic*]."[64] In fact, when I interviewed Chen at GDC in San Francisco in 2010, he was already thinking about *Journey* and had been impressed with the emotional impact of Jason Rohrer's minimalist art game, *Passage* (2007). *Passage* uses a side-scrolling mechanic to depict the process of aging and moving through life either with or without a partner, as well as the benefits and drawbacks of each choice. And though it requires only a few minutes to complete, *Passage*, like *Journey*, feels decidedly deliberate in its pacing.

Beyond *Journey*'s experiential design, the game's color palette, symbolic language, and textiles are strongly reminiscent of Chinese culture—from the colors red and white, to traditional Chinese characters, to the couplets on paper streamers that often grace doorways and temples in the spring.[65] *Journey* also remediates many of the traits of Asian scroll paintings, in particular the compositional philosophy of traditional Chinese landscape painting, also called shan-shui-hua (山水畫), or literally, mountain-water-painting.[66] In *Journey*, sand, gaseous clouds, and blue-toned darkness often resemble or act like water (Figure 24). Yet I find myself pursuing the principles of shan-shui-hua less as a formal aesthetic system than as an embodiment of environmental ethics. One mid-century curator, Sherman Lee, writing about the Cleveland Museum of Art's acquisition of a shan-shui handscroll called *Streams and Mountains without End* (dating from the Northern Sung period),

Figure 24. Sand waterfalls in thatgamecompany's *Journey*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

gently poked fun at the parallel Western painting tradition of "nudes and apples without end."[67] For Lee, Chinese painting differed from Western painting not only in its longstanding embrace of landscape, but also the use of multiple perspectives and vanishing points and an emphasis on balance and natural symbolism in those landscapes.

Another art historian, Robert Maeda, writing about "The 'Water' Theme in Chinese Painting," suggests this intertwining of form and meaning:

> While the impressive scale of a mountain seems to dominate in a landscape, to the Chinese painter it was a symbol of stability which must be complemented by the fluidity of water. In early landscape, water became an extremely important factor in the depiction of space. In the form of a winding stream it helped to establish both depth and breadth, and in the form of a waterfall it emphasized height.[68]

In an early, natural precursor to the kinds of "new verticalities" discussed by Kristen Whissel in her work on digital effects cinema, waterfalls draw attention to the sublime aspects of existence.[69] This connection to shan-shui-hua could be a way to reorient the current scholarship in game studies toward less anthropocentric and more biocentric ends, whether we use the language of posthumanism, animal studies, actor-network theory, or the many strains of new materialist thought. Again, I am interested in shan-shui-hua less as an aesthetic regime than as a very old paradigm of human-environmental relation and, to borrow Gaston Bachelard's terms, the poetics of space.[70] When we attend to games as spatial or environmental constructs, we can look at the ways in which real mountains and real water, or lack thereof, figure in our collective imagination, and their mediation in mountain-water-games. When I think of mountains, for instance, I think of mountaintop removal in the Appalachian Mountains, the disappearance of glaciers, and the rising number of deaths of those seeking to scale Mount Everest. Sarah Whatmore has described the materialist energies of current theories in cultural geography and related fields as returning to the timeless question of the relationship between the bio (life) and the geo (earth), and mountain-water-games move us past humans and animals and human constructs (technical artifacts) to the thorny issue of nonliving matter, and what Anna Tsing calls "more-than-human sociality," where "social means 'made in entangling relations with significant others.'"[71]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

The artist Christin Bolewski has even reinterpreted Chinese shan-shui-hua to show the contradictions of a more Western sensibility—her digital scroll depicts Western-style mountaineers struggling to scale the illustrated slopes with a battery of modern tools.[72] In contrast, perhaps, we have a game like *Mountain*, released on July 1, 2014, and described by its creator as "an ambient procedural mountain game." Before you are permitted to play the game, you are prompted to sketch responses to three short and randomly selected phrases. On one run through, the game asked me to depict my soul, my childhood, and meaning itself, before generating the mountain and greeting me with the cryptic lines, "Welcome to Mountain. You are Mountain. You are God." *Mountain*'s developer David OReilly advertises the game's features as follows:

- no controls
- automatic save
- audio on/off switch
- time moves forward
- things grow and things die
- nature expresses itself
- ~ 50 hours of gameplay
- once generated, you cannot be regenerated[73]

An offbeat list, to say the least, but by this book's standards *Mountain*'s "features" represent definite progress. Left for the player to discover is that select keys on the keyboard play musical notes, and that certain melodies trigger atmospheric phenomena ranging from snow and rain to fiery comets and destruction at the hands of an alien juggernaut. So for example, "Winter Wonderland" activates a calming snow globe effect, Beethoven's "Moonlight Sonata" triggers a rain of blood, and Wagner's "Ride of the Valkyries" increases the rate at which artifacts appear on the mountain. Another sequence will coax a thought supposedly from the stream of consciousness of the mountain itself (Figure 25). Not surprisingly, in a reaction reminiscent of the brouhaha over first-person walkers, many hardcore gamers have derided the game by calling it an awesome screensaver. But others have been intrigued, even moved by this quirky game. "Nothing You Do Matters in This Game, But You'll Still Obsess Over It," writes Bo Moore of *Wired*.[74] Andrew Webster of *The Verge* called it "the only experience that has ever made me feel sad

This content downloaded from
103.242.197f:ffff:ffff:ffff on Thu, 01 Jan 1976 12:34:56 UTC
All use subject to https://about.jstor.org/terms

Figure 25. Ponderous geology in David OReilly's *Mountain*.

about a geological phenomenon."[75] According to OReilly, within a day of its release, *Mountain* had become the fifth most popular paid app in North America and the number-one paid role-playing game in thirty-three countries.

By now, it may be clear that I believe that an interest in nonhuman or better yet, more-than-human lives and places explains at least some of the mysterious appeal of games like *Mountain* or *Journey.* My thinking here has been influenced by geographer Yi-Fu Tuan's concept of topophilia, and the naturalist philosopher Jakob von Uexküll's theories about animal life-worlds. Uexküll's theories, early twentieth-century forerunners to systems theory, placed the living subject at the center of space and time. Interested in what he called "subjective realities," Uexküll made an important distinction between a meaningful environment (*Umwelt*) and mere surroundings (*Umgebung*).[76] In the former, "Every subject spins out, like the spider's threads, its relations to certain qualities of things and weaves them into a solid web, which carries its existence."[77] In constructive contrast to OOO, Uexküll believed that "without a living subject, there can be neither space nor time."[78] In other words, Uexküll conceived of an animal's perception and effect spaces, both visual and tactile, as selective and subjective recognition and interaction with the physical world, almost as if "soap bubbles" of varying sizes existed around each creature.[79] In his well-known example of the tick, Uexküll argued that

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

the insect attends to only three stimuli in its limited life-world: the first chemical (butyric acid as olfactory evidence of a passing mammal, which signals the tick to drop onto its prey), then mechanical (bodily impact with the mammal after releasing from its perch, which tells the tick to search for a puncture site), and finally thermal (the warmth of a patch of the mammal's exposed skin triggers the tick's feeding).

The tick world's relative spatial simplicity is also evident in its temporal minimalism. Uexküll notes that while in experiments, ticks have successfully been kept alive in a dormant state for eighteen years, waiting for their next meal, human time is much more extensively subdivided: "Our human time consists of a series of moments, i.e., the shortest segments of time in which the world exhibits no changes. For a moment's duration, the world stands still. A human moment lasts one-eighteenth of a second."[80] Notably, "the duration of a moment is different in different animals." Referencing the perceptual illusion of projected film frames as support for his estimate, Uexküll concludes that "the subject controls the time of its environment," though in his holistic theory of natural systems, only humans possess the ability to pursue goal-oriented action, while most creatures simply act according to "Nature's plan."[81] Despite his disinterest in nonliving matter, Uexküll leaves us a vocabulary with which to approach *Journey*'s fascination with distance and duration and *Mountain*'s simulation of geologic consciousness. While human players, in this conceptual scheme, are constrained by their humanness to experience the game *as* humans, perhaps players can also become dynamic scalar figures by which human and nonhuman longevity, mortality, history, and territory are measured.

With the concept of topophilia, geographer Yi-Fu Tuan suggested that analyzing "the affective bond between people and place or setting"[82] could offer a better sense of how people operate within natural environments than surveys and statistics. In a very broad cross-cultural and historical survey that touches on Western and non-Western societies, classical mythology and indigenous folklore, rural and urban dichotomies, art, architecture, and anthropology, Tuan reminds us that "Environment . . . is not just a resource base to be used or natural forces to adapt to, but also sources of assurance and pleasure, objects of profound attachment and love."[83] Tuan also offers thoughts on spatial psychology and symbolism, for instance in his condensed look at attitudes toward what he calls the "recalcitrant aspects of nature," or those that "defy easy human control,"[84] in particular the mountains, deserts,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

and seas. Calling to mind the signature sands and distant peak of the game *Journey*, Tuan claims that vertically oriented cultures, like those of peasants and subsistence farmers, tend to live by cyclical time, to see themselves as part of a religious cosmos and seasonal shifts, rather than the secularized and aestheticized horizontal expanses of modernity, indicated in our terms *landscape*, *scenery*, and *countryside*.

Tuan's broad-stroke observations support an interpretation of game environments that prioritizes their manipulation of the player's experience of time and distance. Rather than the physicist's formula, distance = rate × time, or the min-maxing gamer's investment in efficiency and speed, *Journey* for instance treats both distance and time as subjective indications.[85] This resonates with Colin Milburn's positing of three kinds of "green" games: games of environmental discipline, games of environmental control, and games of environmental responsibility.[86] It is this last category that I am most interested in, because "games of environmental responsibility animate our capacity to respond, to affect and be affected, to engage with others: other species, other people, and the otherness of our own planet."[87] In chapter 5, we will see what it means to lose a beloved game place or setting, in the Azeroth of post-*Cataclysm World of Warcraft*. Does our relationship to a game world also depend on the frequency and duration of our access to it?

Mountains and Rivers with an End

Despite the largely apocryphal saying that you can never step in the same river twice, often attributed to Heraclitus, digital waters are remarkably constant. In shan-shui-hua, water is a symbol of fluidity and change. In the real world, water might connote contamination, as in Flint, Michigan, or shortage, as in the cyclical droughts in California. Yet in games, water has traditionally served as a graphical benchmark, a bar for 3D modelers aspiring to the ultimate in game realism. Curiously enough, landscape painters in the Asian traditions long struggled to represent the dynamism and many states of water, as chronicled in Maeda's essay. Narratively and spatially, game waters often function as natural boundaries to exploration and progression, as a test of endurance, or as a means of concealment (think of the original *Bioshock* [2007] and its underwater city of Rapture). Recently, watery game environments often signal irreversible climate change, like the board game *Forbidden Island* (2010) or Uppercut Games' *Submerged* (2015), in which a young girl must navigate the waters of a drowned city and climb all over its waterlogged

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

infrastructure to save her injured brother (Figure 26). We could also explore game waters as an indicator of mental and emotional states, as in the app *Strange Rain* (2011), which turns your iPad or iPhone into a virtual skylight. In story mode, the game simulates the rain falling on a character's head as he steps outside to contemplate a family crisis. There is also *9.03m*, briefly mentioned in chapter 1, an art/empathy game designed to memorialize the victims of the 9.03 magnitude earthquake that struck Japan in 2011. The ensuing tsunami triggered nuclear meltdowns at the Fukushima reactors and overwhelmed coastal cities, claiming almost twenty thousand lives. In part, then, a struggle for scalar understanding (chapter 2), *9.03m* operates by showing us personal effects taken by the tsunami and much later cast onto the northern coast of California.

Taken altogether, shan-shui-hua, Uexküll's organismic perspective, and Tuan's sociogeographical theories provide tangential but illuminating views into the virtual environments of games like these, less comprehensive interpretations than means to fuse the interests of art historians, scientists, and social scientists with media scholarship. Games are part of a rich tradition of environmental representation, but also offer unprecedented opportunities to examine and experience ecological outcomes through the imaginative and unencumbered spaces and moments of play, and to try on a range

Figure 26. The young girl Miku must navigate humanity's last, undrowned city to save her brother in *Submerged* by Uppercut Games.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

of subjective realities. Despite the seeming oxymoron, "green gaming would be a specific form of gameplay and a narrative genre that posits the environment under threat, a conjectural state of imminent crisis, and tenders gaming itself as a meaningful response."[88] Although a wide range of recent and established scholarship has attempted to get at the larger question of the nonhuman, from time-tested natural philosophy to considerations of the modern military's appropriation of swarm behavior,[89] in this chapter I have fixed on the nonhuman as figured through digital games because I share Haraway's hope for "sf" games, embodied in cat's-cradle string figures, and her desire to call the bluff on the "game over" attitude that often greets "trouble" in the Chthulucene. I also suspect that digital objects are ideally poised to reveal our dependence on and attachment to the nonhuman, given their colonization (some would say usurpation) of our daily routines—and those are, to me, necessary premises for an ethical relationship between humans and between humans and their environments. As many have argued across science and technology studies, cultural geography, feminist theory, sociology, psychology, and numerous other fields, humans are not distinctive but are rather assemblages of human and nonhuman elements, exemplified by the trillions of bacterial cells that compose our gut microbiomes. Humans are also not simply thinking "interiors" opposed to environments "out there" or outside ourselves.

Yet while my own work owes deep obligations to writers like Donna Haraway, Jane Bennett, and others in the "materialist returns" of our current moment,[90] I also believe we need to find more language for more forms of environmental mediation. Echoing Bachelard's belief that all built environments have a homey quality, Tuan recognizes that even "intensely humanized worlds can have their own ecological richness and beauty."[91] Tuan's work on topophilia may be extended to imply that what binds peoples and players to place, both real *and* virtual, are their mythologies, their belief systems, and their suprarational understanding of their environments: "People pay attention to those aspects of the environment that command awe, or promise support and fulfillment in the context of their lives' purposes."[92] Finally, as Tsing cautions, and games effectively teach us, "we might not always be in charge. We might get to know other-than-human worlds in which we participate, but in which we don't make the rules."[93] As we play, in other words, we are always reminded that "our doings are a way to trace the doings of others,"[94] even as we collectively—animal, vegetable, mineral, digital[95]—face escalating environmental disorder and probable system collapse.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:00:39 UTC
All use subject to https://about.jstor.org/terms

4

Entropy

After having moved from the closed cosmos to the infinite universe, we have to move back from the infinite universe to the closed cosmos—except this time there is no order, no God, no hierarchy, no authority, and thus literally no "cosmos," a word that means a handsome and well-composed arrangement.

—BRUNO LATOUR, "Agency at the Time of the Anthropocene"

We are not accustomed to thinking of video games as material things.

—RAIFORD GUINS, "The Life and Afterlife of *E.T. The Extra Terrestrial* for the Atari 2600"

Until this point, I have generally celebrated games' ability to dramatize and make actionable a variety of ecological entities, processes, and framings, from mesocosmic experimentation to scalar toggling to empathy for nonhuman animals and matter. For the remainder of the book, however, I turn to less sanguine modes of ludic environmental representation, for they are equally important and, arguably, closer to the forefront of modern ecological understanding. In this chapter, we will consider entropy, the relationship between economics and ecology, and environmental justice concerns with "externalities" to the smooth functioning of industry, while the next and final chapter will examine more pronounced and even irreversible forms of system collapse.

Ecology, with its roots in cybernetics, and games, which are ultimately indebted to developments in computing and machine intelligence, share a fundamental predilection for systems theories. Not surprisingly, then, most attempts to define the essential traits of games stress their orderliness—that

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

they are rule-based, spatially and temporally delimited, and in the case of digital games, creatively constrained by code and platform. In this chapter, however, I deploy the concept of entropy, or the thermodynamic principle that the universe tends toward increased disorder or degradation of matter and energy, to question game environments and theories of play that pretend otherwise. As a case in point, I survey the environmentally absurd landscapes of popular farm games like *FarmVille* and *Harvest Moon* and their evitable erasure of waste, work, and failure, as seen through agricultural history, theories of the pastoral, ecological economics, and ecological Marxism. Entropy also speaks to recent interest in game materiality as evidenced by the production, disposal, and labor practices of the game industry. In the end I focus on games' unrealized aptitude for demonstrating the flow of energy and material through human and nonhuman systems, which would in turn underscore such core ecological premises as limitation and unpredictability.

While many other terms would have been apropos for this chapter—energy, heat, economy, and sustainability, to name a few—entropy best conveys the neglected material aspects of games and game platforms, and perhaps more important, their inevitable demise. Entropy guides our attention to the shadowy source/sink dynamics of game-related manufacturing and, as we will see later in the chapter, the omission of waste, disorder, and unspectacular forms of excess from most games. Whether or not this is a limitation endemic to games remains to be seen, and here, as elsewhere, we will have much to learn from the already robust history of discussion around the body and embodiment in games and virtual worlds. Where feminist, cultural studies, disability studies, and media industry analyses have pointed to, at worst, ingrained forms of chauvinism and misogyny, the erasure of players' bodies and lived experiences, the precarious economies of game industry labor,[1] and at best, the uneasy potential of games to allow fluid forms of body play and queer world-making,[2] my goal is to expand the scope of material, affective, and biopolitical inquiry to the organic and inorganic environments in which we live and play. In a narrow sense, the question will be whether games do or do not allow environmental actants and processes to body forth, to be represented figuratively and politically, as in Latour's multicameral Parliament of Things. I want to acknowledge, however, that this question may never be cleanly separated from social and cultural considerations of human bodies, desires, and relations in and around games. Invariably, we cannot consider one without the other, whether we frame them in terms of

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

tried-and-true theories of the discursively and socially produced body, phenomenological sensitivity to the world, or recent scholarship on epigenetics and the dynamic sensoria and body schemas of neuropsychology. To focus on environmental matter is not to exclude the human, but to decenter it, to reverse the figure/ground relationship that typically holds between individuals and worlds.

Before turning to particular games with entropy in mind, I first offer a brief primer on the political economy of games. Although comparatively little has been written on this front, books that have taken on this vital work include Nick Dyer-Witheford and Greig de Peuter's *Games of Empire*, Raiford Guins's *Game After*, and James Newman's *Best Before*.[3] Because these authors have already addressed resource extraction, labor, e-waste, and rhetorics of innovation and obsolescence in the contexts of game manufacturing and marketing, I will offer only a short synopsis, along with a few updates from the growing literature on geological media. My purpose throughout will be to demonstrate that economic and environmental concerns are always intertwined. As many before me have noted, the very terms ecology and economy share a common etymological root in the word *oikos* (from the ancient Greek *οἶκος*), the basis of the English prefix *eco-*. For Aristotle, *oikos* implied tending to one's household or family,[4] and modern economists and ecologists have essentially extended that sense of harmonious arrangement to consumers and markets on the one hand, and species and ecosystems on the other, yet not without difficulty.

The second half of the chapter elucidates what we could provisionally call a thermodynamic design principle in games. Given that games have long been described as cybernetic systems,[5] or even the quintessential cultural manifestation of paradigms of control,[6] thermodynamics, and in particular entropy, gives us a way to reopen the closed circuits of the magic circle, the black box, and human–computer interaction. Further, if we grant that games appeal particularly to bureaucrats and advertisers because game algorithms and reward structures interpellate players by urging success through conformity,[7] a thermodynamic design principle would point to the unraveling of such systems, something arguably inherent to the systems themselves. To think through mounting entropy is to think along the lines of the hacktivist exploits admired by Rita Raley, Alexander Galloway and Eugene Thacker, and others, or the idea of the irrepressible multitude, developed by Michael Hardt and Antonio Negri in their work on empire and democracy. Yet entropy

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

takes us even further, modeling resistance through and beyond the realms of human politics and information networks.

While it might be surprising to encounter a concept so squarely from physics as the guiding principle for this chapter, after my enthusiastic exploration of ecological frameworks, entropy has traveled widely across disciplines, from chemistry and probability on through ecology, neuroscience, and quantitative biology. An entire open-access journal was founded in 1999 to explore entropy's many variants, inviting contributions "from areas as diverse as physics, chemistry, biology, economy and philosophy."[8] The author tasked with inaugurating the journal recognized the difficulty of reconciling something like Claude Shannon's entropy (a measurement of variability in information encoding) with the common sense of entropy I am adopting here, but part of entropy's attraction is its ability to operate on multiple fronts: as a measure of heat (thermodynamic transfer), disorder (increasing complexity), and energy (from more available to less available). Entropy also readily spans different spatial and temporal scales (chapter 2), from individual chemical reactions to the heat death of the universe, and is therefore a natural ally of the projects of deep history and time.[9]

Additionally, as much as ecology has been central to the framing of the book thus far, it can be hard to find processes of disintegration and waste in the life sciences, processes that are conveniently captured by an attention to entropy. Because they are hitched to concepts and experimental parameters like homeostasis, self-organization, the organism, the niche, and so on, botany, zoology, biology, and even ecology still show a marked preference for tidy, bounded, and functional systems where one organism's discards are another organism's bounty and death fruitfully begets life. On the whole, "life" science is less epistemologically equipped than physics to help us see games afresh as both gloriously messy and discouragingly wasteful objects, with obvious exceptions like the subdiscipline of restoration ecology, which deals with "novel" and "designer" ecosystems in the wake of human disturbance and planning.[10] Such premeditated and impure ecological thinking aligns well with the investments put forward in the remainder of this book.

Electronic Waste Not, Want Not

In our critical attention to games as texts, narratives, worlds, or sites of player experience, it is all too easy to take their material provenance for granted. Although a few writers have tackled the carbon footprint and labor practices

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

of the global game business, a great deal of work remains to be done, from qualitative ethnographic study of industry employees, to legal and institutional analysis of companies and their policies, to investigative journeys to the sites where game software and hardware are made or thrown away. Those looking for a model of such work would do well to peruse Raiford Guins's obituary of the now infamous Atari 2600 title *E.T. The Extra-Terrestrial*, which he relays through a pilgrimage to the storied Alamogordo landfill where in the 1980s Atari dumped thousands of unsold game cartridges following the game's market flop.[11] Building on anthropologist Arjun Appadurai's collection about the social life of things, including Igor Kopytoff's cultural biographical approach to commodities, Guins performs a kind of material speculation—the history of this fabled lemon of a game and its role in the great video game market crash of 1983 at the time stayed hidden beneath the reddish dirt of southern New Mexico. In 2014, the actual site of the trashed game cartridges was found, excavated, and monetized through sales to collectors, quite literally demonstrating Jussi Parikka's assertion that media are geological even as the earth is itself a medium. Perhaps as formal obituary writing on behalf of people declines, memorials to lost species and things will flourish (chapter 3).[12]

As could be expected of a global media industry tightly coupled with the design of electronics, the game industry has had a substantial impact on the environment. Rendered playable in the mobile/web game *Phone Story*, discussed in the previous chapter, our smartphones, televisions, gaming devices, and personal computers demand raw materials and particularly rare-earth metals that has driven the extraction of "conflict minerals" from mines in Asia, Africa, and South America. These same devices and electronics then return to the "developing" world as e-waste, or electronic waste, after being discarded by Western consumers, to be "recycled" at great cost to human and environmental health.[13] Yet oddly, for years, game companies like Nintendo escaped the scrutiny directed at general computer manufacturers like Hewlett-Packard (HP), whose offices all over the world have regularly been targeted by the radical environmental organization Greenpeace through e-waste "actions."[14] Even today, assessments of the global flow of used electronics sometimes omit game hardware, as in the September 2016 report released by the NAFTA Commission for Environmental Cooperation, which "due to resource limitations" did not cover "a variety of used electronic products and e-waste exports" including "printers, servers, gaming devices, cables,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

digital imaging devices, and audio and visual equipment."[15] These surprisingly common and lengthy lists of exceptions often leave the disquieting sense that the problem is beyond measurement and therefore redress. Fortunately, some industry watchdogs have quickly caught on, especially in the wake of studies pointing to disproportionately high energy consumption by gaming technology. One 2016 report, for instance, found that the average energy use of a "typical," middle-of-the-road gaming computer was "equivalent to that of ten game consoles, six conventional personal computers, and three ENERGY STAR refrigerators."[16] The authors note that a gaming enthusiast's computer could far exceed even that calculation.

Greenpeace has also developed what it calls its Guide to Greener Electronics, first released in August 2006. The guide usually ranks the top fifteen to twenty manufacturers of personal computers, mobile phones, and other devices according to their policies on toxic chemicals, recycling, and climate change. Notably, in the sixth edition of the guide released in late 2007, Greenpeace added television and game console manufacturers, all of whom joined the list at the bottom as the worst offenders.[17] Sharp, Philips, and Microsoft, which had been making the Xbox since 2001, were depicted well into the red on the "greenness" scale, and perhaps unexpectedly, the family gaming giant Nintendo was dead last with a never-before-seen score of zero out of ten. As Greenpeace's report card on the company noted with a wry twist, Nintendo "scored zero on all criteria, allowing infinite room for future improvement." By the fourteenth edition of the guide released in January of 2010, a few years later, Nintendo was still in last place, this time with a score of 1.4/10, having made at least some effort to phase out vinyl plastic, or PVC. In 2012, the casual games company Big Fish Games also singled out Nintendo in an infographic on the environmental impact of video games.[18] According to the poster, "If all games & consoles produced by Nintendo end up in a landfill, that's the weight of more than 5,555 Statues of Liberty," and at the current recycling rate, "it would take Nintendo 1,453 years to recycle all the games and consoles sold" (and this was well before the 2017 release of the Nintendo Switch). Intriguingly, the infographic also suggests the potential environmental savings if games were to be downloaded rather than manufactured. In the glib manner of most public service announcements, it opines that "if all CoD games were downloaded instead of manufactured, it would have the same impact as taking 20,131 cars off the road for a year," referencing the iconic *Call of Duty* (2003–) games developed by Infinity Ward.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

Whether or not downloading a game is superior to buying a manufactured version, at least in terms of environmental impact, merits further investigation in the following section, where I will discuss ample evidence of the high energy demands of "cloud" services. However, there is little to no ambiguity over the copious amounts of electronic waste being generated more and more rapidly in the "developed" world, often illegally exported or improperly donated. The authors of a 2014 report in the *Annals of Global Health* write that "as little as 25% of e-waste is recycled in formal recycling centers with adequate worker protection," and because "the majority of e-waste is recycled in the unregulated informal sector," it "results in significant risk for toxic exposures to the recyclers, who are frequently women and children."[19] Giant trash dumps exist all over the earth and some, like Rio de Janeiro's Jardim Gramacho, have even been examined in feature-length documentaries. Sites like Ghana's Agbogbloshie and China's Guiyu are known in particular as the world's largest digital dumping grounds.[20] And despite being one of the major sources of e-waste, the United States is one of the only countries in the world that has not yet become official party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which was formulated within the United Nations Environment Program (UNEP) beginning in 1988 and subsequently adopted by 185 parties. Just as it did with the United Nations' Kyoto Protocol on climate change, the United States remains only a signatory to the convention, without any legal obligation to adhere to its guidelines for "environmentally sound management of exported and imported waste, especially in developing countries."[21]

Local Warming

A friend of mine used to stick a bag of frozen vegetable biryani inside his computer when it started to overheat, the bizarre outcome of a defective graphics card generating more than the usual waste heat and a lack of adequate ventilation. This problem was particularly pronounced on warm summer days, when the ambient room temperature was already high, and after marathon sessions of playing his then favorite game. Of course, anyone who has spent hours in front of a television or computer might be familiar with technologically induced swelter, but gaming in particular taxes the on-board resources of our digital devices. On web forums, gaming enthusiasts building their own computers regularly discuss high-performance hardware and overclocking (setting your computer's processor to run faster to raise task

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

speed), as well as their cascading needs, among them heftier power supplies and elaborate air- (or preferably liquid-) cooling mechanisms. The energy demands of word processors, web browsers, and other everyday software applications pale in comparison to video streaming and graphics-intensive games, since personal computers tailored to live-streaming and gaming—increasingly the same thing—generally feature graphics cards separate from the central processing unit (in industry parlance, "dedicated" GPUs, or graphics processing units), often with their own power supplies. For most information and communications technology (ICT) users, the energy and heat economies of computing devices barely register until something goes wrong—when we run out of battery charge, or our lap grows uncomfortably warm. Thus the energetics of computing, and gaming in particular, are infrastructural in the manner that historian Paul Edwards, media scholar Lisa Parks, and others have outlined within critical infrastructure studies.[22] In other words, like our cable service or the water and sewage pipes buried beneath our homes, computer power has become something many of us rely on that remains literally and metaphorically beneath our notice.

Games, then, are not a waste of time—at least by some critical standards—but are they a waste of energy?[23] Unfortunately, trying to determine the electrical demands of game consoles, personal computers, mobile phones, game handhelds, tablets, and the many other devices and accessories we use to play games can be a daunting task, more so when considering networked play and connections to cloud services. Even experts have gone back and forth on seemingly simple questions: What takes more power, a wired or a wireless internet connection? What has the larger carbon footprint, listening to a song in the cloud or off your own hard drive? The answers, as with most things, will vary. It makes a difference, for instance, whether you are checking email or streaming video, how far you are from the nearest router or Wi-Fi transmitter, how much "noise" or competing signal traffic is present in your area, and whether you listen to a song once or twice (not a huge fan) or hundreds of times (maybe it was the anthem of your twenties). For people seeking guidelines for sustainable digital usage, there are few certainties, then, other than the general advice that newer devices tend to use far less electricity than older ones,[24] and that devices that are turned off and unplugged use less than ones that are on or "asleep" and plugged in.

Fortunately, the point of this section is less to account for the relative energy expenditures of different kinds of media apparatuses (after all, in

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

comparison to heating and cooling, digital entertainment is only a modest chunk of an average home electricity bill), than to reaffirm that games and gameplay occur in our world and therefore when we play, heat and energy are exchanged as much as data and social communication. When computer fans whir to life after we fire up a movie or a game, we are reminded that our computers or consoles are *engines* of play—they are mechanical appliances, used to a desired purpose, which transform energy into motion, whether it is internal to the device, onscreen, or activated in players' body movements. Already, game designers regularly speak of engines when they discuss software toolkits for game development, like Unity 3D or Unreal Engine. Games themselves are also engines, not cameras, as the sociologist Donald Mackenzie once wrote of financial models (via Milton Friedman),[25] meaning they are more productively seen as shaping real-world systems, rather than simply capturing them. Using the engine as a metaphor to describe game software concurs with James Newman's provocation that there is no such thing as a video game, at least in the sense of a definitive or stable entity conducive to preservation. Hoping to forestall the present Sisyphean labors of video game archivists, Newman proves rather compellingly that what we think of as simply "a game" is in actuality spread over time, through sequels, patches, and updates, as well as across regions, platforms, and player experiences.[26]

Yet not to lose sight of "the stuff you can kick,"[27] let us recall that the computer, console, or mobile device as game engine, like more familiar engines, never operates without a loss, mostly in the form of waste heat. This may seem strangely appropriate for those familiar with Lynn Spigel's work on television's entry into the home, as Spigel notes that for mid-twentieth-century American families, the new television set in the living room largely replaced the hearth as family gathering place. However, as increasingly powerful game devices have taken up residence in domestic space, not only in living rooms but also in bedrooms, home theaters, and "man caves,"[28] genuine microclimates of indoor weather have begun to form. A number of online message threads testify to that effect: take user USMC99's plaintive question on the PlayStation Universe forum, "My room is over heating [*sic*] due to all my electronics, can anyone help?"[29] Although the responses vary from the helpful ("get a fan" and "open a window") to the less serious ("move to Alaska"), it is surprising how several of the comments carry on a sub-conversation about global warming, beginning with forum elder "Moots" suggesting an air conditioner, followed by the conscientious "Or if you're worried about

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

global warming, get a lot of fans." Others later riff on this statement, from Alpha's laughing "Opening a window probably contributes to global warming, besides all the energy you use, so you will be the ruin of us all! " to Renzoblade's denialist response, "hahahahha global warming, the words just cracks me up sorry" accompanied by the recommendation to get an "aircon" and put it on "ice mode." Only a few respondents venture to ask why the questioner needs all the stuff that is making the room too hot, and even fewer suggest that USMC99 unplug or even get rid of the enormous LCD television, PS3, Xbox 360, cable box, receiver, and sound system. In this Neoplatonic Allegory of the Man Cave, the cave grows uncomfortably hot even as we watch the virtual shadows on the wall.

In fact, a thermodynamic approach to gaming has the potential to upset conventional associations between men and gaming, in which technically cultured, "hardcore" (white, cisgendered, heterosexual, able) male players dominate technological play to the detriment of female players, casual players, people of color, GLBTQ-identified, and the differently abled. We could, for example, linger over laptop heat studies and recent scares over male infertility caused by excessive laptop use. The preponderance of young people sitting for hours on end actually using laptops on their laps has resulted in the coining of the evocative condition "laptop thigh," which turns out to be a modern manifestation of *erythema ab igne*, meaning red from fire, also known as "toasted skin syndrome." Historically, *erythema ab igne* was seen mostly in women who worked or sat in front of stoves or fires, but today, researchers are more concerned about men because their testicles lie outside the body, and therefore closer to the offending laptops. Yefim Sheynkin and colleagues warn that men sitting with their legs closed to support laptops may have their fertility/sperm count affected by "scrotal hyperthermia," even with a pad between the laptop and the reproductive organs. Best to keep one's legs apart while using the laptop, they recommend, to allow airflow and cooling of the testes.[30]

Heat, then, brings together energy, space, gender and reproductive morphology, and human and machinic work in ways that drastically expand traditional analysis of games and gameplay. It returns us to the context-sensitivity of ambient gaming (chapter 1), while also giving us a new way to think about game history, production, and waste. Indeed, as Finn Brunton writes in "Heat Exchanges," "the work of computation is the work of managing heat. The history of computing is also a history of air conditioning and temperature

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

control."[31] Similarly, Nicole Starosielski's essay on the thermocultures of geological media usefully inverts our attention to e-waste by looking at the extractive and "purifying" processes that occur on the front end of a media device's life cycle. As she points out, methods of extreme heating and "cooking" underlie both the longstanding goal of elemental purity for the components of communications media, from copper wires to semiconductor wafers, as well as the industrial oxymoron of "waste products."[32] Even plastic demands thermal manipulation, like the acrylonitrile butadiene styrene (ABS) used to create computer and console casing, children's building blocks, and other injection-molded parts;[33] in technical lingo, ABS is a thermoplastic, meaning it can be heated, molded, and then cooled into its final and durable form.[34] After we switch to this thermodynamic register, then, an incredible variety of scholarship and illustrative cases present themselves: insights from the "energy humanities,"[35] Anna Tsing's friction-sensitive salvage ethnography, drawn from her extraordinary study of the global matsutake supply chain,[36] the eye-tracking "heat maps" generated by web marketing companies, modifying the Xbox Kinect for infrared detection, and so on.

Already, there has been a groundswell of interest in the energy (and thus heat) dynamics of "the cloud," that appealing but misleading metaphor for remote data location using networked connections, popularized by but by no means limited to products like Gmail, Google Drive, Dropbox, Box, and iCloud. While companies like Apple and Google emphasize the convenience, security, and reliability of their cloud services, journalists and academics have increasingly questioned the sustainability of the cloud, made plain by enormous, globally distributed, and power-hungry data centers filled with hundreds if not thousands of servers.[37] Tellingly, reports from both ends of the political spectrum agree that the cloud now rivals developed nations in its electrical consumption and is still growing rapidly. Greenpeace's April 2012 "How Clean Is Your Cloud?" report, by Gary Cook, notes that if the cloud were a country, it would have the fifth highest energy demands in the world.[38] Another report, ironically sponsored by the National Mining Association and the American Coalition for Clean Coal Electricity,[39] estimates that current global information and communications technology demand represents around 10 percent of the world's total electricity generated, approximately the same amount of energy that was used to light the planet circa 1985.[40] Although the latter report predictably gives renewable energy sources short shrift while the Greenpeace report tracks those

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

prospects more seriously, both work to make the largely intangible costs of Westernized broadband habits more perceptible. Documents like these therefore often compare the cloud's nebulous but significant energy requirements to those of nations, and put its overall wattage in terms of the ordinary light bulb, whether the comparison serves as rhetorical aggrandizement or cautionary tale. In many ways, Marshall McLuhan presciently described this conflation of light, electricity, and communication in his most famous writing of the 1960s.[41]

Some may find it startling that the cloud is not inherently more energy efficient than the old wired internet. In fact, wired data transmission is typically more energy efficient than wireless networks because the wireless network often requires power in more locations (not just the central office and the home or end destination, but also the cell tower).[42] The cloud's energy footprint compared to landlines and traditional production also depends, crucially, on frequency of use:

> Listening just once to a song stored in the Cloud uses less energy than purchasing and shipping a CD, taking into account manufacturing and transport energy. Listening to the song a couple of dozen times leads to more overall energy used, largely because of greater use of the networks. The Cloud uses more energy streaming a high-def movie just once than does fabricating and shipping a DVD.[43]

Clearly, the cloud offers convenience and less visible clutter, at a price. There are power savings to be had with remote data storage and sharing if the services are used infrequently, but many use the cloud less as archive than wardrobe, a place to keep things that are used every day. If we download photos often enough, we would do better to store them on our own computers, rather than the cloud: "A laptop hard drive operates at ~1 watt whether accessing a photo twice a day (~0.1 downloads/hr) or accessing 100 photos. As download frequency rises the Cloud can consume over 10 times more energy to store and access information than storing on a laptop."[44] One might quibble with the exact numbers, but what remains incontrovertible is that usage matters—even as the rhetoric of the cloud and mobile, portable, and "hands-free" devices banishes physical considerations and the visible evidence of wires, cell phone trees, and data centers, these studies remind us of the machinery behind every click or tap.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

To return to the heat exchanges of Brunton's essay on the thermal architectures of computation, we should also consider that cooling the server farms at corporate data centers demands as much energy as the servers themselves.[45] Experts like IBM researcher G. Ingmar Meijer unanimously agree that "the real key to ratcheting down the energy consumption of a computing facility is liquid cooling. The reason is that thermodynamically liquid cooling is much more efficient than air cooling because the heat capacity of liquids is orders of magnitude larger than that of air,"[46] hence many companies' efforts to situate their data centers near water or in colder climes, in places like Iceland and Finland.[47] Google built its first internally owned and operated data center in The Dalles, Oregon, because of "its mild climate and access to hydroelectric power,"[48] and official images highlight the center's close proximity to the Columbia River and its extensive use of water-cooling towers. Microsoft's Project Natick is a curious attempt to develop self-sustaining small-scale data centers that can be submerged in coastal waters, heralded by the slogan "50% of us live near the coast. Why doesn't our data?"[49] (The idea for an underwater data center purportedly began with a Microsoft employee who had formerly served on a submarine in the U.S. Navy.) The first prototype was deployed off the central California coast near Morro Bay between August and December of 2015, and video documentation of the launch borrows tropes from both nature documentary (pelicans soaring and underwater cameras) and aeronautical drama, with Microsoft employees anxiously monitoring the remote operation in a NASA-esque control room. Both Google and Microsoft underscore the sustainable aspirations of their data centers and downplay the potential negative effects—yet apart from the disturbing notion of literally offshoring our data in the fragile but most biologically productive zones of the shallow sea, there is the additional outrage that these environmental commons have been reimagined as convenient heat sinks for an already overserved technological elite.

Given that approximately half of the technology industry's energy budget goes toward cooling newer-generation server microprocessors that generate more waste heat, Meijer notes the acute irony "that Moore's law (a projection of microprocessor performance) is widely known and often cited, while increasingly critical physical laws of thermodynamics receive little popular attention"—something that this chapter aims to address. Of course, one might argue that our devices and the network itself will become more energy efficient over time, but history shows that efficiencies only spur greater demand.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

As journalist Kris De Decker suggests, perhaps there need to be limits to growth for the internet: imagine returning the internet to a text- and image-only medium (no video), or setting a cap on the speed of wireless internet connections.[50] Already, global energy consumption is likely undercounted not only because of the rapid changes in the ICT ecosystem (much of the recent data comes from surveys conducted before the heyday of mobile devices, for instance, and streaming video/TV is considered one of the biggest variables), but also because many quantification attempts sweep together multiple categories of devices or simply do not account for, say, equipment in electrical closets, multiple devices per household, digital technology embedded in other appliances, and so forth.[51] Furthermore, while a great deal of attention has been paid to data centers and the "last mile" problem of traditional infrastructure delivery, the machine-to-machine internet's needs are far outpacing the conventional traffic between client and user computers.[52] The cloud, it turns out, is inward-facing.

What does all this mean for games? Is playing a game online an environmentally dubious alternative to playing a game off one's own computer hard drive? Are single-player, or better yet analog games the most sustainable choices? As usual, the answers boil down to—it depends. In the remainder of the chapter, I read these questions through the genre of farm games, which handily combines issues around land and energy use, social and natural capital, and the latent pastoralism of digital frontiers. At the very least, farm games return us to the early days of online casual gaming, a time when data storage and network speed were still far from taken for granted. What's more, evaluating the thermodynamics of play provides a countervailing force to the conventionally positive associations with networked, multiplayer gaming, ones that accentuate social bonds and community formation.

The Garden in the Machine

Today, when computers can boast gigabytes, if not terabytes of storage, and many users simultaneously do most of their computing in the cloud, it can be hard to remember that computers were not always so enabling—both in the beneficial sense of making something possible, and the more pernicious sense, drawn from addiction discourse, of supporting unhealthy, even destructive habits. Students nowadays have barely if ever known a time without cloud services, Google, Facebook, and YouTube, solid-state storage,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

and pocketable flash drives. Yet even as recently as the mid-1990s, new games required boot disks (then 3.5-inch floppy disks) to operate, because they were too large to fit on players' computers. This may have accompanied direct modification to a system's autoexec.bat and config.sys files through command-line prompts, because changing certain simple variables in these files essentially tricked computers of the time into thinking that they had more memory than they did to run a game. Interestingly, these trends in general computing, gaming, and social media conveniently converge in at least one historical moment, and one game genre, worth examining at length. While Facebook's meteoric rise has often been attributed to its simple social networking formula, casual games were arguably the most muscular engines of the platform's success. In the late 2000s, as social media sites quickly reshaped the online sphere, millions of players joined Facebook and services like it because of games like Zynga's *FarmVille.* As it turns out, the humble farm game convinced millions to loosen their definition of friendship and log on regularly, in order to colonize the pastoral frontier of the social web.

Because of their basic graphics and limited gameplay mechanics, casual games have often been dismissed as collateral fluff to the real innovations in online social networking and big-budget game development. But veteran gamers and industry pundits alike were stunned by the unparalleled successes of social and casual games in the first decade of the new millennium. As *Wired* games writer Chris Kohler conceded in a 2009 reflection, "The '00s will be remembered as the decade when the videogame industry got flipped on its head," as "publishers came to the belated realization that all those simple, accessible games from days gone by weren't obsolete; in fact, there were untold millions of people playing *Solitaire* on their computers, just waiting for something better to come out."[53] The mass-market appeal of browser-based and downloadable puzzle games like *Bejeweled Blitz* (2008) and time-management games like *Diner Dash* (2004) has given the lie to once conventional industry wisdom: namely, that game consumers demand blockbuster titles with intricate storylines and progressively better graphics. Within this growing constellation of popular casual games, farm games significantly held pride of place. Kohler lists *Happy Farm* (2008), a Chinese farm game, as one of the top fifteen most influential games of the prior decade, despite the fact that most Americans have never even heard of it. As he explains, *Happy Farm*'s trendsetting role as a model for *FarmVille*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

and games like it justifies its inclusion alongside more well-known properties like *Grand Theft Auto III* (2001), *The Sims*, and *Wii Sports* (2006): "Whether or not social games are the next big thing, *Happy Farm*'s blend of planting, growing, and harvesting crops turned out to be the simple game-design formula that had gigantic repercussions." Surveys of the current rosters of casual games support Kohler's observation that farming has emerged as both a preeminent theme and set of game mechanics. Games include many different kinds of mechanics, as in discrete, rule-governed processes, and some are more vital than others, from loading, aiming, and firing a gun in a first-person shooter to wooing a potential spouse with home-cooked meals in a game like *Harvest Moon.* Tellingly, even games that are not ostensibly about farming, such as Zynga's 2010 releases *FrontierVille* (later renamed *The Pioneer Trail*) and *CityVille*, included farming as a core component of gameplay.

To gain some sense of the dramatic impact farm games have had on the overall online landscape, consider the web comic *xkcd*'s famously tongue-in-cheek "Map of Online Communities," first published in 2007 (Figure 27). Only a decade or so ago, there were few dominant players. The clearest frontrunner, MySpace, found itself thronged by eager social media competitors, MMOGs formed a modest island nation, and Web 2.0 blogs and start-up companies with niche followings littered the seas of cultural transmission. Taken altogether, the world of online communities circa 2007 appeared largely user-generated and highly fragmentary, a seismically active geological terrain of submerged volcanoes, fragile atolls, and exposed peninsulas, many mere migratory stopovers for viral propagation. By late 2010, *xkcd*'s subsequent map depicted a postwar world of monolithic corporate continents.[54] MMOGs, about which an arguably disproportionate amount of game criticism has already been written, continued to occupy a sizable, but relatively isolated isle; YouTube, Twitter, and Skype had become established territories; and Facebook and the Chinese QQ service through Tencent had arisen as global superpowers. Perhaps most striking of all, both Facebook and QQ featured a farm game as their most prominent province—for Facebook, *FarmVille*, and for QQ, *Happy Farm*.

Paradoxically, the 2010 map suggested that somewhere within its enormous socially networked and short-message-service (SMS)-enabled land masses lay a pastoral utopia, a seemingly off-the-grid haven for even the most jaded of tech geeks. According to available Facebook user data, the number of active *FarmVille* accounts peaked in March of 2010 at around 85 million,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

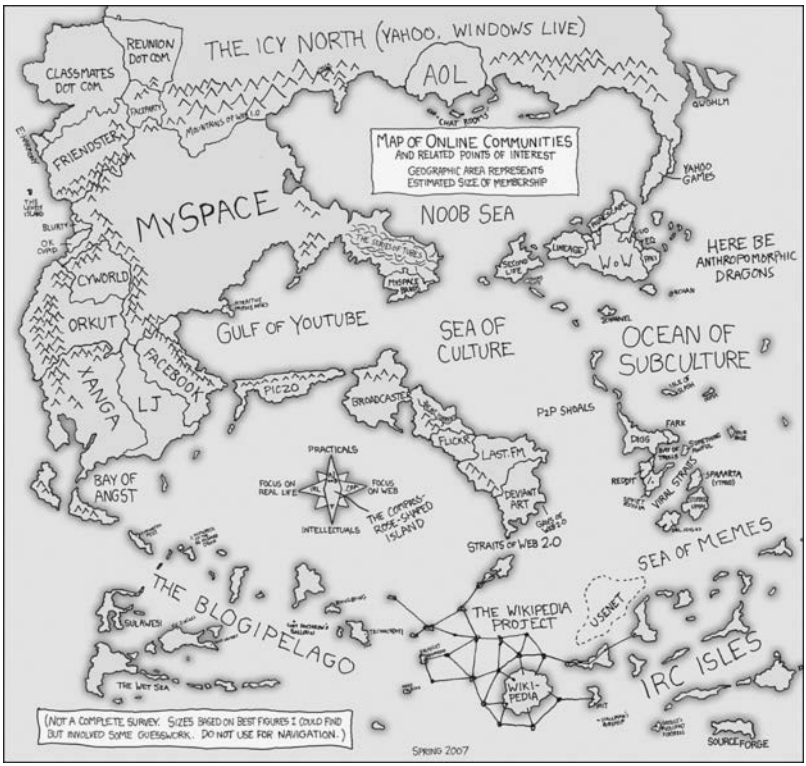

Figure 27. The web comic *xkcd*'s humorous representation of the online world, posted May 2, 2007 (Randall Munroe, "Online Communities," *xkcd*, http://xkcd.com/256/).

and *FarmVille* players at the time constituted anywhere from 15 to 20 percent of Facebook's overall user base.[55] (By comparison, *Happy Farm*'s mostly Chinese and Taiwanese players were said to number well over 200 million, and at the time the Chinese blogosphere was littered with anecdotal reports of marriages broken, jobs lost, and lives ruined by addiction to the game.[56]) In 2011, Zynga went so far as to tout *FarmVille* as "the most popular game in the world," and exhorted the unconverted to join its ranks using a combination of peer pressure and comforting solicitousness. "Play FarmVille—the biggest game on Facebook. Your friends are!" or "It's not just a Farm—It's a home away from home!" were just a few of the many taglines likely to appear in Facebook advertisements at the time. Although *FarmVille* remains the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

best-known game in its category, along with its various expansions and successors like *FarmVille 2* (2012) or *FarmVille 2: Tropic Escape* (2016), they are far from the only examples of virtual agricultural play. Beyond the dozens of "social" online farm games like *Farm Town* (2009), *myFarm*, *Happy Farm*, *Happy Farm 2*, and *Sunshine Ranch* (2009), there are also hosts of single-player, downloadable PC games like *Farm Mania* (2008), *Farm Craft* (2008), *Farming Simulator* (2008–), and *Farmer Jane* (2008), console-based farm games like Namco's extremely popular *Harvest Moon* series for the PlayStation, and mobile/handheld titles like Supercell's *Hay Day.* A popular game portal like Big Fish Games hosts over sixty PC games with the word "farm" somewhere in the title, along with dozens more that are clearly related, like *Plantera* (2016) and *Chicken Chase* (2007).

Meanwhile, the Environmental Protection Agency continues to report that less than 1 percent of the over 313 million people living in the United States claim farming as an occupation, and less than half of those list farming as their *principal* occupation.[57] These radically discrepant numbers suggest that Americans no longer concerned with the day-to-day production of food were nevertheless heading back to virtual farms in droves, for reasons I propose go beyond their convenient scaffolding for minimal sociality. As I have argued before,[58] the marked success of the agriculture-game genre depends on its reductive idealization of country work, what some saw as positive evidence of a "new techno-pastoralism."[59] Yet despite its venerable history in literary representation, pastoral has in modern times become a flabby descriptor connoting any kind of idyllic, temporally removed way of life, rural in nature and ostensibly yielding simpler pleasures. Typically seen in direct contrast not only to the urban but also the mechanical and technical innovations represented therein, pastoral as figured through farm games is more accurately described by the cultural critic Leo Marx, who argued that a complicated, superficially paradoxical blend of agrarian ideals and machinic enthusiasm came to characterize the American way of life in the nineteenth century.[60] For Marx, the entry of the technological into the pastoral held the potential for extraordinary insights. Thus, Henry David Thoreau's description of a locomotive passing through his beloved Concord woods recalls an earlier, pivotal time when both the shock of mechanical invention was more apparent but when it may have been easier to see the machine less as an interloper than as a vital catalyst. Marx also distinguishes between two varieties of pastoral: a "popular and sentimental" version at large in mass

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

culture, and a more rarefied, "imaginative and complex" form, characteristic of the writers he extols.[61] The one is mere unlettered escapism, the other the stuff of genuinely insightful literary experience:

> An initial receptivity to the pastoral impulse is one way in which our best writers have grounded their work in the common life. But how, then, are we to explain the fact that the same impulse generates such wholly different states of mind? While in the culture at large it is the starting point for infantile wish-fulfillment dreams, a diffuse nostalgia, and a naive anarchic primitivism, yet it also is the source of writing that is invaluable for its power to enrich and clarify our experience.[62]

We might then turn to Marx's two pastorals to either celebrate or denigrate farm games. Unfortunately, by far the bulk of such games falls into the less meritorious camp, although I will conclude with a few more promising examples. As we will see, not only the literary framing of the pastoral, but the historical, economic, and ecological implications of the games and their implementation will make obvious the genre's current limitations. Specifically, enjoyment of farm games depends on the conscious erasure of labor, waste, and failure—in other words, entropic excesses to the "diffuse nostalgia" and "naive anarchic primitivism" of digital back-to-the-land fantasies.

Landscape's Labors Lost: Technology and the Counter-Pastoral

In what is primarily a tale of technological revolution, Southern historian Paul Conkin has detailed American agriculture's comprehensive shift toward pervasive technological infrastructure in the twentieth century.[63] Observing the considerable alterations the decades have wrought in his semi-rural hometown in eastern Tennessee and the country at large, Conkin struggles with a fundamental ambivalence: while by and large he celebrates many of the massive gains in production efficiency enabled by tractors, combines, and rural electrification, "chemical inputs" like synthetic fertilizers and herbicides, and selective breeding, he also recognizes the dwindling number of farmers and the often damaging effects that intensive farming has had on the nation's land and waterways. American agriculture has been so effective at driving up yield, replacing workers, and eliminating pests, pathogens, and the necessity of time-consuming crop rotation, that in many respects it has fallen victim to its own manifold successes. For much of the century following the short

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

period of balanced supply and demand before the First World War, American farmers have consistently faced massive production surpluses and market saturation, which has driven prices down and invited near-constant government intervention in the form of production regulations and hefty subsidies. In the meantime, pests and diseases affecting both plants and animals have returned in novel, strengthened forms to plague the vast monocultural landscapes of single-crop farms and concentrated animal feeding operations (CAFOs), while any number of alarming public-health trends, most notably a rise in childhood obesity and type 2 diabetes, have indicted an American food culture based on excessive processing and caloric overabundance.

Naturally, few of these problems arise in the farm game, where technology, much as in the real world, permits the displacement or erasure of work, waste, and natural contingency. In *FarmVille*, growing that typically takes entire seasons to come to fruition, that in the physical world is vulnerable to all sorts of biogeochemical reductions, is condensed into the easy work of a few minutes and hours. A modest parcel of land is given to you free of charge just by beginning to play the game, and though at first you must laboriously plow your land, plant seeds, and harvest crops plot-by-plot with carpal-tunnel-syndrome-inducing, repetitive clicks or taps, your profits quickly roll in and enable you to purchase top-of-the-line farm machinery—tractors to plow, seeders to plant, and harvesters to collect—vastly simplifying the earlier processes. Eventually, players can even build combines, which merge all three tasks for one-click harvesting, plowing, and seeding. Farm games' technological effacement of human, animal, and environmental labor in many ways simply extends conventional pastoral notions of country life, which tended to obscure labor by imagining rural living as paradoxically both productive and idle. Raymond Williams, in *The Country and the City*, offers a particularly perceptive genealogical tracing of the pastoral genre, and its predication on a studied inattention to the discomforts and dislocations of the laboring class. Drawing on his own rural childhood on the Welsh border, Williams is less concerned with pastoral as a literary conceit than as an artifact of and testament to changing social and economic relations in England.[64] Williams carefully demonstrates that every generation casts back to an earlier era for a supposed agricultural purity, and then he sets about restoring socioeconomic truth to the pastoral ideal in English literature. First, he excavates the often injurious and less glamorous systems of land tenancy and enclosure

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

that underlie the romantic tales of courtship, marriage, and gentlemanly intrigue that permeate the novels of authors like Jane Austen. Then he pairs pastoral with an equally important "counter-pastoral" impulse exemplified, for him, by authors like George Eliot in *The Mill on the Floss* (1860), who did not let domestic servants and laborers fade into insignificance or local color. Williams is also intent on deconstructing any lasting division between country and city, while acknowledging the polemical attraction of such a dichotomy. For him, country and city are inextricably linked, whether as the necessary means of production and economic centers of exchange, or as convenient conceptual foils for each other. Zynga's *CityVille*, a practical paean to population growth, urban sprawl, and blatant consumerism, was by this measure nearly a fated complement to *FarmVille*.

Echoing Williams's astute assessment of eighteenth-century English landowners and the development of agrarian capitalism, the official narrative of agricultural distress in the United States over the past century or more has largely centered on the diminishing ranks of white, middle-class, midwestern farmers. The plight of the archetypal American farmer, by now an established trope in the national psyche, conjures tales of small, family farms driven to bankruptcy or neglect by youthful flight to urban centers; consolidated agribusiness; the high price of the latest technological innovations in machinery, pesticide control, and irrigation; drought and aquifer depletion; legal battles over patented seed stock; and even the unrefined palates of at-home consumers. But when the EPA, citing Purdue Research, reports on the continuing decline in the number of American farmers, it summarizes data limited to self-reporting farm owners and legal workers, a "graying" population that is rapidly aging out of existence like the equally romanticized frontier cowboy.[65] As sobering as this trend is on its own, it leaves aside critical subtexts from the agricultural South and West, the stories of thousands of undocumented, border-crossing workers and the nearly complete exodus of African Americans from farming despite their long yet fraught relationship to the land as slave laborers and tenant farmers.

Farm games, with their default cast of pale, cheerful faces, seem doubly removed from these realities. Ethnically diverse migrant workers constitute a critical but underserved segment of the nation's agricultural workforce, with migrant farmworkers making up nearly half of those employed in seasonal agricultural work. Over 70 percent of American farmworkers were born

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

outside the United States, most in Mexico, although in the case of California other populations from Latin America and Asia have grown in representation, including indigenous peoples "such as the Hmong from Southeast Asia, the Mixtec and Zapotec from Mexico, and the Maya from Guatemala."[66] Many of these workers are exposed to a wide range of abuses because of their illegal status, ranging from unacceptable occupational hazard and lack of medical insurance to scant wages and sexual harassment. Yet aside from this controversial reliance on undocumented and migrant workers, American agriculture has little to boast of in terms of economic, racial, or sexual diversity:

> Agriculture is, by far, our least diverse economic sector in terms of race, ethnicity, and gender. More than 97 percent of principal farm operators are white, and just over 90 percent are male, although women make up a much larger share of nonprincipal or secondary operators. African Americans, once so critical to southern agriculture, have almost completely deserted farming. Only 29,090 are principal operators, meaning either owners or tenants.[67]

The general lack of racial diversity in the contemporary farm game therefore represents either truth or sham, depending on which rung of the economic ladder is being consulted, but is in all cases disheartening given already widespread resentment of legal and illegal immigrants and congressional debate over settlements for black farmers who have experienced both outright and systemic discrimination at the behest of the federal government.[68] Political conservatives were anxious to paint a recent settlement, the 2010 follow-up to 1999's *Pigford v. Glickman*, as an unmerited handout to yet another special-interest group clamoring for government dollars. But as Paul Conkin attests, compensation is long overdue, given the racial injustice embedded in farm history: "Race is now a prominent issue in farm politics. This is a bit ironic, because the concern for African Americans, in particular, comes much too late. Most blacks have long since departed agriculture."[69] For much of the past century, federally established and monitored allotments (and related quotas and pricing and financial support mechanisms) determined what and how much farmers could grow. Farms were initially assessed as having a "base" or "base acreage" determined by previous production and area already under cultivation, and this base became the basis for a variety of regulations and monetary incentives down the line—a higher base meant

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

greater potential profit, favoring established large landholders and those with the capital to amass more land (a property's base evaluation went with it upon sale). Conkin describes the procedure of establishing base acreage as "the foundation of an enduring aristocracy" akin to "primogeniture and entail laws in Europe." From the get-go, then, modern American farm policy enshrined inequality, and only recently have attempts been made to narrow the gap between large and small farming operations and to make amends for long years of racially motivated economic oppression.

Meanwhile, although an online, social farm game like *FarmVille* tends to offer customizable avatars—a limited range of skin colors, hairstyles, facial features, and attire—most of the story-based downloadable farm games feature a feistily optimistic, redheaded heroine (Figure 28). If we were to extrapolate from these images, the formula for a catchy farm game seems to involve some incongruous combination of overalls and plaid shirts, no-nonsense ponytails or pigtails, and flawless cosmetic glamour. But what is by far the most striking is the complete absence of brown skin—in fact, these fair-skinned ladies sport nary a freckle or sunburn even after toiling in the hot sun for months on end. Though *FarmVille* offers a range of male and female avatars and the popular *Harvest Moon* franchise generally features a young boy as protagonist, male avatars are on the whole much less common in downloadable farm games, presumably because the games are targeted at the growing audience of female casual gamers and their supposed preference for "positive fictions."[70] The men that do appear in these games are generally relegated to the status of either sidekick or villain. Thus, one common narrative demands that the game's sassy young heroine return to the family farm in order to save "Gramps" (*Farm Mania*) or some other elderly relatives' homestead (*Fantastic Farm* [2009]) from financial ruin, neglect, or even the ruthless machinations of global agribusiness (*Farm Craft*). One might reasonably argue that these "Ginger v. Goliath" plotlines reflect a growing preference for local, farm-fresh food—less automation, more community-based farming, fewer megastores, more farmer's markets—but despite their earnestness the games still read as covert forms of wishful thinking designed to suppress the messier, less palatable aspects of agricultural labor. In these games, farm life is hard work, but always profitable; the work is voluntary, not forced upon you by unemployment or transnational labor crises; and the work is often done singlehandedly or with the help of at most one relative or a handful of workers.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

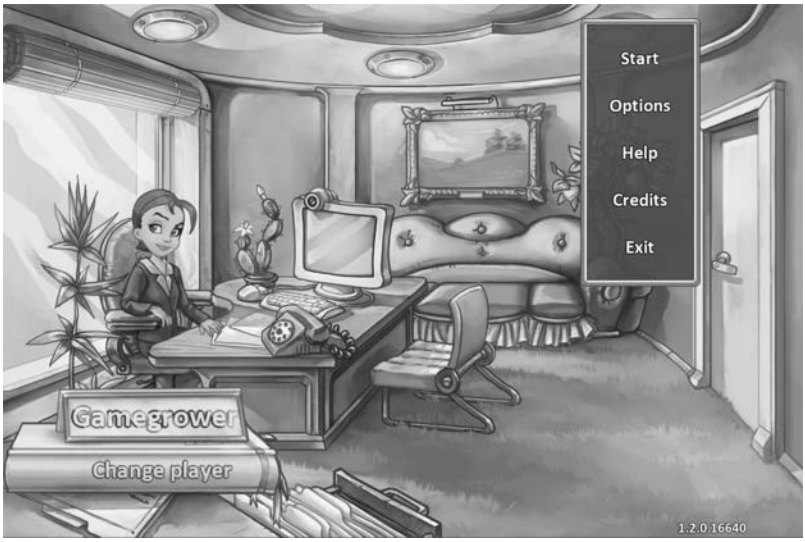

Figure 28. Plucky, redheaded heroines abound in farm games, like Ginger, the organic-farming heroine of Nevosoft's *Farm Craft* and *Farm Craft 2: Global Vegetable Crisis* (2011, pictured here).

At best, the onerousness of real farming is mimicked by the endless series of taps or clicks required to play such games, which rarely, if ever, require keyboard input. However, most of the games quickly introduce means, usually technological (though sometimes magical), with which to condense efforts or displace them onto the game's built-in artificial intelligence. In *Fantastic Farm*, a witch-becomes-farmer tale, a few waves of the magic wand allow nonmanual watering by sending errant rainclouds to dispense precipitation over dry plots. In *Farm Craft*, you can save up money to purchase sprinkler systems that free you from having to water each plot with a watering can. The *Farm Craft* series also offers a "worker-hiring" mechanic, so as Ginger, you can hire men to water, fertilize, pick fruits and vegetables, or take care of livestock, and even a manager to manage all the rest. In this, *Farm Craft* comes closer to the reality of farm work, namely its distribution over a network of people, but the depicted roster of white male workers makes apparent both the persistence of the country rube stereotype and the continuing absence of racial and ethnic diversity. Although the *Farm Craft* games were developed by the Russian casual-games company Nevosoft, they

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

were sold worldwide.[71] And like most farm games, they fail to acknowledge the realities of seasonal, migrant, and ethnically diverse laborers.

In depicting a kind of agricultural utopia void of workers but replete with labor-saving technology, farm games thus inadvertently reprise the capitalist drama of modern agricultural history and economics. They also unwittingly cleave to one side of a longstanding divergence of opinions between agriculture's boosters and dissidents—favoring those who believe modern industrial agriculture represents "an outstanding, and somewhat neglected, success story" (Giovanni Federico, in the tellingly named *Feeding the World*) over those who see contemporary agribusiness as either delivering a monopolistic deathblow to ancient and inherently anticonsumerist forms of peasant culture (John Berger in *Pig Earth*) or willfully ignoring natural limitations on growth (ecological economists like Herman Daly and environmental scientists like Mitchell Thomashow, who raises an eyebrow at "the optimistic, green revolution projections of plentiful food and filled tummies").[72] Vandana Shiva, a noted environmental activist and author, has argued on both critical fronts over some three decades of research and writing on the destructive colonialist and capitalist ambitions of the Green Revolution in India and other areas of the global south.[73] Evidently, agriculture in the real world has never been a reclusive affair, despite the typical farm game's vision of agriculture as a single-player adventure (even social games like *FarmVille* are essentially single-player, though each player can have multiple neighbors that can visit and help tend the farm). Agriculture also cannot simply remain the cultivation of land and livestock for sustenance, because it is inevitably bound up with the question of sustainable population and the promises and prayers of American foreign policy and philanthropy through export and food aid.

To return the labor of technology or people to the farm game is to reinforce the notion that work is a valid way to appreciate and interact with natural and hybrid natural-artificial environments. As scholars Richard White and Anna Tsing have argued, in relation to logging and mushroom hunting in the Pacific Northwest, respectively, work may be a desirable counter to passive appreciation of a landscape despite its violation of environmentalist standards of wilderness purity and human nonintervention.[74] In game studies, of course, it is play that is seen as the active counterpart to passive spectatorship. In this way, both work *and* play, activities traditionally seen as polar opposites, align as meaningful modes of interacting with other-than-human worlds.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

Farm Ecology: Nonhuman Labor and Ecological Economics

Taken in its most general sense as productive activity applied toward economic gain, labor cannot be restricted to purely human forms. Of the many nonhuman forms of labor, there are those obvious examples provided by working animals, most commonly horses or dogs, and the more ambiguous cases of environmental labor—natural processes like plants' conversion of carbon dioxide to oxygen, without which our atmosphere could not sustain life as we know it. Economists have traditionally designated both renewable and nonrenewable "natural resources" like sunlight, breathable air, precious metals, and fossil fuels, and "environmental services" like air purification and waste treatment as free gifts to the market economy. But as human impact on the natural world has become more and more pronounced, threatening to exhaust and disrupt an environment poorly protected by perceptions of its vastness and resiliency, a number of prominent economists have attempted to develop economic and philosophical models that more adequately express human dependence on the natural world. Environmental economists and ecological economists (not the same people despite their nomenclatural similarity) still dispute the appropriate way to value natural resources and environmental services: if not as free gifts, as classical economics would have it, then perhaps as forms of natural capital with mathematically amenable values (Herman Daly and Robert Costanza), or more radically, as entities and activities to which we cannot sensibly ascribe monetary worth (Paul Burkett and John Bellamy Foster).

Daly, one of the founders of ecological economics, has built his heretical economic philosophy around proving that the mantra of "sustainable growth" is a destructive oxymoron. Across his many writings, Daly directs economic behavior away from quantitatively oriented growth toward qualitatively oriented development and the ideal of a "steady-state economy." Influenced by economist Kenneth Boulding's well-known articulation of two fundamentally opposed economic systems—the unconstrained, immoderately wasteful "cowboy economy" and the deeply constrained, minimally wasteful "spaceman economy," or life on the open plains versus life in a tiny capsule—Daly has long urged forsaking the avarice and negligence of what he calls "empty-world" economics in favor of the practical humility of "full-world" economics.[75] While the frontiersman's disregard for environmental impact may have excited little censure in days of sparse settlement, abundant supplies,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

and feebler technology, when people were still very much aware of their vulnerability to external natural conditions, the same attitude appears wildly anachronistic in our current moment of rapid population increase, resource scarcity, and pervasive technological dominance over our environment.

Ecological economics, without entirely discarding classical economics, inverts the latter's priorities by embedding a Latourian attention to nonhuman representation in its models:

> Today's newly emerging paradigm (steady state, sustainable development), however, begins with physical parameters (a finite world, complex ecological interrelations, the laws of thermodynamics) and inquires how the nonphysical variables of technology, preferences, distribution, and lifestyles can be brought into feasible and just equilibrium with the complex biophysical system of which we are a part. The physical quantitative magnitudes are what is given, and the nonphysical qualitative patterns of life become variables.[76]

Responding to classical economics' axiomatic treatment of economies as closed, self-sustaining systems populated by abstract, largely symbolic producers and consumers, Daly insists that human economies must be regarded as subsets of the material world with the consequent imposition of natural contingencies and limitations, not the least of which is the bounded, finite character of our physical planet and its energetic inputs.[77] To this end, Daly grounds his models on thermodynamic principles, in particular the first law regarding the conservation of energy and the second law regarding entropy. Thus economic "throughput" continuously turns less-ordered, high-energy materials into more-ordered, low-energy commodities, but never with complete efficiency. The environment serves not only as "source" but also as "sink," as we make use of its resources and return to it the often toxic byproducts of manufacturing and a questionable legacy of near-immortal plastics and radioactive waste. Though the environment offers potent absorptive and regenerative capabilities, Daly recognizes that the scale of human activity now threatens to overwhelm the world's "ecological carrying capacity," putting us squarely in the midst of what some scientists have dubbed the "sixth mega-extinction" in our planet's history, or a massive reduction in biological diversity triggered by humans and their unprecedented industriousness.

Despite their outward natural orientation, agriculture-themed games like *FarmVille* imitate the artificially closed systems of classical economics rather

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

than the environmentally open systems of Daly's theories. Just as farm games overlook the politically unpalatable realities of exploited and historically excluded agricultural workers, they also turn a blind eye to nonhuman labor and the equally unpalatable ecological realities of industrial waste, entropy, and resource finitude. The lack of sobering ecological limitations—what classical economists like to call externalities to the market, in a mirroring of the rhetoric of environmental gifts and services—make such games dubious models for any genuine back-to-the-land sentiment. Farm games offer bucolic paradises where the use of machinery and intensive agricultural methods never leads to environmental degradation, where animals may be harvested for their products without coming to noticeable harm, and where key natural resources like clean water and nutrient-rich soil are always available and never subject to competition. Along with the inevitable depletion of soil and other resources, farm games also bypass the typical constraints of climate, season, and weather, both by excluding them from instantiation in the game and encouraging the clever use of technical solutions, ranging from the plausible, such as greenhouses and chemical fertilizers, to the fantastical, such as the "unwither" spray in *FarmVille.* Given this range of technological conveniences and magical cheats and saves, virtual farmers possess effective mastery over their cultivated landscapes as well as the broader environment that subsumes them. Just as fertile soil is a given in farm games, rather than an objective, fresh water is also plentiful and available at no cost—this despite water's deeply contested status in the real world, and the many limits on its quantity and quality.

Both environmental degradation and limitation are realities that lie at the heart of the thermodynamic principles underlying ecological economics. But perhaps the clearest evidence of entropy and environmental externalities to economic systems lies in waste, whether it is legally and ethically marked as pollution or trash or, as is more often the case, goes unnoticed or is deliberately overlooked until its sheer size and severity cannot be ignored. Though capitalism would prefer to imagine otherwise, commodities cannot be created out of whole cloth, and production can never achieve 100 percent efficiency—such are the fantasies of perpetual motion, Dyson spheres, and the lossless Carnot engine. Fascinated where others have been repelled, literary ecocritic Timothy Morton has given the name "dark ecology" to all those ugly substances lurking beneath the glossy veneer of consumerism, in a philosophical attempt to counteract luxury culture's repression of death,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

excess, and decomposition.[78] For Morton, typical invocations of ecology speak in superlatives, stressing positivity and harmonious living, but this is, in its own way, as closed a system as the abstract ideal of classical economics. Where the marketer and the effete consumer see grocery and department store shelves lined with a reassuring panoply of products—say not one but twenty different kinds of toothbrushes, in a range of cheery colors, some with short bristles, long bristles, soft bristles, hard bristles, injected foam handles, rotating heads, or cartoon imprints for the young or young-at-heart—dark ecology looks beyond the point of acquisition and the brief lifetime of a toothbrush's use. It trails behind a toothbrush after it has been tossed in the garbage bin, while it makes its way from household waste to landfill, or washes out to sea and joins the growing rafts of plastic-based flotsam circling in the North Pacific Gyre, or what has been called the Great Pacific Garbage Patch. Delighting in the scatological, Morton mocks our failure to think "beyond the U-bend," teasingly referring to that crooked spot at the base of our toilets beyond which our own excrement travels, leaving an overtly pristine bowl of clear water but joining the feces of a thousand others in aging pipes and pools at waste treatment plants or flowing directly seaward. Dark ecology reminds us that ecology is not solely about the bright optimism of interconnection and interdependence, a warm, furry, mammalian comfort in our cohabitation, but also a universe of waste, dirt, shit, and trash that does not disappear, though it may fade or become otherwise as it gets taken up again and again by a sprawling web of organisms and inorganic actors.

By this standard, farm games at best mimic or at worst perpetuate distaste for the murkier sides of a consumer culture based on convenience, choice, plenty, and growth. Virtuality becomes both blessing and curse in this respect: on the one hand, it serves as an opportune shield against criticisms of ecological inaccuracy, but on the other hand it is the very basis for a vital disconnect between the raising of food and the politics of its consumption. *FarmVille* farmers assiduously raised crops only to sell them to an abstract marketplace. While a few harvested bushels could be sold to neighbors via homey-looking farmer's market stands, crops bought in this way could only be used as raw materials, turned into pig slop, or expended for metaphysical "mastery" bonuses (players "master" crops by planting and successfully harvesting them in great quantities). Crops transformed into goods in bakeries, wineries, and other structures could not provide gustatory

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

satisfaction, but could be traded for fuel to power farm machinery. Incidentally, fuel could also be found while plowing one's own land or tending a neighbor's fields, as if nature itself rewards agricultural diligence and considerate visitation. Ultimately, even as farm games leverage the growing grassroots interest in organic, locally sourced food and what we might call "personalized agriculture," their clean, carefully antiseptic landscapes more closely resemble the impersonal bounty of bulk discount stores than artisanal farmer's markets or roadside stands. Sunlit, verdant fields admit no suggestion of consumer waste, let alone the industrial waste generated by intensive farming or concentrated animal feeding operations. Viscerally lacking, farm games treat animal and plant life as little better than innocuous parcels of prepared, packaged, and frozen food—designed for quick, mindless consumption within a flattering master narrative.[79] Not surprisingly, Zynga regularly negotiates corporate partnerships or advertising agreements that allow outside content to appear in its games, and in the case of *FarmVille*, many of the featured brands played directly to the game's promise of wholesome, direct-from-the-farm food. McDonald's, Stouffer's, and Frito-Lay have all made "guest farm" appearances in *FarmVille*, and players that take the time to

Figure 29. Brand promotion in Zynga's hit casual game *FarmVille*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

visit and tend these temporary farms are rewarded with in-game bonuses and branded farm décor, like a Frito-Lay delivery truck or a Stouffer's macaroni-and-cheese tree (Figure 29).

Cynics might well argue that farm games all too accurately model the basic nature of agriculture as manipulation and alteration of land, as well as the longstanding affinities between farming, capitalism, and technology—a triad now so deeply engrained across the world that only a tiny minority of hobbyist or subsistence farmers might claim to operate outside of it. To speak specifically of farm ecology, one must recognize that almost all farms constitute artificial ecologies that reduce the complexity and biodiversity of natural ecosystems to monoculture, an approach that has proven inherently susceptible to pests and diseases as well as troublingly reliant on synthetic fertilizers to replace depleted components of the soil. Far from embodying the evolutionarily rich interconnections of Charles Darwin's entangled riverbank,[80] farms replace variety with uniformity, or the smooth, heterogeneous spaces of natural systems with the striated, homogenous land of rows and fields. Even for Conkin, the devoted farm historian, agriculture and environmentalism suggest an unavoidable antipathy:

> Of all human activities, the cultivation of crops has had the largest impact on the face of the earth, beginning with the elimination of up to half of all forests. If one places a high value on an environment little affected by humans, then agriculture by necessity is hostile to environmental health. It has eliminated wilderness, shifted the balance of plant and animal species, altered the hydrological cycle, and, in a limited way, altered climate.[81]

Recalling my introductory discussion of anthromes, Conkin recognizes the extent of human impacts on the land, and expresses surprising skepticism toward the concept of sustainable farming: "I doubt that, in the strictest sense, any system of farming is fully sustainable, because of at least a few nonrenewable inputs such as fossil fuels."[82] Conkin ultimately recommends that we reinstitute crop rotation practices, use integrated pest management to reduce toxic pesticide use, and return to alternative forms of agriculture that minimize tillage or soil disruption. Transitioning back to what he calls "low-input" agriculture, with its emphasis on the recycling of nutrients, might bring farming back in line with the ideals of natural escape and country simplicity sought by players of farm games all over the world.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

That *FarmVille* and games like it inevitably caricature complicated biological and economic processes comes as no surprise. Games, like other media, must selectively present or order experience without attempting to replicate reality. Already, games of all stripes simplify what would otherwise be very difficult tasks to perform: firing a gun, scaling walls, piloting intergalactic spacecraft. At the same time, games can easily enliven tasks which in the real world would seem onerous: waitressing in *Diner Dash*, or running a household while working nine to five in *The Sims.* Farm games partake of both strategies, offering cheerful simulations that render the dull, offensive, or harsher aspects of agricultural work reassuringly mundane. Though the results can seem vaguely parodic, especially when viewed with socioeconomic or ecological interests in mind, game designers would no doubt protest that their priority is entertainment, not verisimilitude. Games play upon widely recognized, culturally encoded frameworks—pastoral retirement, rags-to-riches entrepreneurship—but stop well short of accuracy when that entails alienating drudgery and demoralizing failure. Even if some games do rely on claims of especial realism for their appeal, many aim less for total fidelity than just enough realism to produce play that is both familiar and relevant. Accordingly, farm games are deliberately simple affairs; only a few minutes of exploration will teach you what you need to know to operate successfully in their domain. There may be little worth in holding farm games to an impossible standard for environmental truth. But the games nevertheless exert an important influence on how millions of players conceptualize country life, food production, and right relations between humans, animals, and the environment. For this reason, if nothing else, these games matter in ways that go well beyond their ability to divert and amuse. Furthermore, as farm games continue to multiply and evolve, iterations that emphasize greater environmental sensitivity will likely hold player interest for a longer time, because the games themselves will feature more knowledge-based connections and challenges. A few representatives of the genre are already taking positive steps in this direction, and some implemented trends in particular are worth mentioning here, what we might call *cross-species interaction*, *environmental variability*, *ecological localization*, and *dark ludology.*

Most virtual farms appear to teem with different forms of life, while the actual experience of play feels oddly disconnected. Avatars, crops, trees, and livestock have as much significant contact as marbles clattering about in a glass jar. Put another way, the farms are less lively ecosystems than outdoor

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

showrooms, equipped with coded to-do lists skillfully masked as cute and colorful country decor. Farm games could make crop selection less arbitrary and more biologically meaningful, not only by encouraging smart crop-rotation practices (for example, planting crops with nitrogen-fixing bacteria after crops that leach nitrogen from the soil) but also by instituting important interspecies dynamics, among them predation, pollination, scavenging, and decomposition. Players should be able to increase crop yield or grow healthier plants by considering their temporal or physical proximity to other species, both plant and animal, for instance, by planting a symbiotic Three Sisters garden (squash, beans, and corn), or using animal waste to improve the soil. At the moment, farm games favor very precise, Cartesian planting that requires orderly squares on a grid with only one plant type allowed per square. Only a few games model any kind of congress between animal and environment, as in *Farm Craft* when harvested crops are fed directly to hungry livestock. Some farm games have introduced honeybee pollination and both plant and animal breeding mechanics, though the latter is accomplished with an ease that obscures the morally and legally fraught nature of such manipulation and the various technologies necessary to its success. Not long after the height of *FarmVille*'s popularity, students at the University of Washington Bothell Campus developed an alternative *Wetlands Restoration* (2012) game that was made available on Facebook and mimicked much of the *FarmVille* look and feel while attempting to capture more of the multifarious dealings between plants, animals, people, fungi, bacteria, and inorganic matter. In *Wetlands Restoration*, species diversity depended not only on proper terrain placement and proximity to water, but species could also interact in mutualistic and antagonistic ways. Furthermore, in an echo of *Adventure*, the game drew from the campus's historic relation to its local watershed and some fifty-eight acres of wetlands that were restored primarily from 1997 to 2002. Games like *Wetlands Restoration* are "multicultural" in the sense that they oppose monocultural systems, while reminding us, as Tsing writes in *The Mushroom at the End of the World*, that "theories of heterogeneity are still in their infancy."[83]

Environmental variability refers to a game's capacity for treating its in-game environment as a dynamic system, one that changes and develops with or without the intervention of the human player (chapter 1). Presently, most farm games unfold within a game environment that is largely static, rather than homeostatic. In *FarmVille*, for instance, cleared land remained cleared

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

no matter how long it was left idle. *FarmVille* farmers had little sense of weather or seasons, though players could purchase "snow cover" or other terrain colorings to decorate their farms for certain holidays. In marked contrast, Zynga's game *FrontierVille* (later renamed *The Pioneer Trail*), released on Facebook in June 2010, achieved greater ecological complexity because it encoded environmental variation and did so in a less arbitrary fashion. This difference may be in part a function of *FrontierVille*'s broader narrative mandate: players took up farming as only one aspect of life on the historical American frontier. Whereas *FarmVille* was distinctively pastoral, *FrontierVille* evoked classic Western. Thus *FrontierVille* players took on the role of aspiring homesteaders looking to stake and tend a claim in the "untamed" wilderness (unfortunately, the game largely avoids suggesting previous Native American presence or dramatizing conflict between white settlers and indigenous peoples). As in *FarmVille*, players began on a modest square of unoccupied land, but in *FrontierVille* the square was conspicuously filled with mature trees and natural "debris"—thorns, rocks, grass, cacti, even bleached animal skulls—which had to be cleared before planting and building could occur.[84] Should you have assiduously cleared a quarter of your land, then logged off with the intent to later build a cabin and raise some potatoes, you would return a few days later to discover that the land you had so carefully cleared had been partially repopulated by grasses, wildflowers, and even sapling trees. If other commitments kept you away from your homestead even longer, those young trees would eventually grow to their full size and the tall-grass prairie would happily reclaim your land. Every day brought its own weather, though it was not visually reflected in the game and had little tie to the natural processes on your land. Rather, each forecast brought with it special action bonuses or gifts, seemingly random in their association, so that some days you could receive extra coins and collectibles when chopping wood, or more food when harvesting fruit trees, and so on. Finally, *FrontierVille* seasons mirrored season changes in temperate North America, with tree leaves changing color in the fall, dropping entirely in the winter (at which point snow covers the ground), and returning in the spring. Though still arbitrary in some regards, *FrontierVille* usefully modeled a much deeper game ecology that responded to change and seemed to possess life independent of the player's actions.

A third development worth some attention is the growing opportunity for people to play farm games from all over the world, simply by going online.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

Since most farm games take as their environmental template plant and animal species endemic to their region, playing a range of foreign farm games may help to educate players about unfamiliar foods, animals, and products as well as the environmental conditions necessary to their continuance. In the Chinese game *Happy Farm*, for instance, I planted carrots, turnips, peppers, potatoes, and corn and imported those raw materials into the dubiously named *Happy Factory* extension, where workers then converted them into several types of Korean kimchi, vegetable chips, and vegetable oil. In the Japanese game *Sunshine Ranch*, I planted lychee, tea, taro root, and countless gourds and melons, while raising red-crowned cranes, golden frogs, and ducks, chickens, and cattle of all kinds. Meanwhile, the original *FarmVille* still features fairly standard American fare but has increasingly ventured into more exotic species in a form of agricultural ecotourism (for instance, *FarmVille*'s English Countryside expansion [2011] offered provincially characteristic arrays of crops, flowers, and livestock, like barley, hops, cara potatoes, cornflowers, squill, and heritage sheep breeds). While games often undergo what is called "localization" as they cross into new regional markets, this localization typically refers to linguistic translation—dubbing or subtitling in the new region's primary language.[85] Localization is in fact somewhat of a misnomer, as it is an attempt to universalize a game through a bare minimum of customization. Someday, game developers may choose to devote equal time and energy to ecological localization, whether that means producing games with a distinctive regional character or tailoring games for target regions in a creative nod to the philosophy of bioregionalism. For instance, the serious game *3rd World Farmer*, which began as a student project at the IT-University in Copenhagen in 2005, arguably does the former, in its depiction of the penury and precarity of life on an imagined African farm.

A fourth and final dimension on innovation might be seen in light of ecological economics' insistence on open systems, described earlier, and the accumulating scholarship in discard studies and residual media.[86] This is, quite simply, the acknowledgment of waste, and the human and nonhuman processes that produce degradation—instead of Morton's dark ecology, a dark ludology. In farm games, this remains quite rare. In the "sustainable" town-building game, *Banished*, agriculture is seasonally dependent and vulnerable to infestation, but the game's developer has alternately implemented and removed soil-depletion mechanics and crop-rotation practices for fear of their onerousness for players.[87] In Eric Barone's delightfully referential

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

Figure 30. Grandfather's dying invocation to take over the family farm in the game *Stardew Valley*.

Figure 31. Linus happily lives out of a tent on the outskirts of town in *Stardew Valley*.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

farm game, *Stardew Valley* (2016), you can rifle through your neighbors' trash for food and many useful items, and the occasional scrap (soggy newspapers, broken CDs, broken glasses, and the like) can even be collected and repaired using a crafted "Recycling Machine." Although farming in the game remains relatively painless, *Stardew Valley*'s meticulously self-aware design makes the quixotic aspirations of its genre plain, reflected in everything from the clichéd opening narrative of escape from corporate drudgery (Figure 30) to the colorful cast of characters, among them the essentially Freegan and houseless Linus, who revels in his subsistence lifestyle (Figure 31). Linus is, in fact, the only townsperson who will not be offended if he sees you snooping around in someone else's garbage can.

Certainly, many other types of games could be productively subjected to a "dark" ludological analysis. For example, one might consider hidden-object games as operating via a visual logic of hoarding—witness antiquing games that offer the playful equivalent of the saying that one man's trash is another man's treasure.[88] Kyle Bohunicky has usefully outlined a theory of "ecomods" in discussing user-generated modifications of the game *Skyrim*, which ranged from those that added missing species to the game world to others that provided unique player services, including garbage collection.[89] All of these areas—cross-species interaction, environmental variability, ecological localization, and dark ludology—indicate exciting and original directions in game design, both within and outside the space of agricultural games.

Reimagining the Real-Time Strategy Genre

It is worth considering, in conclusion, what category of game farm games belong to, and whether or not particular game genres, not just individual games, offer more or less environmental promise than others because of their core design principles. Granted, game genres are as easily contested as genres in other areas of cultural production, like literature, cinema, or music, in part due to a confusing colloquial overlap with particular companies' aesthetic styles, intended player configurations, and technical platforms for design and distribution. Consequently, a game might be classified both as a platformer and "a Nintendo game," or a role-playing game might be doubly identified as a signature BioWare title or massively multiplayer online game. My examples thus far probably imply that some genres are innately more conducive to environmental gameplay, for instance open-world or sandbox-style games, but they also indicate that environmental gameplay spans a broad range of

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

budgets, platforms, mechanics, modes, contexts, and genres, from analog to digital, sedentary to mobile, AAA to indie. To my mind, farm games partake of several key game genres, though they are most often identified as part of the recent trend toward small-scale, "casual" and ostensibly "social" games on platforms like Facebook and Yahoo! When asked to define the nature of social games, over two dozen leading game designers and tech pundits came up with the following answers: "a game that has a very gentle learning curve, easy-to-understand UI [user interface], and lives on a social network, taking advantage of your friendships in meaningful ways within the game" (John Romero, the creator of *Doom*); "those where there is more emphasis/enjoyment playing with friends than there is playing against them. It's more about a shared, fun experience with bragging rights than classic 'winning'" (Ian Livingstone, president of Eidos); and "games that use the platforms of the social web to propagate" (Tadhg Kelly, game designer).[90] Many of the respondents felt that "social games" was a clear misnomer, because "these games tend to feel very asocial, turning people into resources rather than friends and agents you have to negotiate and communicate with" (David Hayward, indie games conference organizer), while others took issue with what is largely Facebook's and Zynga's market capture of an entire realm of game interaction labeled "social" that in many respects better describes, say, a family gathering to play *Wii Sports* in their living room, or a group of friends playing simultaneously (synchronously, rather than asynchronously) over a network on Xbox Live.

Many of these criticisms of social games' supposed sociality echo my own frustrations with the genre, particularly the lack of meaningful interaction with friends who prove useful only as senders of in-game gifts and evidence of social status—for instance, in *FarmVille*, you cannot expand the perimeter of your farm unless you have a certain number of in-game neighbors (drawn from your Facebook friends list) or you consent to pay real-world money to bypass the limitation. Social games quickly begin to feel rather asocial when the interaction is limited to annoying, asynchronous requests for help and people-gathering for in-game advancement. Again and again, should you wish to pester your friends a little less or to succeed in the game without asking your third cousins, twice removed, to join you as neighbors, the obvious option is to pay to play. Thus these ostensibly social games become not only asocial but also aggressively monetizing, leveraging social discomfort or desires for privacy for profit. Not surprising, then, is this definition of

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

social games from a managing director of a social game company in the United Kingdom: "A 'social game' is any game which uses the social graph to increase and improve the gaming experience, while utilising game theory and psychology to generate revenue from the active user base from a combination of virtual goods, advertising and offers" (Andy Rogers, enteraction).

My own contention is that farm games are a modified manifestation of the older, much more venerable genre of real-time strategy (RTS) games, the history of which has been well documented by Henry Lowood.[91] RTS games themselves evolved from tabletop and turn-based war games, and their military simulation genealogy tends to reveal itself in the consistent focus on resource management, base- and army-building, and tactical combat against either AI or, more commonly now, other players. *Dune II* (1992) and *Warcraft* (1994), often recognized as the genre's founding titles, already exemplify the strategies involved in successful RTS gameplay: extractive mineral, gas, or oil mining; lumber harvesting; using peons or civilian workers; with resources then applied toward the construction of unit-producing structures (for example, a barracks for soldiers) or technology upgrades (research and development). Oddly enough, farming is not part of this picture, as the labor forces embodied by both army and civilian corps seem to require no sustenance or maintenance beyond the initial creation and training cost.

"Real-time" in this context simply refers to a style of play that is no longer about turn-based gameplay. The quintessential turn-based game might be chess—one player takes a turn, then the other, and on and on, and as Lowood points out, this leads to a very different experience of the game based on meditation and strategic thinking. In some sense, Lowood argues, the application of "strategy" to RTS games is inaccurate, as the "real-time" genre forces players to focus more on tactics, or "micro," at an often frenetic pace in which multiple theaters of action are unfolding simultaneously. "Real-time" means both player and opponent are acting simultaneously—gaming is no longer a polite exchange of carefully calculated moves, but rather a loosely orchestrated melee that rewards quick thinking and muscle reflexes and attention to both "micro-" and "macro-" scales (terms that reflect the genre's unwitting adoption of economic metaphor). Most social games are less real-time than persistent and asynchronous, as their asynchronism is meant to appeal to casual game players who may not have the time or interest to play regularly or coordinate play times with others. Players of a word game like *Lexulous* (2008), "the first breakthrough social network game,"[92] are thus free to

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

exchange moves at their convenience, whether minutes, hours, or even days have elapsed between them.

Despite this important dissimilarity, I believe farm games, as a subset of social games, could be seen as a "civilian" outgrowth of the militarily oriented bulk of RTS games, because both kinds of games clearly model the extractive logics of resource use and development, as well as cartographic logics of mapping and terraforming. Both stress resource gathering, structure building, and the manipulation of agential units, though in a brilliant or disturbing twist, depending on who you ask, social games have engineered actual people—whoever you are linked to in an online social network—into units, rather than giving you command of imaginary troops of soldiers. Though social game companies like Zynga would prefer that players regard their games as promoting positive social interaction, connecting relatives and friends across great distances, or providing the grist for the occasional friendly competition or challenge (of the "I beat my mom at X!" variety that Jane McGonigal adores), the games are lackluster models of the social contract, let alone the natural contract Michel Serres would prefer that we enact.

Farm games are also related to any number of other game genres, including hunting games, pet-care games, and "god games," but each of these genres models a very different relationship between human and animal or human and environment. My intent is less to pin farm games to some eternal place in a genealogical tree than to tease out the various developmental influences that contribute to how such games model relations between humans and the natural world. Far from condemning hunting games as overly violent or gruesome, one might argue that they more effectively tear the veil between representation and reality, at the least making no pretense about the kinds of outdoor experience being imagined. Others might claim, in the vein of Temple Grandin or Donna Haraway, that the closest understandings of nature and other species come through the relationship between a trainer and an animal, not at the other end of a rifle or fishing rod. Still others may prefer the visions of cosmic order or chaos made possible by sandbox games like *Spore*, *SimEarth*, or *Populous* (1989), where the player is less a terrestrially bound being trying to muddle through everyday life than an omniscient, omnipresent deity hovering above the world like an invisible puppeteer. Farm games' innate resemblance to "god games" is made evident by the fact that many of the games (*myFarm*, *Happy Farm*) bypass avatar use entirely in favor of a disembodied subjectivity either meant to represent the player

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

herself or some godlike agency. In these games, the action icon alternately becomes hoe, watering can, fertilizer bag, or pesticide spray, and the player's taps or clicks translate directly to change on the field without the intermediary of a denim-wearing farmer or farmhand.

Game theorist and designer Ian Bogost notoriously lampooned the entire genre of social games, with the farm game at its center, by offering his own satirical Facebook game entitled *Cow Clicker* in 2010. *Cow Clicker* took the farm game to its absurd extreme, removing any semblance of virtual pasturage and loving husbandry in favor of the most bare-bones care imaginable. The game was stubbornly 2D, appearing as a three-by-three grid on your screen, in which, at first, only one large, blocky, cartoon cow materialized. Your only challenge was to click on the cow every six hours, in order to earn "Mooney," though if your friends joined you in the clicking of cows, their cows would appear in your grid and benefit from your attentive clicking. Resembling little more than bovine tic-tac-toe, *Cow Clicker* invited players to pay real money to customize their cow, turning it, say, plaid or virulently purple, all in the name of meaningful individuality (my cow was a cheap, dusty yellow, because I barely had any Mooney). Bogost deliberately thumbed his nose at the laughably basic mechanics behind most "casual" or "social" gameplay—repeated clicks or taps, at arbitrarily set intervals (for example, in *FarmVille*, why does rhubarb takes sixteen hours to mature while wheat takes twelve? And raspberries two? Who gets to determine that?)—and by making the game's commercialization so blatant, also poked fun at the constant incentives to players to invest more heavily in their virtual agricultural experiences. What may be surprising is that millions of players took to *Cow Clicker*, whether in support of its antiestablishment ways or because of a genuine love for the game, leading the game to offer its own "swag" (*Cow Clicker* T-shirts and mugs) and increasingly bizarre custom "skins" or graphics for its bovine avatars (my favorite was perhaps the ASCII cow, rendered entirely in punctuation marks).

Perhaps it is too easy to dismiss farm games as trite, all-too-evident attempts to milk players for money. Perhaps Ted Friedman was right to praise *FarmVille*'s gift economy, or what alternate-reality game designer McGonigal has called "a virtuous circle" rather than the vicious ones we all abhor. While McGonigal has enough sense to admit that playing *FarmVille* is "not a good substitute for real interaction," she does believe that games can "build stronger social bonds and lead to more active social networks."[93] She urges the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

creation of games that generate "prosocial" emotions, as well as games that "make us part of something bigger and give epic meaning to our actions."[94] McGonigal's focus is on social interaction, what people or more specifically gamers can accomplish when they put their heads together, with the support of a game scenario or framework that helps them to organize their activity and measure their progress. My own concern with games as environmental constructs might add to this the importance of player context and perspective—less a desire to bypass human agency and intention than a call to wonder actively at the place of such agency within natural, physical environments, whether real or virtual. As we struggle to come to terms with the scale of environmental change and injury, games that make the leap from single-player to multiplayer, that channel the collective, social action of players toward more than just virtual farming or wordplay, may show us the way past apathy and individual limitation. Yet in keeping with this chapter's focus on entropy and excess in capitalist production, the next and final chapter follows disorder to its extreme conclusion: games as worst-case scenarios.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:13 UTC
All use subject to https://about.jstor.org/terms

5

Collapse

It's more than climate change; it's also extraordinary burdens of toxic chemistry, mining, nuclear pollution, depletion of lakes and rivers under and above ground, ecosystem simplification, vast genocides of people and other critters, et cetera, et cetera, in systematically linked patterns that threaten major system collapse after major system collapse after major system collapse. Recursion can be a drag.

—DONNA J. HARAWAY, *Staying with the Trouble*

Real life, you may have heard, has permadeath.

—RICHARD ALLAN BARTLE, *MMOs from the Inside Out*

Collapse is where many would expect a book about the ecology of video games to begin, given the recent prevalence of dystopic and postapocalyptic games like those in *The Walking Dead* (2012–), *Silent Hill* (1999–), and *Fallout* (1997–) series, the first and second *Bioshock* (2007, 2010) games, *The Last of Us* (2013), *The Flame in the Flood* (2016), and the online multiplayer game *DayZ* (2013), to name just a few. Interlinked social and environmental breakdown are notably central premises of certain game genres. Thus survival horror and action-adventure games share a tendency to insert players into hostile environments—for instance, deadly cold in *The Long Dark* (2017)—often populated by creatures run amok, from once-human zombies to feral animals. Although the root cause of these grim scenarios varies (common ones include a rogue biological agent, nuclear Armageddon, otherworldly demons, or good old-fashioned human greed and megalomania), games in these genres frequently place players on the defensive in lawless worlds where both nonhuman nature and people are dangerously

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

unpredictable. In such games, success may be defined in the barest of terms, such as procuring adequate food, water, and shelter, and personal downfall awaits even minor mistakes. Sandbox, or open-world games are also fundamentally concerned with collapse, although on a larger and more structural scale. As I will discuss momentarily in relation to destructibility ratings, it is the theoretical ability to visit ruin upon one's game world that makes sandboxes so sandboxy, whether or not one exercises the option. We might recall here how Will Wright demonstrated the extent of *Spore*'s capacities during a TED talk (chapter 2), by essentially setting a planet on fire.

Of course, collapse figures in games beyond strictly environmental modes and narratives. All games arguably derive their exigency from the initial posing of a problem that needs fixing, as well as the threat of failure without player action: repair a broken spaceship before life-support systems fail (*Pikmin*), find food before your stomach empties (*Don't Starve*), or build a shelter before night falls and monsters emerge (*Minecraft*). The idea of collapse may seem a touch dramatic when applied to the casual puzzle game or side-scroller, but as anyone who has ever played a children's game of pick-up sticks or the wooden tower game Jenga could attest, gravity is one of the very first constraints we encounter in elementary play. In other words, things fall, be they blocks or civilizations. Here I conflate the physical and moral senses of the term *collapse* in part because games also do so, in ways reminiscent of the vertical symbolism in recent cinematic digital effects.[1] Etymologically, collapse means to slip or fall together, as when a house of cards tumbles into a loose pile. In ecology, collapse refers to system breakdown, or failure, and thus is often associated with a rhetoric of "the point of no return"—push a habitat or a species too far past its carrying capacity or abilities to adapt, and we may lose it entirely, no matter what we do to stop it. To put these meanings of collapse side by side is less to belabor the obvious disaster motifs in contemporary games than to imagine, like Donna Haraway, how we may "stay with the trouble" in a time of unprecedented environmental crisis. If we are going to fail to keep the average global surface temperature from increasing over two degrees Celsius this century, or to save incalculable species from extinction, including our own, at least we can fail together. But Haraway refuses to wash her hands of intractable problems, urging us to cultivate response-ability and ways of becoming-with other critters. As usual, she is right. We hardly need another book about catastrophe. What we do need is a way to carry on and find productive modes of being even in a compromised situation.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Although spectacles of player and game-world death will feature prominently in the pages ahead, this chapter is less about apocalypse or post-apocalypse than it is about failure. Failure is certainly more apropos for the kinds of environmental challenges we are facing in the present, which are crises of our own making, since apocalypse implies a fate visited upon us by some higher power beyond our control. Thus while studies of disaster movies, dystopian science fiction, cyberpunk and new weird literature, and theological approaches to the end of the world are all potentially relevant, in approaching the collapse of game environments I am especially drawn to theorizations of failure by the queer theorist Jack Halberstam and games scholar Jesper Juul (also discussed in chapter 2). For both Halberstam and Juul, failure is an art worth cultivating. Echoing Bernard Suits's well-known definition of gameplay from *The Grasshopper* as "a voluntary attempt to overcome unnecessary obstacles," Juul emphasizes the mingled pain and pleasure of losing and failure as an impetus to the development of player skill and resiliency. Halberstam tries to reorient queer negativity, or the refusal of the sunny, normative aspects of mainstream queer culture, through a more generous understanding of failure, be it of convention, intelligence, memory, or continuity. Though not concerned with games directly, Halberstam makes these points primarily through lowbrow popular texts, and in particular, children's animation, and recognizes that "failure preserves some of the wondrous anarchy of childhood."[2] For Halberstam, the realms of cartoon imagination are replete with narratives and forms that contest the business-as-usual of progressive heterosexual teleology through multifarious animal-human relations and radical kinship collectives. Going forward, both Halberstam and Juul will assist us in acknowledging the mixed affects of failing and in wondering, at the same time, by whose standard are we failing? If success in modern times—in the form of enormous houses, piles of stuff, and investment portfolios—has contributed to our current predicament, perhaps failing is the only sane option.

Keeping failure in play is one way to remind ourselves that collapse has an internal logic, one that does not allow us conveniently to displace responsibility onto external forces. Collapse happens from within, even if at times it is inevitable, like the deflating of a soufflé fresh from the oven. Instead of simply seeing falling and failing as isolated incidents and collapse as a complex aggregate, we can think about failure and collapse as two points on a continuous spectrum. While we typically conceive of failure in personal

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

terms and collapse in more systemic ways, this chapter will explore how failure, particularly environmental failure, links collective action or inaction to the types of cascading organizational faults at work in the worst natural and human-made disasters. Together, failure and collapse encourage trans-scalar examination (chapter 2) and reinforce the idea that games are both economic and ecological systems (chapter 4). What may prove more fascinating than disaster is what Naomi Klein has called disaster capitalism, or the way that corporations and governments take advantage of emergencies like Hurricane Katrina to assert greater control and reap profits through the monetization of basic services.[3] Many of the components of disaster capitalism are present in the production and play of some of our most cherished games. And if financial institutions can be deemed "too big to fail" while individual bodies can experience collapse, whether from fainting spells or death from the "complications" associated with a condition, it is clear that assigning or taking responsibility is a tricky affair. What follows is therefore a kind of secular eschatology of environmental end-times as seen through the popular culture of games. Because games archetypally foreground player agency, the questions posed by collapsing or collapsed game worlds are helpfully not just "What is happening?" or "What happened?" but more important, "What am I (or even better, are we) going to do about it?"

In fact, despite its name and place in the order of things, this final chapter is not so much about endings as it is about beginnings, or how we make a start in the face of looming or already elapsed calamities. We will therefore need to distinguish carefully between varieties of apocalyptic imaginings, as some envision futures in which humans are noticeably absent, while others pin their hopes on a small number of survivors. It will also be necessary to consider how different cultural forms constrain what environmental changes may be presented. Amitav Ghosh, author of *The Hungry Tide* (2004), recently penned a nonfictional treatise in which he wonders at the lack of climate-change fiction in the literary canon.[4] Although Ghosh acknowledges that poetry and science fiction have more commonly taken up this charge, its omission in his chosen genre of the realist novel he finds scandalous given the increasing regularity of extreme weather. Ghosh reasons that the failure of the novel to come to terms with the improbabilities of climate change may, in part, stem from the novel's period of origin, in that it came to maturity at the very time when carbon was first being delivered into the atmosphere at an unprecedented rate.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Unlike the realist novel, digital games developed in tandem with some of the worst excesses of late capitalist economies as well as growing concern over human environmental impact. In a reversal of highbrow novelistic convention, games routinely indulge in the counterfactual and the cataclysmic, and players not only bear witness but are also encouraged to tinker with, jury-rig, exploit, expend, and intervene in game environments. Close cousins to the thought experiments of science fiction, contemporary digital and analog games are similarly overlooked by critics despite being generically suited to Anthropocenic storytelling. Yet rather than indulge wholeheartedly in what Greg Garrard has labeled disanthropy, namely the desire for a world without us, games like *The Last of Us* or *The Flame in the Flood* give us worlds with far fewer of us—a seemingly slight distinction, but an important one. Games like these often invite religious interpretation, but the difficulty of sorting who has been saved from who has been left behind quickly muddies scriptural clarity. After all, a hero or heroine that still lives amid the ruins of human civilization fits the usual ludic exceptionalism of most games, yet the punishing and vaguely masochistic nature of survival games calls into question the typical pleasures of play.

Is it even possible to play a game without us, that is, humans or humanoids of any kind? Presaging Ghosh's anxiety over the failure of fiction to grapple with climate change, Garrard muses about the relative formal abilities of various media to portray human absence:

> The helpless allegiance of written genres to narrative voice and anthropomorphic characterization makes disanthropic literature conspicuously self-contradictory, and probably impossible. In film, though, the ostensible impersonality of the camera—its mechanical indifference, even—makes it possible to bracket out both humans as objects and, to some degree, the human subject in its most obtrusive forms.[5]

We might extrapolate Garrard's tacit criteria to contemplate whether or not video games share with literary works a fundamental impediment to telling disanthropic stories. Like cinema, video games partake of the mechanical objectivity of a technical apparatus,[6] but as in literature, most games revolve around players embodying characters and the attendant demands of progression, or plot development. Without plunging into the old narratology versus ludology debates about games' positioning vis-à-vis other media, I contend

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

that nothing per se keeps games from offering opportunities for disanthropic play. Remember *Flower* (chapter 1), *Spore* (chapter 2), and *Mountain* (chapter 3)? Other disanthropic games not yet discussed include the PlayStation 3 title *Tokyo Jungle* (2012), in which you play diverse critters in a postapocalyptic future Tokyo, or the Nintendo 64 game *Space Station Silicon Valley* (1999), in which you remotely control a sentient microchip that jumps from robotic animal to animal in a space-station safari park gone rogue. While no game as of yet matches the austere rigor of Garrard's favorite disanthropic example, Michael Snow's film *La Région Centrale* (1971), some come close, like Ian Bogost's meditative *A Slow Year* (2010), created for the Atari 2600, which he describes as a videogame chapbook of four "game poems," one for each season.

Before turning to disanthropic games that explicitly confront individual and species death, whether of humans or other creatures, first we must take a closer look at the ways in which video games figure environmental damage. Games are already notorious for their spectacular depictions of violence, most often directed by players at other players or against in-game characters. However, environmental destruction is increasingly featured in games' lists of selling points—what pundits refer to as their degree of "destructibility." As I will argue, destructibility merits our attention but it also diverts us from less extravagant forms of game violence. Further, just as naïve media-effects arguments habitually ignore the capacity of violent material to produce antiviolent sentiment, playing at ecological disaster in games may actually strengthen our belief in the reality and fixity of anthropogenic environmental harm. Games turn out to be fit vehicles for envisioning the "rambunctious gardens" of a "post-wild" future,[7] marked by multispecies entanglements and obligations (chapter 3).

Violence Fast and Slow

A giant tsunami is surging toward the tiny village I have nurtured, perched on a sandy archipelago in the middle of the ocean. The native islanders grow frantic, but there is no higher ground to which they might flee. As their player-god, I draw a mighty breath to repel the wave as it bears down on the village, and for a time, the waters part. The villagers run back and forth in front of the cylindrical wall of water, exclaiming. Quickly, however, the water rises so far that even the protection of divine breath cannot hold. Seawater pours into the opening, the village is washed away, and tiny human figures can be seen taken by the flood. As they say, nature abhors a vacuum. Such a scene is

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

surprisingly common in the Ubisoft Montpellier game *From Dust*, designed by Éric Chahi and marketed as "A Modern God-Game Where Nature Is the Star!"[8] In order to receive top billing, nature apparently must be a showboating performer, less about tiny and incremental changes than massive upheaval by quake, eruption, fire, and torrent. As set forth by the terms of this book, *From Dust* is undoubtedly a violent game, yet by ordinary standards it is considered family-friendly fare. Even a parental watchdog organization like the nonprofit Common Sense Media rates the game highly (four out of five stars), marking it as appropriate for kids ten and older and noting that although the tribespeople do perish, "the camera's nearly stratospheric location means these deaths are never graphically depicted."[9] In the category breakdown under "What Parents Need to Know," *From Dust* receives just a two out of five for violence, which according to the site's reviewing guidelines means there is not even a "fair amount" of violence in the game (for comparison, the popular party game *Mario Kart 8* [2014] for the Nintendo Wii U also received a two out of five for "Violence & scariness," yet is rated appropriate for ages six and up).

Anyone involved with the design or study of games knows that for decades, violence in video games has been a fraught topic, and certainly the one most intensively covered by mainstream media outlets. Games like *Grand Theft Auto* and *Call of Duty* regularly come under congressional examination after mass shootings such as those in Columbine, Colorado, in 1999 and Newtown, Connecticut, in 2012. In June 2011, the Supreme Court struck down a California law prohibiting the sale of violent video games to minors, ruling that games, like gruesome fairy tales, are constitutionally protected forms of free speech, yet politicians and self-professed experts continue to press legislative action over video game violence and its potential effect on minors and pathological individuals. Video games and other forms of screen violence almost always bear the brunt of public and official reprisal, rather than lack of services for the mentally ill, cultural glorification of military strength, and the distinctively American rhetoric of survivalism and frontier individualism. Yet my concern here is less that games are too convenient a scapegoat for heinous acts committed by armed killers, than that the obsession with players maiming or assassinating virtual enemies has obscured other, equally important forms of game violence. Without exempting games from necessary scrutiny of their often extreme and tasteless interpersonal violence, what might we gain by leaving behind the perpetual struggle over First and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Second Amendment rights? One could productively argue that limiting the definition of violence to the kinds of spectacular brutality common in fighting, action-adventure, and shoot-'em-up games—that is, overt and graphic physical harm generally committed by humans against other humans—ignores the reality that a different and more pervasive violence is constantly being perpetrated in today's world, what Rob Nixon has called the "slow violence" of environmental destruction and cumulative toxic effects.[10] More games feature worlds or environments that incite aggressive modification than are violent in the conventional sense, even if they frequently mask these less sensational but just as destructive sorts of violence, for instance by severing industrial and commercial activity from the social and ecological realities of labor, pollution, and waste (chapter 4). This suggests that a disproportionate amount of attention has been paid to a particular type (violence) and subtype (graphic violence) of game material, without considering a broader and in many respects more pertinent aspect of games, namely their environmental content.

Because the previous chapter on entropy in many ways dealt with ecological slow violence and its omission in games (such as farm games' disregard for the gradual salinization of soil through irrigation), this chapter will dwell on the catastrophic environmental scenarios admittedly more prevalent in games. Rather than simply condemn the lack of subtlety in the forms of nature play found in *From Dust* and other games, I propose that players might use these outlets, crude as they may be, for purposes ranging from education and disaster preparedness to emotional catharsis and pleasurable amoral aggression. As students of game collapse, our objective going forward will be to look beyond anthropocentric violence to other ways in which virtual game worlds duplicate as well as disavow human and nonhuman social and material worlds. In *From Dust*, for example, several contradictory impulses complicate any straightforward reading of the game as exalting human dominance over the natural environment. For one, the humans in the game are largely secondary, at the mercy of both the player's abilities and natural forces. Although the game's story mode positions the player as a benevolent god charged with using elemental powers to tend nascent human society, as a sandbox *From Dust* also clearly invites destructive environmental play. YouTube videos abound of *From Dust* players subjecting their tribespeople to eradication by wave, lava, fire, and tremor, yet everyone seems to feel such behavior is all in good fun. Again, oddly, the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

stereotype of violent content in games leaves environmental havoc aside as innocuous by comparison, even when it involves "people" like us. In an entirely different vein, Kotaku's editor-in-chief Stephen Totilo briefly reviewed *From Dust* as a balm to our collective sense of environmental violation, with the lead "After a Year of Natural Disasters, A Game That Lets Us Fight Back."[11] Totilo's review appeared at the end of July 2011, amid unusually extreme weather including unprecedented drought in eastern Africa, numerous tornadoes in the United States, and record flooding in Thailand. Granted, he makes no mention of any specific events, but it is likely that high in his mind was the March 11 earthquake off the coast of Japan and the subsequent tsunami and nuclear plant breach at Fukushima. Thus in the nine-and-a-half-minute gameplay video that he shares to tantalize readers, Totilo repeatedly saves his villagers from both tsunamis and volcanic eruptions, presumably making good on his headline's promise.

Interestingly, environmental catastrophe can also feature prominently in the so-called "persistent" worlds of massively multiplayer online games, as in the third expansion for Activision Blizzard's immensely popular *World of Warcraft*. In this 2010 expansion, called *Cataclysm* (usually abbreviated to *Cata*), the existing game world of Azeroth was dramatically altered in a global breaking known as The Shattering, caused by the escape of the astral dragon Deathwing from the elemental planes. For perhaps the first time in any MMOG's history, the game's starting geography was radically transformed, rather than merely added onto in the customary logic of content agglomeration. Where earlier expansions had taken *WoW* players off-world to a demon-ridden Outland (*The Burning Crusade*, 2007) and then to the new continent of Northrend (*Wrath of the Lich King*, 2008), in *Cataclysm* once sleepy and familiar low-level zones like the night-elf starting areas of Darkshore and Ashenvale were completely made over by geotectonic forces. Throughout Azeroth, some land masses rose while others subsided, giant fissures appeared overnight, and swaths of desolation followed upon the attendant eruptions, landslides, and tidal waves. Some zones changed their character entirely, as when the formerly parched Shimmering Flats area of Thousand Needles, previously home to tortoises, scorpions, vultures, and the like, was completely flooded and thereby renamed the Shimmering Deep. Although players could in theory read the worldwide cataclysm wholly in mythical terms, as the destruction wrought by a vengeful god of old, to do so they would need to willfully disregard the obvious environmental

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

resonances of Deathwing's impacts. In the Badlands, for instance, Deathwing's passage left a swath of scorched earth referred to in-game as the Scar of the Worldbreaker, marked by smoldering, decapitated red rock formations that strongly evoke mountaintop removal techniques in actual mining regions. Coastal Alliance towns like Auberdine in Darkshore and Menethil Harbor in the Wetlands were also destroyed or flooded by sea-level rise (Figure 32).

Cata also notably allowed *WoW* subscribers to play goblins (Horde) and worgen (Alliance) for the first time, races that had long embodied technological exploitation and untamed nature, respectively, in the *Warcraft* universe. Worgen are essentially magical werewolves descended from druids who lost themselves in their creaturely forms, while goblins are cunning, mercantile engineers, organized into cartels and prone to large-scale terraforming and resource extraction operations. In this expansion, the goblins took over the once remote autumnal wilderness zone of Azshara and reshaped it to look like the Horde symbol from above, and instituted extensive mining and building operations, including the trade prince's golf-course-style "pleasure palace." To get a sense of the inveterate goblin ethos, consider that elsewhere in the game, in the Tenebrous Cavern in the Abyssal Depths zone of Vashj'ir, a goblin nonplayer character by the name of Fiasco Sizzlegrin sheepishly gives Horde players a quest entitled "Environmental Awareness." Evidently of two minds, Sizzlegrin enlists the player's help with finding a more sustainable source of fuel for the goblin submarine *Verne* (piloted by Captain "Jewels"),

Figure 32. Sea-level rise claims the Alliance town of Menethil Harbor following the global environmental upheaval of *World of Warcraft*'s 2010 expansion *Cataclysm*. Image credit: John Mark Josling.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

first lamenting "I don't know about you, but I really miss the unlimited raw materials that were down in the ruins!" but then conceding that the ship's current fuel is "both bad-smelling AND deadly to the local wildlife. We need to be more environmentally conscious." If the player dutifully returns with the desired samples, Sizzlegrin is satisfied but also implores "Please . . . don't tell the other goblins that I'm an environmentalist! I don't think I can take the mocking!" Curiously, the Alliance version of this quest, although suggestively called "Bio-Fuel," does not advance the same environmentalist agenda. Many critics have already remarked on the cultural stereotypes of *Warcraft* player races[12]—the Native American tauren, Jamaican trolls, Chinese pandaren, and so on—but plainly the franchise's ongoing saga of racial strife is also undergirded by a long environmental history in which Azeroth's various factions have conveyed their politics through their treatment of game environments. *Cata* thus derived much of its initial shock value not only from Blizzard's brazen refashioning of remembered landscapes, but also because a host of forces (apocalyptic Twilight's Hammer cultists, warlike orcs, and technology-obsessed goblins) conspired to directly assault the previously sacrosanct nature preserves of the vaguely Shintoist night elves.

What may be surprising to those who have never played a game like *WoW* is that many players expressed grief over the loss of these places, and some even took the time to document them in advance of the expansion's release. Take the YouTube user "Wowprecatarchive," who posted thirty-one videos of soon-to-be-altered areas over three and a half weeks in August and September of 2010, about four months before the expansion's release but well after its first teaser at the 2009 BlizzCon. Although even the most trafficked video of "Auberdine, Darkshore—Pre-Cataclysm" has only a little over three thousand views as of writing,[13] the comments below it are telling in their overall tone. The first to comment ("BlitzenXmas") effuses "thank you for uploading this, this is my fav town. Why couldn't Blizz just leave Auberdine and darkshore alone!!! It was so quiet and peaceful. Because of the new game I'm quitting," followed by a request to reuse the clips in his or her own "goodbye video." A number of years later, in 2014, several commenters apparently find the video and leave mournful emoticons and messages, like "Mirror" with "Wow just wasn't the same anymore after Cataclysm. / Auberdine (Darkshore) was my favourite area of the game. / rip." Comments continue to accrete even now, from a hopeful request for clips of other removed content, to a terse testimony recalling the original "vanilla" *WoW* ("+battlemonk" with

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

"2005 i was there"), to a plaintive-sounding "Austin Aagard" with "Who's here in 2017?? I miss this zone." User "ciscoponch67" neatly sums up this overpowering sense of nostalgia and bereavement with the following lengthy expression of gratitude: "Thanks, for this video. I've been wanting to see the pre-catyclysm areas sooooo badly. I really needed this. I loved how beautiful the lands in kalmidor were before the expansions. This video brought back soooo many fond memories. Thankyou soooo much!!!!" When researchers studied the impact of childhood nature experiences on adult environmentalism, they found that "the single most important influence on individuals that emerged from these studies was many hours spent outdoors in natural habitats during childhood or adolescence—alone or with others." However, they went on to note that "other important childhood experiences included the example of parents, teachers, or other adults who fostered an interest in nature; scouting and camping; hunting and fishing; *witnessing the destruction or alteration of landscapes or habitats*; and *media or books*."[14] Without being limited to children, *WoW*'s experiment in worldbreaking with the *Cataclysm* expansion could be seen as combining media influence with the force of seeing precious landscapes destroyed. Little to no data exists on *Cata*'s impact on environmental attitudes, but we should at least wonder at this outpouring of emotion over virtual geography, articulated through countless video memorials, forum discussions and blog posts, fan artworks, and even fan fiction. Many players believe that *Cata* dealt the deathblow to *WoW*'s popularity, noting that the game's subscriber base was over 12 million strong in 2010 before *Cata*'s release but declined sharply thereafter, and though this was likely a matter of coincidence rather than causality, how many players *did* abandon the game upon seeing their "newbie" haunts reworked?

The *Cataclysm* expansion merits further study both as an instance of widespread environmental redesign in a persistent game universe and as a simulation of global catastrophe. Educators looking to impart climate change's predicted geopolitical effects on Earth can find a model in the opportunistic invasions that accompanied the sweeping changes in Azeroth's landscapes, with the now hostile Horde forces and other Alliance enemies quickly moving to deforest and mine newly vulnerable lands. Historically we are conditioned to think of warfare as originating in the cultural spheres of religion, politics, and social customs; however, in 2007, then United Nations Secretary General Ban Ki Moon famously described the genocide in Sudan's Darfur region as the world's first climate-change conflict, arguing that "Amid the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

diverse social and political causes, the Darfur conflict began as an ecological crisis, arising at least in part from climate change."[15] A paper published in the *Proceedings of the National Academy of Sciences* (*PNAS*) in December 2009 calculated that armed conflict could increase up to 54 percent in sub-Saharan Africa by the year 2030, linked to the rise in temperatures. The authors acknowledge that economic well-being remains the single most important factor in civil and transnational conflict, but nevertheless stress "a large direct role of temperature in shaping conflict risk."[16] Although clear-cut ties between warming and armed violence may be elusive, there seems to be little overall controversy about more indirect connections, for instance through temperature-associated water scarcity and failures in agriculture. Social scientists have long understood that rates of many types of violent crime exhibit seasonal fluctuation and are often highest in the summer,[17] and one cannot help but wonder what a worldwide fever will do to territorial tempers.

One final distinction that *World of Warcraft* helpfully exemplifies is that between two characteristic modes of play: PvP, short for player versus player, and PvE, or player versus environment. This terminology probably arose with early multiplayer online games,[18] and nowadays it is standard practice for MMOGs to offer predominantly PvE servers or shards and just a few PvP ones that cater to subscribers looking for less restricted player-killing. Essentially, in PvE, a player need not worry about being ambushed, ignominiously killed ("ganked"), or otherwise griefed by other players, although they share the game world. Apart from designated PvP areas or contests, the focus is on completing game objectives and progressing against nonplayer characters, for instance, by slaying monsters. In PvP, the same game objectives still exist, but the threat or thrill of player persecution adds greater risk to one's experience. While this jargon applies only hazily to other kinds of games (Is *Scrabble* PvP? Are all single-player games PvE, even ones that feature an AI opponent?), I am consistently struck by how the label "player versus environment" stands in for a more congenial and collaborative form of play, despite the stark pitting of human players against practically everything else. For me, being conversant with the term does not prevent it from conjuring a comical vision of games as X-Men-style danger rooms in which players square off against convincing computer-generated scenery. In other words, PvE rhetoric unintentionally glorifies solo and social play at the expense of a more robust notion of game environments, in a ludic instantiation of the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

old proverb that the enemy of my enemy is my friend. Yet historically speaking, PvE was the de facto mode of most computer and console gaming before networked online play became commonplace.

At its crudest, the PvE mindset manifests every time a game encourages a player to mindlessly shoot open a box, bash a barrel to smithereens, or otherwise demolish probable containers to get at what's inside, usually money, weapons, or useful supplies. Loot crates and conspicuous vases are, of course, a flimsy narrative pretext for player augmentation, and this environment-as-utility-belt mentality (or Heideggerian *vorhandenheit* and *zuhandenheit*, if you prefer) is, as I have already argued in earlier chapters, common to the normative view of games as vehicles for player progress.[19] Today, however, PvE has assumed a new and even more disturbing form, through its metonym, *destructibility.* There are obviously many other ways to interact with or take notice of game environments, but depressingly, game reviews now celebrate the "environmental destructibility" level of titles, regularly assembling "top-x" lists of such games as *Far Cry 2* (2008) and *Battlefield: Bad Company* (2008) because in one, you can start brush fires, and in the other, you can demolish buildings. Back in 2011, one writer had ventured to diagnose "a general lack of satisfaction beginning to creep in with the humble FPS. Blowing people up is no longer enough; players who want to vent frustration need to be able to blow stuff up as well."[20] But by 2014, another returned from the industry showcase E3 satisfied that "environmental destruction has come a long way in gaming."[21] Scenic havoc had apparently reached its pinnacle in *Battlefield 4*'s "levolution" mechanic, which allowed players to trigger map-altering events like a dam bursting, skyscraper collapsing, or gas line exploding, given enough ammunition or incendiary material. Advertised by developer EA DICE as "breath-taking game-changers,"[22] these levolution events at the least primed players to approach game maps as potentially modifiable. Upon the game's release in 2013, players rushed to determine how to bring about the levolution event on each map, although not all of them granted strategic advantage—some open up different paths for infantry or change lines of sight, but others seem to be included purely for show. Perhaps the most dramatic occurs on the map helpfully entitled "Flood Zone," where players can breach a levee and turn the Chinese urban scene into a watery tableau, necessitating boats instead of land vehicles and engagement via canal and rooftop rather than the streets. A generous environmental reading of levolution might praise the mechanic for introducing a more improvisational style of play to

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

the first-person shooter and encouraging players to take greater account of the game's terrain, insofar as that could yield advantages or an extravagant show. However, I remain skeptical about these extreme forms of PvE, or player versus environment, gaming. What we truly need are games where the player is in, of, or *with* the environment.

As the *Battlefield 4* example demonstrates, environmental destructibility often goes hand in hand with armed conflict, just as collapse usually follows both social and ecological states of exception. In *Battlefield 4*, sites formerly designated for civic, commercial, scientific, or military-industrial use (such as offshore windmills, a city center, a radio telescope, or an abandoned tank factory) become host to pitched battles between the Russians, Americans, and Chinese, eerily reflecting experts' predictions that climate change and extreme weather will exacerbate international and internecine clashing. Not by accident do the game's multiplayer levels evoke actual disasters ranging from Hurricane Katrina ("Flood Zone") to 9/11 ("Siege of Shanghai") and a high-security prison straight out of the musings of Jeremy Bentham ("Operation Locker"). Put in terms of game design, I find it likely that the once distinct modes of PvP and PvE will continue to converge, not just because networked online play is more readily available now or because games themselves have become more complex, but because mastery over nature and mastery over other people are increasingly one and the same thing. That is why, despite political stalemate over climate change in Washington, D.C., U.S. military leaders consider global environmental change very worrisome for national security, and accordingly have made deep-pocketed preparations for everything from sea-level rise to oil scarcity.[23] One 2016 report published by the Union of Concerned Scientists, entitled "The US Military on the Front Lines of Rising Seas," for instance, warns that the Department of Defense stands to lose billions of dollars as higher coastal waters threaten military installations, many of them naval, such as the Naval Air Station in Key West or the largest naval base in the world in Norfolk, Virginia.[24] Someday in the not-so-distant future *America's Army* and other first-person shooters may embrace scenarios in which U.S. troops are forced to defend water rights against thirsty (not just bloodthirsty) neighbors, or take part in generational feuds over vanishing arable land.

Any spectacles of environmental violence inevitably raise the question of whether mediated catastrophes serve a prophylactic function, while inuring us to the growing likelihood of ecological ruination, or whether such showy

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

displays actually detract from environmental messaging, as Robin L. Murray and Joseph K. Heumann have argued in relation to cinematic "eco-disaster."[25] Subsequent to his well-known theory of remediation (developed with Jay David Bolter), Richard Grusin has reasoned that media now play a more defensive, *premediating* role, particularly in the wake of the extensive television coverage of the first Gulf War and the attacks of September 11, 2001.[26] Grusin identifies news media in particular—by which he means not just newspapers and television, but also social media—as obsessively rehearsing calamities both before and after the fact, in order to prepare us for them and future shocks of a similar kind. Thus in the run-up to Hurricane Sandy's landfall on the New Jersey and New York coast in 2012, meteorologists, government agencies, newscasters, and bloggers zealously tracked the storm's every move and tried to anticipate everything from its path and intensity to its probable toll in dollars and lives. For Grusin, such behavior points to "the way in which the temporality of news media has shifted from a focus on the present and recent past to a focus on the future."[27] Yet he cautions against treating the latter as somehow less real than that which has already transpired, observing that premediation may help call things like states of emergency and mass evacuations into being. Indeed, in commenting on "superstorm" Sandy, he remarks that "disaster and catastrophe are always and already forms of premediation." And while premediation does not prevent disaster per se, it "works to prepare people affectively for what might be coming."

At first glance, games seem to lack an important qualification for premediation because they deal with imagined events. Yet premediation by definition deals in the realm of possibilities, not all of which will be realized. However, whether Grusin's term is an appropriate descriptor of games presenting environmental collapse or not, such games patently draw from the same cultural imaginary that fuels the premediating tendency. Already, we have seen that a game in which natural disaster figures centrally may still operate in a compensatory or therapeutic fashion—recall Stephen Totilo, the editor-in-chief of Kotaku, and his satisfaction in playing *From Dust* during a year of extraordinary environmental catastrophes. As Totilo's stance suggests, so-called "god games" like *From Dust*, *Spore* (chapter 2), or *Black & White* (2001) provide an instructive contrast to the environmentality of first-person shooters, because they task the player with the design and responsible management of human settlements through terraforming and other celestial

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

interventions. But before we make too much of the god game's loosely faith-based environmental stewardship, let us also recall that at times players happily subject their creations to divine eradication. I vividly remember playing Bullfrog's *Populous* on the PC and raising massive volcanoes in the middle of encroaching colonies (earthquakes, swamps, floods, and even Armageddon itself were also options, the last destroying all buildings and summoning every follower for a final reckoning). Part of the fun of playing a god, in other words, is the freedom to enact either benevolence or retribution. If we think of benign alteration and malicious destruction as different only in degree, rather than kind, we could conclude that the recent destructibility innovations of the first-person shooter are simply converging with the long history of deity-in-a-sandbox games.

One final god game that bears more than a passing mention in regard to premediation is Maxis's *SimCity*, as well as its various successors, some of which were produced after Electronic Arts acquired Maxis in 1997. Like *The Sims*, the *SimCity* series is well represented in the academic literature on games, with scholars mulling over aspects ranging from its utility in teaching urban planning to its simulation of weather and crime rate.[28] Most relevant here is the game's inclusion of a wide palette of potential disasters, including tornadoes, earthquakes, fires, nuclear meltdowns, and alien invasions. Disasters occur randomly during the course of play, but they can also be activated by the player (as mayor) after certain conditions have been met. In the remastered *SimCity* (2013), for example, access to the earthquake disaster is given after the player mines 100 tons of coal or ore (in an achievement entitled "Dug Too Greedily and Too Deep"), while access to the tornado disaster ironically follows upon the more sustainable achievement of having twenty-four wind turbines at renewable power plants ("Blowin' in the Wind"). Although we ought to dispute the term "achievement" in relation to licensing such wanton destruction, *SimCity* amusingly walks the line between active and passive premediation. In all the *SimCity* games, disasters also serve as the linchpins of preconstituted levels based on real cities and events, among them an unsettling global-warming scenario in the original *SimCity* called "Rio de Janeiro, 2047," which models sea-level rise through recurrent floods along the city's waterfront. Decades before the shameful municipal water crisis that led to numerous deaths and an outbreak of Legionnaires' disease, Flint, Michigan, was likewise featured in *SimCity 2000* (released in 1993), although at the time the player's challenge was just to grow the city's population from

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

10,000 to 21,000 within five years in-game. Unsurprisingly, most analysis of the *SimCity* games revolves around its city-management toolkit, with disasters seen as merely adding a stochastic element and pretexts for organized response. Games and learning specialist Kurt Squire emphasizes that sandbox games like *Civilization III* (2001) and *SimCity* are less educational cure-alls than enjoyable contrivances that must be properly contextualized to produce learning outcomes. For instance, students need to recognize that the game's simulations are by necessity simplistic, and that the general principles matter more than the particulars. Squire's caveats thus echo Rob MacDougall's experiences with using games to teach history, where *Civ* and games like it are patently less useful for their stereotyped portrayal of ancient civilizations and their leaders than as tacit proof that history is both malleable and contingent.[29] As Squire notes, *SimCity* players knowingly indulge in this mixed reality:[30] "As Doug Church commented at the 2002 Electronic Entertainment Exposition, most people who have played SimCity recognize that it can be an excellent resource for understanding urban planning, most people would also not want to live in a real city designed by someone who has only played *SimCity*."[31] Put another way, becoming an expert player of *SimCity* only goes so far, delivering the broad strokes of city planning with little of the fine detail.

At the same time, *SimCity*'s disaster-prone metropolises are proving uncomfortably close to our current reality, so much so that the game creators have voluntarily censored it even as researchers hope it might model the smart cities of the future.[32] Mark Sample observes that Electronic Arts requested the removal of the airplane disaster in the classic *SimCity* when an open-source version of the game was released in 2008, renamed *Micropolis*. He points to evidence in the now widely available source code, where programmer documentation in the disasters.cpp subroutine reveals that in the original game there was a one out of nine chance of an airplane crashing into your city (by comparison, there was a two in nine chance of a fire outbreak and a two in nine chance of a flood), and that EA eliminated this possibility after 9/11 and later asked that it be taken out of *Micropolis*, as well. For Sample, these changes raise a number of questions relating to historical revisionism, the power of corporations, and the normalization of only certain kinds of disaster: "There are questions about the relationship between simulation, disaster, and history that call to mind Don DeLillo's *White Noise*, where one character tells another, 'The more we rehearse disaster, the safer we'll be

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

from the real thing. . . . There is no substitute for a planned simulation.'"[33] DeLillo's satire of disaster preparedness notwithstanding, why is it that *SimCity*'s catastrophes seem to represent only playful devastation for some while they raise the specter of unforeseen mortality (or bad public relations) for others? Some players court disaster; others go to great lengths to avoid it, slavishly attempting to determine the causes and probabilities for each type. Perhaps recognizing that many players do not enjoy having their carefully constructed cities unpredictably wrecked, Maxis has customarily provided the option to turn disasters *off*—known to series aficionados under the initial moniker "no disasters."[34] Intriguingly, the programmer's documentation highlighted by Sample also indicates that EA's decision to cleanse *SimCity* of terrorist associations took the form of replacing the slim chance of an airplane crash with an equally slim chance that "nothing happens," rather than replacing it with another, presumably more palatable disaster. Knowing this, we might raise our eyebrows at the pretense of a world where planes cannot crash and disasters may be toggled on and off like a light switch, but what is even more curious here is the implicit assumption that the randomness of "natural" disasters is at least tolerable for some, whereas disasters brought about by human error, mechanical failure, or targeted malice are anathema. The distinction holds even after granting that several of the game's disasters straddle this line because they are indirectly brought about, as when a giant Godzilla-esque lizard decides to trample one's city following the overproduction of garbage.

Catastrophe, like collapse, has by turns referred to either naturally occurring or human-wrought calamity. Etymologically, the word signifies a sudden overturning, with origins in Greek tragedy, although today it commonly denotes natural disasters of the usual variety. However, Mary Ann Doane further argues in her essay "Information, Crisis, Catastrophe" that since the advent of television, catastrophe has been pressed into service to characterize the failure of technical apparatuses—in an industrial society, strangely what scares us more than earthquakes or tornadoes are explosions and plane crashes:

> The time of technological progress is always felt as linear and fundamentally irreversible—technological change is almost by definition an "advance," and it is extremely difficult to conceive of any movement backward, any regression. Hence, technological evolution is perceived as unflinching progress

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

> toward a total state of control over nature. If some notion of pure Progress is the utopian element in this theory of technological development, catastrophe is its dystopia, the always unexpected interruption of this forward movement. Catastrophic time stands still. Catastrophe signals the failure of the escalating technological desire to conquer nature. From the point of view of Progress, nature can no longer be seen as anything but an affront or challenge to technology.[35]

Again, Doane concerns herself primarily with television, as Grusin did in his discussion of premediation, but her analysis is suggestive for our interest in collapse as mediated by video games. Both Grusin and Doane see modern catastrophe as inherently premediated, in particular by contemporary screens. En route, Doane elaborates three temporalities surrounding the mediated event: information, crisis, and catastrophe. Information constitutes the regular flow of television content, or what fills out the schedule, exemplified by the news program. Crisis is of a limited duration and typically hinges on human actors, as in "political" incidents like an international hostage negotiation. Finally, catastrophe is instantaneous, marked by its happening "all at once"—in a cataloging reminiscent of *SimCity*'s litany of disasters, Doane here discusses everything from hurricanes to nuclear meltdowns to the explosion of the Space Shuttle *Challenger* in 1986. Doane derives her explanation in part from mathematical catastrophe theory, where catastrophe is defined "as unexpected discontinuity in an otherwise continuous system" (chapter 2) and works best when it describes "sudden and unexpected effects in a gradually changing situation."[36] For her, the difficulty lies in reconciling this formal definition with television's complicated status as a system of discontinuities. Televised catastrophe essentially punctuates and sometimes even arrests an already episodic flow by calling attention to the scale of loss (death toll and damages) and the faultiness of technology. Thus even naturally occurring disasters come to figure as human failures:

> And so, just as the media penetrates events (in the media event), technology penetrates nature. This is why the purview of catastrophe keeps expanding to encompass even phenomena which had previously been situated wholly on the side of nature—earthquakes, floods, hurricanes, tornadoes. Such catastrophes no longer signify only the sudden eruption of natural forces but the inadequacy or failure of technology and its predictive powers as well.[37]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Sadly, anthropogenic climate change has rendered this once narcissistic belief in the human grounds for natural catastrophe a reality.

Especially when mediated by television, catastrophe always becomes in some way about the body's encounter with death, Doane observes. Even morbid coverage of catastrophe's victims instinctively pleases us because through it we experience disavowal—relief that it *could* have been us, but it was not (at least this time around). But catastrophe's peculiar relationship to time also connects the mediation of television or games to less anthropocentric temporalities of loss. Already, television blurs information and catastrophe by highlighting the impermanence of its communicated knowledge. Discussing something as paradigmatically informative as the nature documentary, Doane thus remarks that "information becomes most visibly information, becomes a televisual commodity, on the brink of its extinction or loss,"[38] not unlike endangered species or folkways.

What Doane calls catastrophe and I call collapse therefore operates in multiple temporal registers—in its anticipation, as a break or rupture in the normal course of things, and in its aftermath. The counterweight to obsessive premediation is repetition after the fact, seen for instance in the endlessly looping news footage of the second plane hitting the World Trade Center on the morning of 9/11. Both impulses are manifestations of the risk society as formulated by sociologists Anthony Giddens and Ulrich Beck, the latter in the wake of the Chernobyl nuclear accident, namely modern society's overwhelming orientation toward the management of threat, and above all environmental threat. One question that remains, however, is whether collapse in games performs similar kinds of buffering work, and how games' celebrated replay value compares with "television's compulsion to repeat" and new media's perpetual air of crisis in which we must continually "update to remain the same."[39] In the next section, I first elaborate on popular accounts of collapse before linking them to the somewhat paradoxical subgenre of "permadeath" games, games that up the ante on players' customary investments of time and effort by making in-game death permanent. Although by some measures permadeath is little more than a design gimmick, games you may only play once create a striking contrast to the laissez-faire iterability of most games. I see in permadeath evidence that players and developers are willing to let go of the premeditated mayhem and extreme environmental plasticity of games like *SimCity* or *From Dust* and instead, learning to proceed with care.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Games without Us

In 2007, Alan Weisman published a grim yet playfully imaginative vision of a future Earth in *The World without Us*.[40] In it, Weisman imagined what our planet would eventually look like if humans vanished all at once, leaving our wheatfields and plastics, ranch homes and land mines behind. The answer was predictably mixed—some of our most definitively human creations, our buildings, would quickly succumb to the elements, while others would persist indefinitely, like our host of industrially manufactured chemicals. The short answer, however, was that the Earth's other residents would move on with little fanfare, despite the ample piles of rotting wood and enduring toxins in their midst. Population ecologists might call Weisman's bestselling account a story of environmental collapse, although it is weirdly evacuated of the actual scene of humanity's end, instead featuring reports from the here and now as well as speculative forays into the posthuman future. This neatly sidesteps both our role in engineering collapse and its potentially grislier aspects, even as the book clearly operates within the familiar narrative contours of a fall from metaphorical heights. As readers of Weisman's book, we bear witness to ecological overshoot and the subsequent breakdown rather than the scriptural fall from grace. Overshoot refers to when a species or population exceeds the long-term carrying capacity of its environment, leading to the collapse of the population (and sometimes the environment, too). Whether it is the product of short-term, dramatic changes—think asteroids and cold snaps—or long-term, less noticeable ones, like habitual overfishing or climate change, collapse is notably sudden. Extreme collapse reigned in the "Big Five" mass extinction events in Earth's 4.5-billion-year history, including the storied annihilation of the dinosaurs at the end of the Cretaceous period and the death of all but 4 percent of the Earth's species at the end of the Permian period, which has been aptly labeled "The Great Dying."

To a much greater degree than its close synonyms disaster and catastrophe, collapse designates a systemic phenomenon, which makes its use in environmental discourse so common. Again like a house of cards folding in on itself, we cannot speak of individual collapse, or at least when we do, we mean that the organism's entire body failed in a systemic way. Collapse indicates many moving parts, a kind of reverse Rube Goldberg machine where everything conspires toward failure. That is why collapse is often tied up with the notion of "tipping points," points beyond which certain, usually

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

undesirable, consequences inevitably follow, like the two degrees Celsius beyond which most climatologists see the Earth's climate as dramatically shifting to a warmer state. (While the tipping point is commonly spoken of as a "point of no return," it would be more accurate to say that the tipping point transitions us from one relatively stable state to another, different stable state.)

For those inclined to chart history's recurrent patterns, collapse has been a productive term with which to relay comparisons. Probably the most well known example comes from the globetrotting professor Jared Diamond, whose *Guns, Germs, and Steel* won the Pulitzer Prize for general nonfiction in 1998 and whose 2005 *Collapse* ponders shared reasons for the demise of early societies like the first Polynesians to settle remote islands in the South Pacific, the Greenland Norse, and the ancient Native American tribes who once flourished in what is now the southwestern United States.[41] True to his characteristic interests in the science of biogeography and environmentally inflected theories of historical development, Diamond examines five factors for each of his case studies: known or inferred human environmental impacts, like evidence of deforestation; climatic variation, as occurred with the Little Ice Age that began in the late Middle Ages; another two concerning the society in question's fluctuating relations with both friendly and hostile neighbors; and finally, in a sizable catch-all, other political, economic, social, and cultural factors.[42] For Diamond, these are the major contributing determinants in any society's triumph or failure, and while problems in just one or two areas may not spell immediate disaster, trouble on most or all of these fronts would signal that downfall is nigh. Of special interest here is Diamond's observation, based on meticulous analysis of the historical record, others' recent research, and his own extensive fieldwork, that collapse generally follows quickly upon success—that is, civilizations at their cultural peak also tend to be at their highest population levels and making the maximum draws on their environmental resources, and are thus more susceptible to climate change, internal and external warfare, outdated customs,[43] and so on, and tumble shortly thereafter. And lest we assume that societal collapse is a relic of less enlightened times, before the blossoming of modern environmental know-how, Diamond also shares many contemporary examples from countries like the United States, China, Haiti, Rwanda, and Australia.

In a similar but more targeted fashion, British historian Clive Ponting has singled out humans' relationship to the environment as the key factor in a

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

society's rise or decline.[44] Above all, Ponting believes that "the most fundamental alteration in human history—and one which made possible all the subsequent developments in human society," is the invention of agriculture and animal husbandry (chapter 4).[45] Yet while Ponting seems to posit ancient hunting-and-gathering lifestyles as inherently more sustainable than our current, agriculture-based ones, he also counsels against any easy opposition: "Both ways of obtaining food should be seen as parts of a spectrum of human activities of different degrees of intensity to exploit animals and plants."[46] Like Diamond, who unreservedly exports the term "mining" to any practice that involves resource extraction with little thought to the future, Ponting recognizes that humans inevitably transform their surroundings, only to a greater or lesser degree depending on attitudes, technical means, and sheer numbers. If, as Diamond writes, "the essence of mining is to exploit resources that do not renew themselves with time, and hence to deplete those resources,"[47] mining does not just apply to hard-rock mining for metal or gems or for fossil fuels like coal and natural gas, but also to things like topsoil, which is being depleted and eroded by agriculture and human disturbance at rates far beyond its natural replacement rate through weathering and geological processes.

Mercifully, both Ponting and Diamond have exhumed all this cheerless history not merely to satisfy popular intellectual curiosity, but as a means to situate our present junction, as the titles of their books attest. As Diamond generously suggests, we can choose to succeed. Or, as Ponting admonishes, even great civilizations need to manage their natural resources wisely or they will face extermination. (And if any of this rhetoric of shrewd decision-making and resource management is starting to sound suspiciously like a civilization-building game, now you know how environmental history reads to a games scholar.) Diamond himself espouses what he describes as "cautious optimism" in the face of otherwise appalling statistics about biodiversity loss and rampant social and environmental inequality, as well as the many documented foibles of individual and group human psychology that predispose us to collective failure—among them notoriously short-term thinking, denial even in the face of identified problems, and selfish overuse of shared resources in the fear that our neighbors will do the same, famously articulated by Garrett Hardin as the tragedy of the commons.[48] Nevertheless, Diamond's discussion of contemporary situations makes it clear that none of the problems we face are, as he says, insoluble. Because they are of our

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

own making, they are also theoretically subject to our control. Diamond is thus careful to offer at least a few positive models of sustainable societies (New Guinea and Tikopia) and disastrous environmental courses altered (Tokugawa Japan), in a regrettably slim chapter on "paths to success." Ponting, meanwhile, appears less sanguine. Following lengthy chapters on such lighthearted topics as "The Rape of the World," "Disease and Death," and "Polluting the World," Ponting refuses to predict whether our modern industrial societies will persist or perish: "The achievements of modern industrial, urban, high-consumption, high-energy-consumption societies have been remarkable. However, the other side of the coin is that the scale of the environmental problems they have created as a consequence of these achievements is unprecedented and of a complexity that almost defies solution."[49] And just because a breakdown has not thus far occurred, adds Ponting, does not mean that one is not imminent. Like many other an environmental writer, then, Ponting and Diamond lay out their facts but ultimately must leave it to us to weigh them and act accordingly. This may explain why some of Diamond's favorite examples come from landscapes personally dear to him, from the plight of ranchers and dairy farmers in Montana's Bitterroot Valley to his longtime home in the smoggy ferment of Los Angeles. They are stirring reminders that these are not just stories about people long dead, but missives from those alive today, in places that are still with us.

One such place is a remote, sparsely populated island deep in the South Pacific known to its indigenous population as Rapa Nui and to outsiders as Easter Island. If you have heard of Easter Island, chances are it was as a classic case of human-wrought environmental collapse. Long ago, Polynesian settlers came to the island and established complex tribal communities capable of erecting the now iconic enormous stone statues called *moai*, until deforestation, the overhunting of flightless birds, and other activities unsustainable for such a small territory reduced them to internecine warfare, starvation, and even cannibalism. Although thousands of Rapa Nui continue to live on the roughly sixty-three-square-mile island today, which is now formally a part of Chile, academics like Ponting and Diamond invariably dwell on Easter Island as the anthropological parable par excellence of the consequences of human insensitivity to ecological constraint. Whether we rate the above-mentioned outcome as deplorable or commendable, given the island's challenging location and resource limitations,[50] there is something noticeably appealing about islandology,[51] or the ability to assess social and environmental

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

impacts in a relatively contained fashion. No doubt influenced by his long-time research in the New Guinea highlands, Diamond visits not only Easter Island but also a succession of other islands or "island continents" in *Collapse*, among them Iceland, Japan, Australia, Indonesia, and of course, Papua New Guinea. Sometimes these islands afford surprising real-world experiments in geographical similarity and political difference, as when Diamond compares the countries of Haiti and the Dominican Republic, which share the same island in the Caribbean but have had dramatically different national outcomes due to divergent environmental and political policies. Ecologists have already long prized islands for opportunities to study evolution and other environmental processes in naturally delimited ways, as when a young Charles Darwin observed bird speciation on the Galapagos Islands or Robert MacArthur and E. O. Wilson first put forward their theories of island gigantism and dwarfism (the insularity of islands creating conditions for either abnormally large or abnormally small animals and plants).[52] More important for my purposes, the value that both historians and scientists seem to recognize in the island's isolation is one mimicked by game environments. In other words, *games are a lot like islands*—(porously) bounded zones, with comparatively few parameters, where cause and effect are magnified and lead more easily to a reckoning. With islands we have, in effect, circled back to the fragmented biomes (introduction) and experimental mesocosms (chapter 1) with which we began.

Like Easter Island, in particular, the permadeath games discussed in the remainder of this chapter skirt the line between tragedy and survival, simultaneously inviting us to read them in moral terms while resisting external analysis. Resistance occurs because, as Eugene Thacker concludes in his book *After Life*, the "basic dilemma" of any philosophy of living is "to think a concept of life that is itself, in some basic way, unhuman, a life *without us*."[53] Peering into the past thus does more than warn us that those who ignore their history are doomed to repeat their mistakes. It also enables us to think a world apart from humans, either before our arrival ("prehistory") or after our untimely demise. While Weisman saw *The World without Us* as forestalling fear and anxiety around the death of human civilization by beginning after its end,[54] he also lingers over remnants from "the world just before us" such as the Białowieża primeval forest at the Poland-Belarus border and ancient wonders like the Great Pyramid of Giza. Like the rhetoric of wilderness, extinction, and even genocide, Weisman's elaborate thought experiment

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

is an exercise in thinking life from the outside (in the case of wilderness discourse, we can take this quite literally). With our contemporary watershed moment in mind, let us now take the previous chapter's focus on entropy to its extreme conclusion, by looking at a growing body of games and game practices whose defining feature is their irreversibility. This includes both the long-established but recently rediscovered genre of permadeath games, born from the roguelike tradition, and so-called "legacy" board games, where in the course of play players must materially alter, and sometimes even destroy, the game's components, making repeat play impossible. Why, we might ask, would a genre defined by extravagantly complicated game worlds and harsh penalties for player error regain popularity at a time when consciousness of environmental precarity is at its peak? And why do some players feel compelled to risk the loss of a game, game world, or gameplay experience when countless less punitive games are available? Even as I accept that no one reason can adequately account for these developments, I suspect that game permadeath is rapidly proliferating beyond its canonical borders, into narrative, material, financial, biopolitical, and ecological realms, because our personal and collective fates lie heavy on us indeed.

End-Times

Permadeath is, most simply, a game mechanism in which playable characters that die remain dead and therefore become unplayable. Veteran game designer Richard Bartle has called this "never-to-return death,"[55] and while one could certainly argue that early games, particularly coin-operated arcade games, were all technically permadeath games, one could also make the case that permadeath as a recognizable genre might be dated to the year 1980, which saw the release of both *Rogue* and the *Pac-Man* arcade game. With Namco's *Pac-Man*, games that heretofore had revolved around fairly abstract player representations—racecars, spaceships, and sports equipment—began demonstrating a clearer investment in player-characters. Because permadeath is now so often described as the meaningful death of a player's character, earlier games like *Pong* (1972) and *Asteroids* (1979) seem to fall outside the permadeath genre, and exemplify the difference between games merely ending and permadying. With *Rogue*, originally developed in Unix at the University of California, Santa Cruz, and later ported to DOS in 1984, most of the lasting criteria for permadeath gaming were established, including the random generation of game levels (often conflated with procedural generation),

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

turn-based play, tiled graphics, and, of course, permanent death. These criteria were contentiously formalized in 2008 in Berlin at the first International Roguelike Development Conference, now referred to rather grandly as "the Berlin Interpretation."

Not surprisingly, permadeath remains something of a niche phenomenon. Losing hours of progress to a fluke occurrence or momentary lapse of attention can be frustrating, if not utterly demoralizing. Historically speaking, as arcade games declined and home gaming consoles and personal computers grew more prevalent throughout the 1980s and 1990s, game designers began experimenting with more forgiving forms of gameplay, allowing players to save their progress and in cases of defeat or less than optimal completion, to backtrack and try again. Today, bolstered by cheap data storage, games routinely offer convenient save points, ample save files, penalty-free respawning, and even automatic saving. Together with the meteoric rise of casual games, the move away from permadeath has thus been seen as a strategy to bring novice nongamers into the market with less intimidating fare. In the domain of massively multiplayer online games, where persistence of game worlds is maintained on remote servers and player data seldom gets deleted, permadeath is especially rare, as it is generally considered poor business practice to permanently kill off one's paying subscribers. All this does not prevent Bartle from gently poking fun at the risk-averse disposition of current (MMO) play:

> It's hard for modern MMO players to get their heads around the concept of permadeath (or PD as it's sometimes known). They can't really grasp the idea that a character is actually >GONE< when it's killed. Even designers don't always get it. They'll come up with ways around it, such as having clones or fighting your way out of the underworld. That's not permadeath, though. With permadeath, your character Does Not Come Back, Ever.[56]

Bartle's faint disdain here is representative of the widespread belief that games have been "watered down" or "cheapened" by newer player-friendly conventions. These are seen as namby-pamby coddling, while permadeath games, modes, or runs are typically labeled as "ironman" (as in *XCOM: Enemy Unknown* [2012]) or "hardcore" (as in the *Diablo* [1996–] series), even the "hardest of the hardcore experience."[57] Reminiscent of the backlash against casual games, which are erroneously perceived as predominantly catering to

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

less skilled, female players,[58] the gender implications of permadeath are plain to see—like the "sudden death" of traditional sports, permadeath creates high-stakes, masculinist play that readily devolves into ludic machismo. A full discussion of permadeath's gender associations is impossible here, but it is worth noting that the survivalist aspect of most permadeath games aligns them with the long and equally masculinist nature-writing tradition, studded with purportedly lone men measuring themselves against purportedly wild places.[59]

If most players avoid permadeath and even those who seek it out tend to experience intense negative emotions, such as fear and sadness,[60] we might ask why there has been a renewed interest in permadeath gaming in the past decade, in both stringent (roguelikes and games that may only be played once) and more lenient forms (what developers sometimes call "roguelites" or "roguelikelikes," in reference to the original *Rogue*)—for example, *One Chance* (2010), *Dwarf Fortress*, *Heavy Rain* (2010), *Don't Starve*, *XCOM: Enemy Unknown*, *The Binding of Isaac* (2011), and *Spelunky* (2008). The appeal of a tough challenge and the sheer adrenaline rush involved certainly go some way toward explaining why so many players voluntarily choose such punishing game encounters. According to researchers Marcus Carter and Fraser Allison, permanent death actually makes the experience of playing more enjoyable, so long as the character's death is perceived as meaningful, that is, motivated by the game's logic. It turns out that negative emotions experienced on the way to more positive ones are also willingly entertained, a behavior explicated in psychology as "excitation transfer effect":

> In excitation transfer, our arousal is increased by a stimulus with a negative valence, but becomes associated with a stimulus with a positive valence, resulting in an overall positive experience that borrows the intensity of a negative stimuli (or vice versa). On a roller coaster, for example, we draw our thrills from our intuitive perception of danger, but experience the thrill as positive due to our awareness that we are in fact safe.[61]

Carter and Allison draw their conclusions from an extensive survey of players of the online multiplayer survival game *DayZ*, first released as a mod of the *ARMA II* first-person shooter in 2012 and subsequently rereleased as a standalone title. In *DayZ*, player life is infamously fragile—everything

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

from diseases, accidents, and starvation and dehydration to zombies and hostile players conspires to end one's stint in the game's stark, postapocalyptic world. Yet many of the over 1,700 *DayZ* players who responded to the researchers' survey answered favorably to questions like "How do you think the increased consequence of death affects your experience playing the *DayZ* standalone?" and "When you play *DayZ*, how enjoyable do you find the consequential nature of death?" While I would argue that the phrasing of the questions ("increased consequence," "enjoyable," and "consequential") may have predisposed respondents to view permadeath in a positive light, the results still merit serious consideration.

Like Carter and Allison, who were themselves building upon Katie Salen Tekinbaş and Eric Zimmerman's definition of "meaningful play," Bartle believes permadeath "adds *meaning*" to otherwise forgettable game experiences.[62] Game critic Brendan Keogh has argued in a similar vein, particularly after embarking on his own introspective semi-permadeath experiment in *Minecraft.* Keogh called the project *Towards Dawn*, because each game day he chose to navigate his character east, "towards the morning sun," living like a "nomad" instead of settling in one place as most *Minecraft* players do. This meant that Keogh, if slain, would respawn at his long distant, original starting point, for him functionally ending his journey in that particular game world. Impressively, Keogh's "accidental perma-death experiment" lasted for some two years,[63] spread over sixty-two scrupulously documented in-game days, long enough that even Keogh eventually grew tired and decided to bring his wanderings to a satisfying end. Although technically, *Towards Dawn* was an exercise in self-imposed permadeath, akin to Ben Abraham's equally well-annotated run in *Far Cry 2*,[64] Keogh felt the danger keenly:

> Just as Abraham's every action became a conscious consideration of how to remain alive in *Far Cry 2*, my every step east became fraught with anxiety. I would have to track the safe route down a mountain without falling; I would have to ensure I was carrying food before venturing out onto an ocean. Occasionally, the algorithms that determine the landscape would place an open lava pit on the world's surface and a wrong step could see me fall in. In a typical *Minecraft* game, death is a minor setback; it means returning to my base and replacing my lost gear with the extra resources in my chest before I head out again. In *Towards Dawn*, however, death meant the end of the journey east and demanded that I was ever vigilant as I moved forward.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

In a later analysis, Keogh reflects on permadeath's apparent ability to reorient player priorities: "The player no longer throws the character's body around on an experimental whim; the stakes are much too high for that. 'What if' is no longer a reason to recklessly play *with* the game, but a reason to play the game with more care."[65] Whether freely elected or algorithmically enforced, permadeath in games works to stress the precariousness of play by making personal failure irrevocable. Already, however, we can see glimmers that permadeath is never just about the player and his or her level of skill, for it also imbues the game environment with meaning. While admittedly many players still treat permadeath as an opportunity for manly exploits, at its most promising, permadeath fosters a thoughtful deviance from the usual, take-and-make relationship between players and game worlds. It might even produce uncommon feelings of respect for entities and processes beyond the player's direct control.

From an ecological perspective, then, there are important differences between games that employ failure as a temporary setback and those that attempt to impose permanent death or otherwise irrevocable material alterations, echoing games' treatment of natural resources as either unbounded or finite (chapter 4). Destructive environmental play carries its own lessons, not all of them regrettable. But permanent death raises the possibility of gameplay closer to the reality of our current individual and collective vulnerability. Yet before we wax too hopeful about permadeath's potential, let us take a close look once again at its conventions—first and foremost, whose death generally matters? And what is death, if not the death of a person? The answers will attest to the many ways in which permadeath can be read.[66]

There Is No Planet B

In the game industry, permadeath almost always refers to the death of people. Thus in one of the few literature reviews on the topic, authors Amra Copcic, Sophie McKenzie, and Michael Hobbs define permadeath as "the permanent in-game death of a playable character."[67] *Kill Screen* writer Thomas Rousse offers a similar set of criteria by which to evaluate whether or not a game qualifies as permadeath:

1. the character's life must be significant to the player
2. the character's life must be unique
3. the character's life must be at risk of being irrevocably lost.[68]

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

By character, Rousse means the player-character or avatar. In theory, this could be anything from a fleck of pollen to the universe itself, as essayed by David OReilly's *Everything* (2017), but not surprisingly, most game designers opt for human protagonists (or at least recognizable humanoids). As survivalist dramas, permadeath games relish pitting people against each other or against environments characterized by scarcity and unpredictability. Sometimes, the player-character is the last, best hope for humanity, as in *One Chance*. At other times, he or she is simply the unfortunate remainder left after an indiscriminate plague or zombie infestation, as in *DayZ*. Either way, death holds meaning only for the human survivors. In other words, permadeath games indulge a fundamental conceit, namely that meaningful experience begins and ends with the player or player-character, who is most often human. As animal-studies scholars have shown time and again, this anthropocentric bias permeates the Western philosophical tradition, for many culminating in Martin Heidegger's curious insistence that animals have only a poor sense of world and no concept of death, leading to the oft-repeated maxim that only humans die, while animals merely perish (chapter 3).

In addition to the question "whose death matters?" we must add the deliberately naïve follow-up "what do you mean by death?" Any dictionary reminds us that death is not just the end of life, but also the termination of the existence or duration of things. Game designer Randy Smith has in this manner argued against a narrow view of game death as "deliberate and fatal personal violence,"[69] as exemplified by the tragic death of former-outlaw-turned-family-man John Marston in the game *Red Dead Redemption.* This chapter asks what an expanded notion of permadeath would allow, one that placed the nonhuman or even the nonliving on par with the human. Explorations of new forms of permadeath, whether environmental, material, financial, or otherwise, could kindle a rethinking of resource management, survival, and even win/fail states in games, by embracing economic and ecological concepts of expendability and limitation. In a mode reminiscent of physicists' models of the heat death of the universe, some have convincingly argued that permadeath is just as much about entropy and the decline in process intensity (a concept borrowed from game designer Chris Crawford) as it is about player death, and that play is a means of rendering the game world functionally inert by neutralizing narrative and ludic possibility.[70] Unfortunately, current realizations of game permadeath remain narrowly human-centered. Even when permadeath explicitly confronts ecocide, as in

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

the game *One Chance*, salvation lies in the preservation of a human cellular blueprint.

The relative scarcity of ecological permadeath is somewhat strange given that one of the core components of permadeath design is procedural level generation, which frequently leads players and designers to talk about permadeath game worlds as functionally unique. This is because many permadeath games or modes delete the player's game world upon the player's death, so for example *Minecraft*'s hardcore mode, technically a subset of "survival" mode, dictates that the map associated with a saved game be erased upon player-character death. When players of permadeath games express sadness over a game's end, they often regret the loss of the game world as much as, if not more than the loss of their character. Upon dying, the player loses access not only to that character but more important to that particular procedurally generated world. He or she may start again, but the new world—whether dungeon or map—will never be quite the same as the old one. Like snowflakes, procedurally generated worlds share family resemblances but are each distinctive and not readily replicable. Take, for instance, Brendan Keogh's saved *Minecraft* game in which he conducted the performance art of *Towards Dawn.* Although Keogh made the file available to his followers so that they could in theory retrace his steps, he had to issue the following caveat because of the constantly changing nature of the game: "*be aware that the direction of sunrise and sunset has changed in a later update to* Minecraft, *so if you were to follow me, you will not actually be walking towards dawn for the first many days*."[71]

Rob Parker has also helpfully noted that although players and media outlets often use "random" and "procedural" generation interchangeably, in actuality, these are not the same thing.[72] Some roguelikes, like *Nethack* (1987), create completely randomized dungeons, while others, like *The Binding of Isaac*, combine "handcrafted" or custom elements like premade rooms into random assemblages. Given that procedural content generation has led to many overly inflated claims about "the last game you'll ever need to buy,"[73] seen in the furor over Hello Games' *No Man's Sky* (chapter 2), the subtle difference becomes important. On the one hand, procedural content generation is the basis for claims about the irreplaceable specificity of any given game world. Many of the most compelling permadeath games, among them *Minecraft*, *Dwarf Fortress*, and *Don't Starve*, feature such complex natural environments. *Don't Starve*, for instance, draws from over thirty different kinds

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

of biomes, including deciduous forests, savanna, tidal marshes, and coral reefs. This procedural variety, in turn, may lead to environmental permadeath games that invite world stewardship, just as Keogh sees permadeath play as typically leading to an ethics of "care" for the player's character. On the other hand, many have suggested that procedural generation on the contrary creates tediously predictable environments based in the repetition of world elements. Again in *Don't Starve*, for example, although each playthrough of the game will feature a different combination of biomes, each biome type can be counted on to feature certain terrain, flora, and fauna. In other words, permadeath's conceit of randomly generated worlds appears exceptionally specific but also obscures a generic impulse. Whereas Rousse felt that "By playing permadeath games, players embrace the aura cast off by technological progress," because "characters are given a place in time and space, a history, and a touch of authenticity,"[74] procedural generation's naysayers feel that all we get is the work of E*ART*H in the age of its electronic reproducibility. In some ways, procedural generation of game worlds mirrors the algorithmic generation of plants discussed in chapter 3, at a much larger scale.

Hesitation over procedural generation aside, what if we tinkered with Rousse's three criteria for permadeath games, by substituting the word "environment" or "world" for his "character"?

1. the world's life must be significant to the player
2. the world's life must be unique
3. the world's life must be at risk of being irrevocably lost

As already discussed, numbers two and three hold for procedurally generated game worlds. However, as our brief foray into the destructibility fad in game design revealed, players have grown accustomed to treating game environments with cavalier disregard. This dispassion toward environmental death in many ways mirrors the typical attitude toward player death—either because the game environment is such a trivial veneer for resource distribution that you need not feel any remorse over destroying it, from loot crates to expendable furniture, or because there is no real scarcity. Just as in some games regeneration, resurrection, or reloadable save files create a functionally immortal player-character, respawning supplies and mobiles and newer persistent-state games can essentially deliver worlds without end,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

characterized by limitless resources and farmable challenge. Only a few games treat permadeath as both player-character death and ecological permadeath, or world death, as I will discuss in the case of *Eco* (2018).

For now, note that my revision of Rousse's permadeath criteria proves disconcertingly apropos of our situation here on Earth, as well. In the "real" world, if you believe the vast majority of scientists who see human actions as pushing the biosphere past a certain brink, then number three ("the world's life must be at risk of being irrevocably lost") is undoubtedly true. Or perhaps more accurately, life *as we know it* will be lost, for the planet itself and at least some of its inhabitants will continue on so long as the sun continues to burn. As for number two ("the world's life must be unique"), the Drake Equation aside, the planet Earth does seem to possess a singular status in the known universe. It is arguably the first criterion at which we encounter resistance, just as with games. Not everyone feels concern over environmental life, or at the least does not rate it as highly as fellow humans, or short-term gratifications and conveniences like air-conditioning and cars. Thus without stretching too far, we can use permadeath games to think about mortality in terms of human life and beyond it, for example, in the broader spectrum of species biodiversity or new materialist philosophy. While we can see permadeath's recent resurgence as evidence of a growing awareness of the precarity of *human* existence in the Anthropocene, we would also do well to remember that scientists have proposed these times as a sixth megaextinction, a reminder that it is not just about us, but also about dodos and Chinese river dolphins, the Maryland darter and Appalachian yellow asphodel.

Needless to say, for researchers coming from environmental disciplines, the concept of permadeath may seem maddeningly tautological—after all, what is more permanent than death? We who regularly contemplate environmental crisis already possess a finely honed sense of the end of things, evident in the plethora of categories and metrics we have devised to measure biodiversity loss, species loss, habitat loss, and so on. Inklings of this occupational morbidity have even seeped into the culture at large, so that today even schoolchildren and supermarket shoppers craving fair-trade chocolate are conversant with the language of vulnerable, endangered, and critically endangered species. But I would argue that, as silly as permadeath sounds outside of game contexts, its intent is not all that different from the classifications popularized by the International Union for Conservation of Nature's (IUCN) Red List of threatened species. Both are efforts to make death tangible, and

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

in some way meaningful. Both, moreover, contain prescriptions for action—play skillfully, consume wisely, donate money, or whatever the case may be, in order to keep the living from forever passing over to the dead. If you are tempted to question the reality or impact of in-game death, remember that extinction itself is a malleable designation. The IUCN's threatened species exist between two poles—of "least concern" and "extinct"—and increasingly, there are varying grades of extinction: extinct, extinct in the wild (where the only surviving specimens are in captivity), and the closely related "functionally extinct" (where, for instance, the remaining population no longer has a significant ecosystem role or surviving individuals are unable to reproduce). Add to this the growing hope for "de-extinction" science, or bringing extinct species back to life using ancient genetic material, and we start to see how even extinction may soon need the "permanent" modifier to emphasize its importance.[75]

This is not to say that extinctions are not real, or that they are not incredibly saddening to contemplate, but to acknowledge that extinction as a finding and a category is inevitably mediated by many parties, including science, the mass media, and academics. Real-life permadeath is the occasion for Ursula Heise contemplating bags of wooden, extinct-species toys in a shopping mall in Hong Kong,[76] Thom van Dooren scouring the ethological literature on true corvid species to get a glimmer of their lost mourning practices,[77] or Vinciane Despret speculating about the final sentiments of the last American passenger pigeons, a species that was once so prevalent in North America that it literally darkened the skies.[78] Both Heise and Haraway turn to literary articulations of permadeath, in particular Orson Scott Card's *Ender's Game* (1985–) books, best known for the first novel in which a young boy is groomed as a military prodigy and unknowingly commits genocide against an alien species. (Much less well known are the subsequent novels in the series, in which Ender grows to manhood and tries to make amends for his earlier actions, becoming a *Speaker for the Dead.*) Even Doane weighs in on the mediation of environmental permadeath. Discussing television specials of the National Geographic variety, she observes that "the life of a particular animal or plant becomes most *televisual* when the species is threatened with extinction."[79] While for Doane cinema derives its realism from the spatial register and television is quintessentially about time, evidenced in the catastrophic interruption that insists on its actuality, we are left to imagine how games signal their own reality in relation to ways of dying. Having already

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

examined both glib and gritty depictions of disaster in sandbox games and traditional permadeath games, I devote the remainder of this chapter to novel modes of permadeath gameplay, which heighten even their stereotypically high stakes through formal experiments in collaborative world-making, material alteration, and representations of real death.

Analogous to the scalar impulses we saw at play in chapter 2, permadeath games are ideally suited to dramatizing struggles for collective, and not just individual, survival. A notable example comes from the small, Seattle-based studio Strange Loop Games, which is currently developing what they describe as a "global survival game," called *Eco*. *Eco* resembles multiplayer *Minecraft* in that players share a malleable three-dimensional world in which they can gather, craft, farm, and so on, with the primary difference being *Eco*'s explicit emphasis on social and environmental sustainability. In fact, *Eco* innovates on a dizzying number of fronts (under the aegis of educational design for older schoolchildren), but its chief credo is that everything a player does in the game impacts the game's environment, whether for good or ill. Each *Eco* server hosts a modest number of players (during the alpha I saw anywhere from single-digit populations to at most a couple of hundred online at once) and the game and its many artificially intelligent processes (predator–prey interactions, hydrology, climate, and so on) run around the clock, even if players are not logged in. Each real day counts as one year in game time, and unless set otherwise by an administrator a looming meteor will annihilate the planet after thirty days (set at only seven days during the alpha), and the associated server will be wiped clean (Figure 33). The only way to prevent the meteor strike is to research the appropriate advanced technology, which demands that players work together and use resources wisely. Overexploiting the planet's resources will lead to an early, nonmeteoric demise, while doing nothing, in some respects the "greenest" option, does nothing to avert the meteor. Some might call this aspect of *Eco*'s design pragmatic, while others might condemn it as techno-utopian, in line with the tech-friendly futurism of thinkers and entrepreneurs like Stewart Brand and Elon Musk. Strange Loop's CEO John Krajewski has repeatedly emphasized that *Eco* is not about prioritizing the game world's survival over the players' survival. For him, what matters is less the nature of the solution than the necessity of finding one, together.[80]

For generations of children for whom *Minecraft* and other voxel (volumetric pixel) games are almost second nature, *Eco* could prove particularly

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Figure 33. Picking an alpha server to play Strange Loop Games' *Eco* in 2017, with or without the threat of a world-ending meteor.

effective. In my first forays into the game, much was familiar from my experience in *Minecraft*—felling trees for lumber, mining, building a home, harvesting food, and so forth. Almost immediately, however, I was struck by the underlying differences. As I assiduously chopped down my first tree in *Eco*, the tree toppled alarmingly to one side as my avatar yelled "Timber!" and what's more, the falling tree destroyed the vegetation on which it fell! When you mine and process ore, the refinery creates tailings that will gradually leach pollution into the surrounding land and water unless securely stored.[81] The game's animal and plant species, at this time based on the ecosystems of the Pacific Northwest, can be hunted or harvested into extinction. Working even consumes calories, and players must not only feed themselves but also balance their intake of protein, carbohydrates, fat, and vitamins by consuming a variety of foods. This combination of scientific scruples (Team Eco regularly consults with ecologists) and savvy tinkering with game conventions leads to surprising, but also enjoyable play. I was delighted, for instance, when the game's designers added stockpiles in the alpha 5.6 release—rather than permitting players to store ridiculously large quantities in small containers, as most games do, *Eco* forces players to stockpile things like mine tailings

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

in a way that takes up as much space in-game as it would in the outside world. *Eco* also encourages data-driven, social decision-making with its educational metagame (graphs and other visualizations of the world's populations) and infrastructure for passing laws, running for office, and criminal justice. Players are pointedly called "citizens." Despite all this, it is entirely possible to play *Eco* in a villainous fashion, and in its own way that is equally instructive. On Earth Day in 2017, Team Eco fittingly published a dev blog post entitled "How to Save the Environment by Letting Kids Destroy It," in which they argued, "By positioning environmentalism in this role, not as goal but as consequence, you allow the player to arrive to it as their own conclusion, through the logical extension of their own behaviors, which is far more powerful than beating them over the head with it."[82] Ideally, *Eco* players would learn to work together to survive and preserve their world for the indefinite future. But even in less responsible play, players are taught that every action has lasting ramifications, a lesson even more apparent in what are called legacy games.

Legacy Games

My friends and I once gamely tried to play *Seafall* (2016), a recent legacy board game from the creator of *Risk: Legacy* (2011). From the start, we were asked to set pen to paper to label our civilizations and their rulers, and as we tentatively explored the map, we were instructed to place stickers on certain spots on the main board and on our own individual boards. After the set-up round, we were further commanded to *tear up* our initial leader cards, because the rest of the game occurs many years later, after the original leaders have become only faint memories. For anyone familiar with traditional board games, habit dictates that game boards, cards, and tokens do not vary from playing to playing, although they might experience wear and tear. One does not, for instance, generally wield a Sharpie during *Monopoly* in order to rename Marvin Gardens "Brian's Organic Bodega," or snip all the spades in a deck of playing cards into the nearest garbage can. But in legacy games, players are commonly ordered to make irreversible changes to the game materials, so that after a certain amount of time or play, the game can either no longer be played or can only be played in a certain way. Like a choose-your-own-adventure novel where any unselected pages would have to be ripped out of the book and burned, legacy games quickly make clear that choices matter. And just as permadeath is a reflexively difficult rule, legacy parameters hit

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

home hardest for players accustomed to conventions like material continuity and impermanent death.

In the journal *Analog Game Studies*, Ivan Mosca argues that legacy mechanics "reorient the gameplay experience from a focus on winning and solving and toward an experience aligned instead with narrative and reflection."[83] For him, "permanent change" and "permanent death" are the two main components of this reorientation. As Mosca observes, legacy games invert many of the canonical features of interactive, especially digital gaming, in that they are linear rather than nonlinear, less interactive than narrative-driven, and limited in terms of replay, if replay is even possible. Legacy mechanics also violate the tenets of the magic circle, for play is no longer a free exercise without consequences:

> Above all, in LEGACY there is not only *character* permadeath, but also *non-playable-character* permadeath, *world* permadeath, and the permadeath of the *player* themselves (LEGACY games are spoiled if players take part in them more than once, hence player permadeath). The shift in meaning of permadeath from one which privileges character to one which applies the term more broadly (to the player or world) can be understood as one which offers the player significantly less control over the game. This lack of perceived control over the game, paradoxically leads players toward an approach to play that values experience and reflection.

Importantly, even though Mosca sees legacy games as expanding the ambit of permadeath games in ways that I have described as having an environmental valence, he does not treat them as coterminous. Mosca believes that legacy rules, even more than permadeath, work against the standard resource accumulation procedures of games, since they militate against the stockpiling of goods, points, levels, and even ability (Andrew Doull has suggested, however, that at least player skill improvement is retained from playthrough to playthrough in permadeath games).[84] Mosca also describes legacy games as possessing two levels of irreversibility: semantic (on the level of in-game representations) and syntactic (regarding rules of the game), in effect "a combination of narrative and material irreversibility": "A double irreversibility—the player permadeath and the impossibility to reiterate—drives LEGACY players to abandon the classic, progressive model of knowledge in favor of an 'openness to vulnerability,' which expands the magic circle to a horizon

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

magnitude." Mosca is here referring to Keogh's permadeath experience in *Minecraft*, which does seem to bear out his contention that legacy gaming leads to greater player reflection. Keogh prefaces his own reflection on the consequences of permadeath play with the following observation: "Most importantly, my relationship with the landscape around me was altered dramatically." Interestingly, Keogh's run also contained inklings of an environmentalist mindset, like backpackers who carry out what they carry in: "I leave as little a mark on the lands I pass through as possible."[85] Rather than hoarding or constructing elaborate fortifications for safety or bragging rights, Keogh wanders, and when it is finally time to build a home and sleep in a bed (in *Minecraft* the equivalent of a save point), Keogh makes a homely cottage with just enough of a garden to keep him from starving. Coming across an apple for the first time, Keogh remarks, "I took the apple and replanted the saplings. It still felt weird to take so much resources from the world after merely passing through it for so long. I was determined to put back whatever I took."[86] The *Towards Dawn* blog, appropriately, is thus subtitled "Leaving the Miner's Life Behind." Permadeath and legacy play, it seems, may be the most "sustainable" play we yet have.

It is worth noting that analysts of permadeath and legacy games frequently turn to psychoanalytical or philosophical approaches to death, whether it is the death drive, Mosca's Heideggerian slant ("being-toward-death"), or Parker's discussion of "terror management theory" (TMT). Parker suggests that the relatively recent social science of TMT may prove useful to the study of permadeath gaming, in its attempt to measure the variables of both "mortality salience" and "death thought accessibility," the former essentially one's awareness of one's own inevitable death and the latter our motivation to insulate ourselves from such thoughts through self-esteem and cultural worldviews. Interestingly, Parker notes, preliminary research by Jason Hawreliak and others suggests not only that we manage existential dread by forming in-groups and out-groups but also that while playing video games may increase mortality salience for novice players, the opposite occurs with veteran players—death becomes less, not more consequential. Parker argues that for core roguelike players, permanent death is less about death than it is about difficulty and skill. Permadeath is therefore the defining distinction between what Parker calls "traditional" and "modern" roguelikes. For Mosca, legacy games deliberately deflate permadeath expectations. With legacy players, "they don't simply play, but they *are played* by

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

the events." This creates a sensation of destiny, where the player is more passive than active.

In legacy games and games like Zach Gage's *Lose/Lose* (2009) or *One Chance* that make theoretically irreversible changes in the game or its platform, the material modification of property substitutes for much more serious and equally permanent alterations—death, forgetting, the sacrifice of technical independence. *Lose/Lose* looks like *Space Invaders*, except that each alien represents a file on the player's computer. Choosing to slay an alien, then, means losing a file permanently from one's computer, leading at least one antivirus company to label the game as malware. Gage describes the game as cracking open the black box of our devices:

> By way of exploring what it means to kill in a video-game, *Lose/Lose* broaches bigger questions. As technology grows, our understanding of it diminishes, yet, at the same time, it becomes increasingly important in our lives. At what point does our virtual data become as important to us as physical possessions? If we have reached that point already, what real objects do we value less than our data? What implications does trusting something so important to something we understand so poorly have?[87]

Cynically, perhaps, we might argue that in a capitalist society, the mapping of loss onto the destruction of property is the quickest way to draw attention to the gravity of the situation. Instead of celebrating play, we might think of legacy games as deliberately bracketing themselves with two antiestablishment acts—opening itself dissipates the collector's value of such games, and these games willingly dispense with their replay value by allowing their assets to be exhausted. Already, gamers increasingly are having trouble with endings. Not only do players rarely complete today's AAA-blockbuster games, with their much-advertised "x+ hours of gameplay," but both simple and more complicated storylines like the Bioware games offer multiple endings, making it difficult for any one player to see all the possible endings. In a way, both the high-wire suspension acts of permadeath gaming (How long can she live? How long can he travel east?) and extreme efforts to keep outdated games alive via emulation or physical continuity (some players keep the same game running for years or even decades on archaic consoles, because of battery life or other issues that threaten saved progress),[88] are ways to resist the steady march of industry obsolescence so carefully orchestrated by game marketers.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Death in Real Life

Games that grapple with actual death represent the limit-case for permadeath gaming. At GDC 2010 in San Francisco, Eric Zimmerman offered a "real-life permadeath" game design challenge, which asked preselected competitors to pitch games incorporating death in the real world. The three entries, dubbed *Last Game and Testament*, *HeavenVille*, and *Karma*, hypothetically tackled the composing of wills, building social networks out of dead people, and facing death as the terminally ill, respectively. *HeavenVille,* which was envisioned as a parody of Zynga *FarmVille*–style games in its zealous leveraging of social networks, won top honors. Chris Remo noted in 2010 on *Gamasutra* that its mastermind Jenova Chen (of *Flower* and *Journey*) advertised the game as a kind of "stock market for dead people," where one could beat out other players by shrewdly investing in relative unknowns who later became popular or assembling blue-ribbon portfolios of celebrities, dignitaries, and laureates. Other noteworthy games that confront both personal and widespread death include Numinous Games' *That Dragon, Cancer* (2016), which relates designers Ryan and Amy Green's experience of caring for a terminally ill child, and "serious" games like Susana Ruiz's *Darfur Is Dying* (2006), about genocidal killing in Sudan; *Hush* (2008), which offers a glimpse into Hutu-Tutsi murders in Rwanda; or *This War of Mine* (2014), supposedly inspired by the experience of civilians during the early 1990s siege of Sarajevo in the Bosnian War. While most player death that occurs in permadeath games does not occur in a politically, socially, or environmentally inflected way, it is likely that games will continue to breach the already fragile barrier between fiction and reality, with inevitably mixed results.

All of these games share with Weisman's *The World without Us* a certain willingness to raise the specter of death and a kind of morbid fascination with afterlife—but whereas most permadeath games by definition end with the death of the player-character, even the "real-life" GDC permadeath games *Last Game and Testament* and *Karma*, Weisman's thought experiment begins with the disappearance of human life. At its most basic level, *The World without Us* works with the uncomfortable knowledge that life would likely continue after our demise, though perhaps in forms unrecognizable to us today. While permadeath game narratives are arguably as much about the scene and cause of death as what comes before, *The World without Us* denies us the morbid pleasure of the death act—was it nuclear war or drastic climate alteration?

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Alien invasion or microbial infection? We have no idea, because Weisman's book imagines the consequences of our absence, something that permadeath games only obliquely address through their obsession with survival. A more ecological version of permadeath might take the time to envision life after player death or even give players the option to play nonhuman or even nonbiological characters upon player-character death. Perhaps a *HeavenVille* renamed *HumusVille* (an homage to Haraway's fondness for humus) would not only have awarded points for famous dead people, but also the rapidly growing ranks of extinct species.

Again, death is not just spectacular and violent but also a refusal of continuation. Players who refuse to reload, replay, or resort to artificial means of prolonging a play session are not unlike members of the fringe Voluntary Human Extinction Movement (VHEMT), pronounced "vehement," and the Church of Euthanasia. VHEMT's figurehead "Les U. Knight" proclaims a stance redolent of deep ecology in its insistence that humans do nothing positive for the world that isn't for themselves. Although their language of "breeding" applied to human reproduction could raise the hackles on even the nonchildbearing, VHEMT's motto of "live long and die out" recognizes the value of already created human life, but focuses almost entirely on people not producing more people. Those who are concerned about population dynamics and about the fundamental barrier to sustainable human relations with each other and the planet need not raise the specter of Malthus or Ehrlich.

Interestingly, a recently proposed MMO called the *Chronicles of Elyria* promises an innovation on game permadeath. The game is advertised as "the first MMORPG where your character ages and dies, encouraging you to think beyond your character to their role in a larger story." Families become the method for inheritance and choosing your next character. Players may have children and reserve them as their official Heirs, although strangely they are thereby kept out of the game world until the original characters pass away. Echoing *Eco*, *Chronicles of Elyria* also stresses sustainability: "Fearless in its design, it embraces a character's ability to impact other characters. A closed economy, finite resources, non-repeatable quests, and a fully destructible environment means the world is experienced differently for every character."[89] Yet despite claims to fearlessness, in *Chronicles*, there is "dying" and there is "DYING"—players may receive fatal wounds and temporarily have their souls separated from their bodies, but this is not the same as the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

character's permadeath, even if each temporary death does shorten the character's lifespan.

Remediation and Repair

To summarize, those who write about game death usually argue that it is temporary, "frequent and inconsequential," even if it often entails a small penalty of some kind. Bartle treats game death as a designed bound on player experience, while Jesper Juul sees all game death as time lost, whether it is spent watching a death sequence, clearing back to the area where you were killed, or waiting for your game to reload. In contrast, writers, players, and designers engaging with the permadeath mechanic stress its ability to provide greater challenge and to heighten the emotional significance of narrative and gameplay. Both of these are arguably evident in the iOS game *One Single Life* (2011), from Australian game studio FreshTone Games, which simulates urban parcour and constantly reminds you of how unlikely it is that you will reach the next stage and the fragility of your hopes. Brendan Keogh's *Towards Dawn Minecraft* experiment, in which he chronicled his character's journey ever east, to be terminated at once upon in-game death, also speaks to the peculiar poetry of permadeath.

Naturally, what interests me from an ecocritical perspective is this weighty sense that permadeath is, above, all "irrevocable,"[90] and Dan Dixon's related suggestion that anxiety over game death is really anxiety over the closing down of options.[91] These are mental states that correspond almost exactly with the anticipation of environmental destruction, from climate "tipping points" to species extinction. Video game players of recent generations have grown accustomed to a generous cushion for failure, and although such flexibility helpfully encourages new or lapsed players to pick up a game that might otherwise appear too intimidating, it also permits play to feel as consequence-free as Johan Huizinga once imagined through the figure of the magic circle. For that reason, in this chapter I have explored how the rise in ludic experiments with the mechanics of mortality relates to contemporary issues surrounding the Anthropocene. The renewed interest in permadeath and legacy gaming in a time when we are confronting permanent global environmental change is not explained entirely by the standard hermeneutics of apocalypse and postapocalypse already extensively documented in science fiction and the cinematic blockbuster. I have taken as my guiding principle ecological collapse, because it shifts the focus from individual failure to collective,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

interlocking breakdown. Thus Jared Diamond urges us not to fool ourselves into thinking that dramatic improvement in any one area will fix the world's current course. Correcting our ills will require dramatic improvement on most, if not all, fronts—agriculture, aquaculture, population, industry, political will, and on and on.

My interest in collapse also stems from its relation to time, much as Doane elaborated with regard to catastrophe. Although collapse and permadeath both gain exigency from their irreversibility, embedded in the very term *collapse* is another, less punitive temporality, for a lapse is only a temporary interval, even as it more pointedly connotes straying into error and laxity of will. Environmentalist rhetoric exploits both time schemes (lapse and collapse), the latter to chasten us into action with the threat of the irreparable, the former to forgive any past infractions as long as present action is directed toward averting disaster. The proverbial carrot and the stick. Lapse and collapse also figure in what scientists call ecological hysteresis, the time lag between changes in effects and observable phenomena. Finally, as Keogh, Rousse, and others observe, permadeath plays with perceptions of risk. Just as Anthony Giddens and Ulrich Beck have described a world "risk society" largely produced by consciousness of environmental hazard, Keogh describes the permadeath mode of gameplay as one based on caution/consideration, vulnerability, and risk aversion, rather than more standard experimentation, risk-taking, and replay. If knowledge of the possibility of permadeath already leads players to structure their gameplay differently, perhaps an environmental permadeath game would encourage those very habits of conservation, thrift, and care needed to salvage Planet A.

As a final rumination on permadeath, I would be remiss not to mention Bonnie Ruberg's recent essay on "permalife" games,[92] in opposition to the masculine hardcoreness of permadeath games. In a game like Mattie Brice's *Mainichi* (2012), one finds oneself stuck in a Groundhog's Day loop of never-ending microaggressions, within which the reflex to hit "Escape" to terminate gameplay takes on an entirely new significance. Permalife challenges resonate with Haraway's staying with the trouble[93]—just as the queer protagonist of *Mainichi* must go on living, day after day, in a world hostile to her gender nonconformity, we must go on living in a world that is, in some respects, broken. Perhaps, as Steven Jackson writes in "Rethinking Repair," we must learn to exercise "broken-world thinking,"[94] whether in regards to Edward Burtynsky's e-waste and shipbreaker photographs or, I would add,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

postapocalyptic games like Nintendo's *Splatoon* (2015) and Bethesda's *Fallout* series. Confirming the efforts of rambunctious gardeners and gamers across the globe, Jackson reassuringly proclaims, "So the world is always breaking; it's in its nature to break."[95] In sum, both analog and digital games offer some of the most thought-provoking representations of collapse dynamics in our culture today, from *Eco*'s ludic experiments in collective survival to *Seafall*'s material transience. Although it would be interesting to shift the register from survival games to subsistence games, as the latter connotes purposeful limitation, less heroic and usually manly bootstrapping than simplicity and economy in all things, asking these fundamental questions about the ways in which games model death has allowed us to identify and address telling lacunae in the study and reception of games. Environments may range widely in terms of detail and visual fidelity, from the relatively impoverished worlds of text-based or single-screen games to the intricate and immersive three-dimensional worlds of massively multiplayer online games and blockbuster console games, but what changes when the environment itself is at stake in play?

Along with the current groundswell of cross-disciplinary interest in environmental criticism in the aftermath of Deepwater Horizon, Hurricanes Katrina and Sandy, and largely ineffectual international attempts to mitigate climate change, permadeath and permalife games are evidence of both fresh wounds and a tremulous excitement over the ways that scholarship can stretch beyond classroom walls and printed pages to the world we inhabit. Notwithstanding their compromised provenance (chapter 4), contemporary games excel at Anthropocenic world-building, evident in these recent formal and generic experiments in nonhuman gameplay and so-called permanent death and legacy mechanics. Although many will doggedly rebel against the proposition that something as patently artificial as a game world might be thought of as environmental, numerous indications point to games' longstanding indebtedness to the natural world, whether for raw material for hardware, energy, aesthetic inspiration, mobile context, or as the model for lively processes. As the preceding chapters have shown, our experiences of the natural world have been increasingly mediated by digital technologies, and while environmentalism, environmental science, and environmental history have by now a decades-long intellectual history, environmental media scholarship remains relatively untested. For now, too, a disheartening majority of mainstream game environments still falls into what I have called the

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

"graphical spectacle" and "resource extraction" camps of environmental modeling. This book urges us to imagine otherwise. In matters of experimentation, scale, the more-than-human, entropy, and collapse, games lend themselves to the representation and exploratory manipulation of simulated ecological functions, and they seem especially well equipped to remedy the common difficulties faced by environmental educators and activists—including the question of how to successfully render the scope and urgency of global environmental change in less didactic or declamatory and more dynamic and intrinsically engaging forms.

Throughout this work, game environments have always designated more than a game's scenery, or the pictorial components of its in-game world, or diegesis. Though many remember the scrolling clouds and colorful obstacles of *Super Mario Bros.* (1985), or the desert sands and garden palaces of *Prince of Persia* (1989–), as the defining elements of their respective game settings, game environments extend beyond surface appearances to the underlying mechanics with which programmers establish the "rules" of game universes. From motion physics to seasons and climatic zones, from resource availability and creature "spawn" rates to concept art and ambient sounds, players operate within a multitude of environmental parameters that determine not only what game worlds look like, but also how they respond to player input. Yet ecological game analysis does not stop there. It extends outward to the ambient contexts of play, everything from the rat's nest of cables and thermodynamic swamp created by high-end gaming hardware, to the swirl of ancillary activity around the augmented-reality player or the weather conditions ideal for virtual pets. For that reason, I have deliberately treated media and mediation in a radically expanded fashion while holding to a fairly narrow definition of ecology as the science presaged by figures like Ernst Haeckel and Jakob von Uexküll, rather than a looser suggestion of significant interrelation implied by terms like political or media ecology. Elsewhere, to similar ends, I have tried to repurpose Jay David Bolter's and Richard Grusin's now classic formulation of media remediation by incorporating definitions of remediation drawn from environmental toxicology.[96] In essence, I argue that games in particular and digital media in general not only refashion other media but also have curative potential. Media are undeniably part of the problem, as Richard Maxwell and Toby Miller, Jonathan Sterne, Jussi Parikka, and Nadia Bozak have cataloged in terms of energy, resources, waste, planned obsolescence, and greenwashing, but they may also present

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

part of the solution. I cannot help but think here of Jennifer Gabrys's work on environmental sensing, and how, like the sensor-actuator model of an increasingly computational planet,[97] games make certain aspects of our environments knowable while also creating avenues for action. Less coincidental than providential, the two heretofore unrelated meanings of remediation ought to be permanently stitched together to remind us that the Earth itself, its atmosphere, and our bodies are media through which countless other things pass, and to call out the ameliorative capacity of cultural media forms.

At a time when the most basic preconditions for play are rapidly changing or dissipating—a stable climate, infrastructure and power supplies, and the raw materials out of which we fashion everything from chess sets to smartphones—we cannot afford to ignore the ecology of games, and not just video games, but games of all kinds. Even now, sea levels are rising to consume coastal golf courses,[98] soaring temperatures have tested ice arenas and jeopardized athletes and spectators in open-air stadiums,[99] and relentless planetary-scale warming is predicted to stymie the ability of all but a few cities to host international sporting events like the Winter Olympics, Paralympics, and FIFA World Cup.[100] It is all too clear that we cannot take this world for granted as we watch, create, and play games, however joyously. This may be our one chance to live, and play, deliberately.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:15 UTC
All use subject to https://about.jstor.org/terms

Acknowledgments

At a time when academic labor is so precarious, and writing, whether in print or online, is hardly in short supply, the opportunity to compose and publish a book based on one's most cherished ideas is a privilege so heady, it is almost scandalous. I am lucky to have the chance to express my deepest appreciation to many years' worth of teachers, mentors, colleagues, collaborators, and students, without whom I would not be the person and scholar I am today. My first thanks go to Kandice Chuh, Matthew Kirschenbaum, and Jeanne Fahnestock, for showing me that the humanities are capacious disciplines; Charis Thompson, Gail De Kosnik, Trinh T. Minh-ha, and especially David Bates, for their guidance and support in the early research and writing for this book; Greg Niemeyer, for allowing me to practice what I preach about environmental game design; Victoria Ford Smith, Yohei Igarashi, Fiona Somerset, Chris Vials, and Cathy Schlund-Vials, for their thoughtful companionship through two Connecticut winters; and many other friends from across the disciplines who have regularly rescued me from tunnel vision, notable among them Kris Fallon, Kris Trujillo, Zach Blas, Irene Chien, Brooke Belisle, Tung-Hui Hu, Ashley Ferro-Murray, Claudia Salamanca, Chris Goetz, Bonnie Ruberg, Jen Schradie, Zach Horton, and particularly Danielle Svehla Christianson, who has always encouraged me to raid the halls of science without undue fear.

I am also indebted to several talented editors and coeditors for their commitment to field-expanding work: Katrina Dodson, whose curated ecocriticism issue of *Qui Parle* in many respects launched me toward these pages; Kimberly Coulter, of *Ant, Spider, Bee*; Elizabeth Swanstrom, of *electronic book*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:18 UTC
All use subject to https://about.jstor.org/terms

review; Nicole Starosielski, who coedited *Sustainable Media*; Jesús Costantino and Braxton Soderman, with whom I oversaw a special issue of the *Journal of Gaming & Virtual Worlds* on permadeath and precarity in games; John Parham, who graciously invited me to help steer a special issue of *Ecozon@* on "green" computer and video games; and of course, former Humanities Editor Danielle Kasprzak and Editorial Assistant Anne Carter of the University of Minnesota Press. My thinking has been similarly enriched by the many, many copanelists and fellow travelers with whom I have discussed my work over the last decade at meetings of the Society for Literature, Science, and the Arts, the Association for the Study of Literature and Environment, the Modern Language Association, and the Society for Cinema and Media Studies.

I am incredibly fortunate to now teach and research at the University of California, Santa Barbara, whose longstanding investments in environmental science, environmental studies, the environmental humanities, and environmental media make for an exciting and busy intellectual milieu. While I wish I could individually name all of my colleagues who are deserving of recognition, I want to explicitly acknowledge Melody Jue, who shares my fascination with science and the natural world; Laila Shereen Sakr, who cofounded the Wireframe Media Studio with me in 2015; Bhaskar Sarkar, Bishnupriya Ghosh, and Jennifer Holt, for their unwavering support; and Janet Walker, whose unflinching dedication to both environmental justice and the theory and practice of media I find perpetually inspiring. I am just as grateful for the truly impressive graduate students who have been my interlocutors and instructors since my return to California, including Lisa Han, Ahmed Asi, Jeremy Moore, Alexander Champlin, Aleah Kiley, Rachael Ball, Daniel Bydlowski, Tyler Morgenstern, Keita Moore, and Intae Hwang.

Playing Nature would not have been possible without the thoughtful feedback of my readers, Matthew Fuller and Allison Carruth, as well as stimulating conversations with many of the individuals who appear in this book or helped provide ancillary context: Jenova Chen, thatgamecompany; Amy Franceschini, Futurefarmers; David Gleeson, Michael Mansfield, Chris Melissinos, and Georgina Goodlander, of the Smithsonian American Art Museum's exhibit on "The Art of Video Games"; Konstantin Mitgutsch, formerly of the GAMBIT Game Lab, and Jason Haas of the Education Arcade at MIT; Tracy Fullerton, director of the Game Innovation Lab at University of Southern California; John Krajewski, CEO of Strange Loop Games; and Stanford University professor Ingmar Riedel-Kruse. Importantly, much of the research

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:18 UTC
All use subject to https://about.jstor.org/terms

for this book was also completed with funding assistance from the Arts Research Center and Berkeley Center for New Media at UC Berkeley, a 2017–18 Hellman Family Faculty Fellowship, and a 2015–16 Junior Faculty Manuscript Workshop Grant provided by the University of California Office of the President Multicampus Research Programs and Initiatives and the UC Humanities Research Institute. Special thanks, again, to the participants in that workshop: Colin Milburn, Allison Carruth, Peter Krapp, Stephanie Boluk, and Soraya Murray.

Above all, I want to thank my family—my mother, Gail, who will never see this book but bestowed a lasting belief in the value of hard work; my father, Ben, for not being too terribly disappointed that both of his children turned out to be humanities majors; my brother, Edmond, for lighting my way through the trials and joys of academic life with his own brilliant individuality; and finally, my husband, Brian, and my son, Elliot, who remind me every day that playtime is for everyone.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:18 UTC
All use subject to https://about.jstor.org/terms

This page intentionally left blank

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:18 UTC
All use subject to https://about.jstor.org/terms

Notes

Introduction

1. Henry David Thoreau, *Walden*, ed. J. Lyndon Shanley (Princeton, N.J.: Princeton University Press, 1971).

2. See Kathryn Schulz's memorably entitled "Pond Scum," in the *New Yorker*, October 12, 2015, which set off a lively debate over the merits of Thoreau's writing and philosophy.

3. "U.S. Cities Are Home to 62.7 Percent of the U.S. Population, but Comprise Just 3.5 Percent of Land Area," United States Census Bureau Release Number CB15–33, March 4, 2015, https://www.census.gov/newsroom/press-releases/2015/cb15-33.html.

4. "Mobile Fact Sheet," Pew Research Center Internet & Technology, February 5, 2018, https://www.pewinternet.org/fact-sheet/mobile/.

5. Some studies suggest that natural representation may have migrated from older to newer formats, for instance away from traditional children's picture books, as the increasing proportion of illustrated built environments reflects the growing urbanization of childhood. See J. Allen Williams Jr., Christopher Podeschi, Nathan Palmer, Philip Schwadel, and Deanna Meyler, "The Human-Environment Dialog in Award-Winning Children's Picture Books," *Sociological Inquiry* 82, no. 1 (February 2012): 145–59, doi: 10.1111/j.1475–682X.2011.00399.x.

6. For a helpful overview of the existing relationship between game studies, visual culture research, and cultural studies, see Soraya Murray, *On Video Games: The Visual Politics of Race, Gender, and Space* (London: I. B. Tauris, 2017).

7. PlayStation, Twitter post, May 11, 2018, https://twitter.com/PlayStation/status/994932916605120513?ref_src=twsrc%5Etfw. The quote seems to have originated with Britt Peterson, "Can a Video Game Capture the Magic of Walden?" *Smithsonian Magazine*, March 2017, https://www.smithsonianmag.com/arts-culture/can-video-game-capture-magic-walden-180962125/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

8. Henry D. Thoreau, "Ktaadn and the Maine Woods. No. V: The Return Journey," *Sartain's Union Magazine*, November 1848, 217.

9. Richard Louv, *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder* (Chapel Hill, N.C.: Algonquin Books, 2005).

10. Although Louv moderated his stance on technology in a subsequent book, *The Nature Principle: Reconnecting with Life in a Virtual Age* (Chapel Hill, N.C.: Algonquin Books, 2011), in which he cautiously allowed for some potential benefits to electronic mediation, in *Vitamin N: The Essential Guide to a Nature-Rich Life* (Chapel Hill, N.C.: Algonquin Books, 2016), he returned to calling for more independent, natural play, evident in a suggested-activities section proudly entitled "These Games (from Around the World) Will Not Be Digitized."

11. I share Anna McCarthy's concern with the term "public" as erasing the use of television (and I would add gaming) in ostensibly public places to create private bubbles of experience. So the term should be used with caution.

12. Katie Salen, ed., *The Ecology of Games: Connecting Youth, Games, and Learning* (Cambridge, Mass.: MIT Press, 2008).

13. Erle C. Ellis and Navin Ramankutty, "Putting People in the Map: Anthropogenic Biomes of the World," *Frontiers in Ecology and the Environment* 6, no. 8 (2008): 439–47.

14. Paul J. Crutzen and Eugene F. Stoermer, "The 'Anthropocene,'" *Global Change Newsletter* 41 (2000): 17–18. Stoermer used the term as early as the 1980s but it did not become commonplace until Crutzen's involvement. Technically speaking, we still live in the Holocene, although the Anthropocene has attracted numerous adherents.

15. Ellis and Ramankutty, "Putting People in the Map," 445.

16. Ellis and Ramankutty, "Putting People in the Map," 446.

17. Armand D'Angour, "Plato and Play: Taking Education Seriously in Ancient Greece," *American Journal of Play* 5, no. 3 (Spring 2013): 293–307. In fact, the Greek terms for play (*paidia*) and game (*ludus*) were famously adopted by the French sociologist Roger Caillois in his book *Man, Play, and Games*, trans. Meyer Barash (Urbana: University of Illinois Press, 2001) and later theorists such as Gonzala Frasca, to describe the spectrum of difficulty and structure between formal and informal play.

18. Katie Salen and Eric Zimmerman, eds., *Rules of Play: Game Design Fundamentals* (Cambridge, Mass.: MIT Press, 2003) and *The Game Design Reader: A Rules of Play Anthology* (Cambridge, Mass.: MIT Press, 2005); Espen J. Aarseth, *Cybertext: Perspectives on Ergodic Literature* (Baltimore: Johns Hopkins University Press, 1997); Alexander R. Galloway, *Gaming: Essays on Algorithmic Culture* (Minneapolis: University of Minnesota Press, 2006); Noah Wardrip-Fruin, *Expressive Processing: Digital Fictions, Computer Games, and Software Studies* (Cambridge, Mass.: MIT Press, 2009); Ian Bogost, *Persuasive Games: The Expressive Power of Videogames* (Cambridge, Mass.: MIT Press, 2007); Jesper Juul, *Half-Real: Video Games between Real Rules and Fictional Worlds* (Cambridge, Mass.: MIT Press, 2005); Constance A. Steinkuehler and Dmitri Williams, "Where Everybody Knows Your (Screen) Name: Online Games as 'Third Places,'" *Journal of Computer-Mediated Communication* 11 (2006): 885–909; Nicholas Yee, "Ariadne—Understanding MMORPG Addiction," October 2002, http://www

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

.nickyee.com/hub/addiction/home.html; Edward Castronova, *Synthetic Worlds: The Business and Culture of Online Games* (Chicago: University of Chicago Press, 2006); T. L. Taylor, *Raising the Stakes: E-sports and the Professionalization of Computer Gaming* (Cambridge, Mass.: MIT Press, 2012).

19. Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, N.C.: Duke University Press, 2007).

20. Jeff Tollefson, "Splinters of the Amazon," *Nature* 496 (April 2013): 286–89.

21. See Robert H. MacArthur and Edward O. Wilson, *The Theory of Island Biogeography* (1967; rpt., Princeton, N.J.: Princeton University Press, 2001); and William F. Laurance, Henrique E. M. Nascimento, Susan G. Laurance, Ana Andrade, Robert M. Ewers, Kyle E. Harms, Regina C. C. Luizão, and José E. Ribeiro, "Habitat Fragmentation, Variable Edge Effects, and the Landscape-Divergence Hypothesis," *PLoS ONE* 2, no. 10 (2007): e1017, doi: 10.1371/journal.pone.0001017.

22. Marie Laure-Ryan has emphasized immersion as one of the key qualities of virtual reality since 2001, updating the claim in *Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity in Literature and Electronic Media* (Baltimore: Johns Hopkins University Press, 2015).

23. As outlined in Paul Baran's "On Distributed Communications Networks," *IEEE Transactions on Communications Systems* 12, no. 1 (March 1964); and Johan Huizinga, *Homo Ludens: A Study of the Play Element in Culture* (Boston: Beacon Press, 1971).

24. Gonzala Frasca, "What Is Ludology? A Provisory Definition," *Ludology.org*, July 8, 2001, accessed December 28, 2016. Ludology is Frasca's term for "the discipline that studies games" (but really all forms of play, including toys and nondigital games), and is derived from the Latin term for game, *ludus*.

1. Mesocosm

1. Motivated by the need for science education, Riedel-Kruse and his colleagues have developed these games because they acknowledge a fundamental human tendency "to toy around with objects." See Seung Ah Lee, Alice M. Chung, Nate Cira, and Ingmar H. Riedel-Kruse, "Tangible Interactive Microbiology for Informal Science Education," *TEI '15*, January 16–19, 2015, Stanford, CA, ACM, doi: 10.1145/2677199.2680561.

2. "What Is a Mesocosm?" MESOAQUA Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean, http://mesocosm.eu/about/what-is-a-mesocosm/.

3. Matthew C. Watts and Grant R. Bigg, "Modelling and the Monitoring of Mesocosm Experiments: Two Case Studies," *Journal of Plankton Research* 23, no. 10 (2001): 1081–93.

4. Rebecca I. A. Stewart, Matteo Dossena, David A. Bohan, Erik Jeppesen, Rebecca L. Kordas, Mark E. Ledger, Mariana Meerhoff, Brian Moss, Christian Mulder, Jonathan B. Shurin, Blake Suttle, Ross Thompson, Mark Trimmer, and Guy Woodward, "Mesocosm Experiments as a Tool for Ecological Climate-Change Research," *Advances in Ecological Research* 48 (2013): 78, doi: 10.1016/B978-0-12-417199-2.00002-1.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

5. Castronova, *Synthetic Worlds*.

6. See, for instance, Gary Alan Fine's tripartite understanding of what we typically call "the player" as simultaneously person, player, and character in *Shared Fantasy: Role-Playing Games as Social Worlds* (Chicago: University of Chicago Press, 1983), or Adrienne Shaw's disentangling of player identification and representation in games in *Gaming at the Edge: Sexuality and Gender at the Margins of Gamer Culture* (Minneapolis: University of Minnesota Press, 2014).

7. I am indebted here to essays like Jean-Paul Thibaud's "Sonic Composition of the City," which reflects on the nascent culture of the Sony Walkman, in *The Auditory Culture Reader*, ed. Michael Bull and Les Back (Oxford: Berg, 2003), 329–41.

8. Jennifer Gabrys revisits the term environmentality from Michel Foucault's late lectures on biopolitics in *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (Minneapolis: University of Minnesota Press, 2016).

9. John David Funge, *Artificial Intelligence for Computer Games: An Introduction* (Wellesley, Mass.: A. K. Peters, 2004).

10. Raymond Williams, *The Country and the City* (Oxford: Oxford University Press, 1975), 54.

11. Bonnie A. Nardi, *My Life as a Night Elf Priest: An Anthropological Account of World of WarCraft* (Ann Arbor: University of Michigan Press, 2010); and Nick Yee, "The Virtual Skinner Box," in *The Norrathian Scrolls: A Study of EverQuest* (version 2.5), 2001, http://www.nickyee.com/eqt/skinner.html.

12. Timothy Morton, *Ecology without Nature: Rethinking Environmental Aesthetics* (Cambridge, Mass.: Harvard University Press, 2007), 33. Morton quotes from Lawrence Buell, *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture* (Cambridge, Mass.: Harvard University Press, 1995).

13. Morton, *Ecology without Nature*, 34.

14. Dana Phillips, *The Truth of Ecology: Nature, Culture, and Literature in America* (Oxford: Oxford University Press, 2003), 6, 7.

15. Phillips, *The Truth of Ecology*, 17.

16. Morton, *Ecology without Nature*, 1, 3. Perhaps because the nature-writing tradition and poetic precursors in the Romantic period are so strong, ecocritical perspectives have thus far been largely confined to conventional literary objects.

17. Phillips, *The Truth of Ecology*, 15.

18. James Paul Gee, *What Video Games Have to Teach Us about Learning and Literacy* (New York: Palgrave Macmillan, 2007), 26; Ian Bogost, *Persuasive Games: The Expressive Power of Videogames* (Cambridge, Mass.: MIT Press, 2007), 120.

19. ELIZA was a natural-language processing program written by Joseph Weizenbaum at MIT in the 1960s that most famously simulated a Rogerian psychotherapist in its interaction with users.

20. Dennis G. Jerz, "Somewhere Nearby Is Colossal Cave: Examining Will Crowther's Original 'Adventure' in Code and in Kentucky," *Digital Humanities Quarterly* 1, no. 2 (2007), sec. 76.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

21. Rick Adams, "Colossal Cave Hints," http://www.rickadams.org/adventure/d_hints/index.html.

22. Roger W. Brucker and Richard A. Watson, *The Longest Cave* (New York: Knopf, 1976), 109.

23. Nick Montfort, *Twisty Little Passages: An Approach to Interactive Fiction* (Cambridge, Mass.: MIT Press, 2003).

24. Morton, *Ecology without Nature*, 33, emphasis in original.

25. Henry Jenkins, "Game Design as Narrative Architecture," in *The Game Design Reader: A Rules of Play Anthology*, ed. Katie Salen and Eric Zimmerman (Cambridge, Mass.: MIT Press, 2005), 676.

26. Buell, *The Environmental Imagination*, 7.

27. See for instance Dean Takahashi, "Game Review: *Flower* for the PlayStation 3 Breathes Life into Stale Games," *VentureBeat*, February 9, 2009, https://venturebeat.com/2009/02/09/review-flower-for-the-playstation-3-breathes-live-into-stale-games/; or Ryan Clements, "*Flower* Review," *IGN*, February 9, 2009, https://www.ign.com/articles/2009/02/09/flower-review.

28. Ursula K. Le Guin, *The Lathe of Heaven* (New York: Scribner, 2008).

29. Timothy Morton, *The Ecological Thought* (Cambridge, Mass.: Harvard University Press, 2010). Morton sets his vision of ecological thinking against many of the established precepts of modern environmentalism, arguing that we should think globally, not locally, big, not small, celestial, not terrestrial, and so on.

30. Tom Hoggins, "*Flower* Video Game Review," *Telegraph*, February 13, 2009, https://www.telegraph.co.uk/technology/video-games/4611024/Flower-video-game-review.html.

31. Katherine Isbister, *How Games Move Us: Emotion by Design* (Cambridge, Mass.: MIT Press, 2016).

32. Antonio Damasio, *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain* (Orlando, Fla.: Harcourt, 2003), 57.

33. Damasio, *Looking for Spinoza*, 7.

34. Edward Rothstein, "Realism May Be Taking the Fun Out of Games," *New York Times*, April 6, 2002.

35. Castronova, *Synthetic Worlds*, 88.

36. Castronova, *Synthetic Worlds*, 89.

37. While Castronova claims U.S. Air Force Colonel Jack Thorpe originated the term "selective fidelity," Thorpe himself credits Dr. Robert Jacobs of the defense contractor Perceptronics: Jack Thorpe, "Trends in Modeling, Simulation, and Gaming: Personal Observations about the Past Thirty Years and Speculation about the Next Ten," *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC)*, Orlando, Fla., December 2010, www.iitsecdocs.com/, 7.

38. Galloway, *Gaming*.

39. Jenova Chen (creative director, thatgamecompany), in conversation with the author, San Francisco, March 2010.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

40. Andy Clark, *Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence* (Oxford: Oxford University Press, 2003), 11.

41. Gee, *What Video Games Have to Teach Us about Learning and Literacy*; Nardi, *My Life as a Night Elf Priest*; N. Katherine Hayles, *How We Think: Digital Media and Contemporary Technogenesis* (Chicago: University of Chicago Press, 2012).

42. Henry Jenkins, "'Complete Freedom of Movement': Video Games as Gendered Play Spaces," in *From Barbie to Mortal Kombat: Gender and Computer Games*, ed. Justine Cassell and Henry Jenkins (Cambridge, Mass.: MIT Press, 1998), 263.

43. Lisa Nakamura, *Cybertypes: Race, Ethnicity, and Identity on the Internet* (New York: Routledge, 2002).

44. Entertainment Software Association, "2016 Annual Report," https://www.theesa.com/wp-content/uploads/2016/12/ESAAnnualReport2016.pdf.

45. I am thinking, for instance, of Lev Manovich's concept of meta-media as well as recent debates in environmental aesthetics between the relative merits of cognitivist (say, with knowledge of scientific processes) versus more intuitive phenomenological approaches to appreciating natural beauty. See Morton, *Ecology without Nature*, 32; Lev Manovich, "Data Visualization as New Abstraction and Anti-Sublime," in *Small Tech: The Culture of Digital Tools*, ed. Byron Hawk, David M. Rieder, and Ollie O. Oviedo (Minneapolis: University of Minnesota Press, 2008); and Allen Carlson and Arnold Berleant, eds., *The Aesthetics of Natural Environments* (Peterborough, Ont.: Broadview, 2004).

46. Jerz, "Somewhere Nearby Is Colossal Cave." Jerz and coauthor David Thomas revisit *Adventure* and caves as a classic game topos in "Cave Gave Game: Subterranean Space as Videogame Place," *electronic book review*, October 6, 2015.

47. The emphasis on the second person may seem at first glance to offer a distinct difference from the usual first person of ecomimetic description. Notice, however, that Morton's first example of ecomimesis in "The Art of Environmental Language" is Denise Levertov's poem, "To the Reader," which addresses its reader with the repeated strain "As you read," which for Morton is simply an inversion of the ecomimetic "as I write." According to Morton, in Levertov's poem "the effect is the same, or even stronger, for, as in advertising language, 'you' becomes a niche in the text, specifically designed for the actual reader" (*Ecology without Nature*, 30). Thus the use of the second person does not automatically invalidate the walkthrough's ecomimetic properties.

48. For example, YouTuber ZversusA has posted an entire series of "nature walks" that take place in zones from Bethesda games. Other players have posted tutorials on how to alter *Skyrim*'s frozen environment to look more like the lush greenery of *Oblivion*, should you find *Skyrim*'s unrelieved snowiness objectionable. Curiously enough, once you start hunting for these types of videos, they start to show up in search results alongside articles like one *Men's Fitness* piece that encourages readers to take walks outside to relieve depression.

49. Miguel Penabella, "Why Are We So Afraid to Walk?" *Kill Screen*, October 27, 2015, https://killscreen.com/articles/why-are-we-so-afraid-walk/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

50. Wallace Stevens, "Of the Surface of Things," Academy of American Poets, https://www.poets.org/poetsorg/poem/surface-things.

51. See Eric Swain, "'9.03M': A First Person Walker Critique," February 5, 2014; and "The Original First Person Walker: 'Dear Esther,'" February 11, 2013, in *PopMatters*.

52. This was part of Key's response to the question of whether he found the term "walking simulator" derogatory, from an interview conducted by Rainer Sigl for his "First Person Walkers" article on the site videogametourism.at. English-language footnotes were posted April 29, 2014, but the article itself is in German.

53. Dr. Jaroslav Švelch, "Computer Games as Resistance in Soviet Era Czechoslovakia: A Heritage of Political Participation through Game Design" (Talk given at UC Santa Barbara, April 6, 2016). Švelch is also the author of *Gaming the Iron Curtain: How Teenagers and Amateurs in Communist Czechoslovakia Claimed the Medium of Computer Games* (Cambridge, Mass.: MIT Press, 2018).

54. Chinese science-fiction author Cixin Liu has a particularly biting response to such criticisms in "Beyond Narcissism: What Science Fiction Can Offer Literature," trans. Holger Nahm and Gabriel Ascher, *Science Fiction Studies* 40, no. 1 (March 2013): 22–32.

55. The Campo Santo dev blog can be found at http://blog.camposanto.com/, and the posts particularly relevant to the *Firewatch* location research process include Jake Rodkin's "*Firewatch* Reference: Inside Fire Lookout Towers" on March 2, 2016, and "Lookouts We Have Known" on November 4, 2015.

56. Sue Thomas, "When Geeks Go Camping: Finding California in Cyberspace," *Convergence* 15, no. 1 (2009): 13–30.

57. Rebecca Solnit, *Wanderlust: A History of Walking* (New York: Penguin, 2000), 31.

58. Sobel has written extensively about environmental education, parenting, and the need to allow children to experience nature as "untutored savages." Aside from his many books, a number of his essays have appeared in the environmental magazine *Orion*, for instance "Look, Don't Touch," July/August 2012, https://orionmagazine.org/article/look-dont-touch1/. Lowell Monke also writes for *Orion*, for example, "Unplugged Schools," *Orion*, September/October 2007, https://orionmagazine.org/article/unplugged-schools/.

59. For an in-depth discussion of gamification see Steffen Walz and Sebastian Deterding's edited collection, *The Gameful World: Approaches, Issues, Applications* (Cambridge, Mass.: MIT Press, 2014).

60. Bruno Latour, *Politics of Nature: How to Bring the Sciences into Democracy,* trans. Catherine Porter (Cambridge, Mass.: Harvard University Press, 2004).

61. My understanding of pervasive play is largely indebted to the organizers and other participants in the CHI 2016 Pervasive Play workshop in San Jose, particularly Kari Kraus, Elizabeth Bonsignore, and Derek Hansen. A broader investigation of locative media can also be found in Jason Farman's *Mobile Interface Theory: Embodied Space and Locative Media* (New York: Routledge, 2012), and *The Mobile Story: Narrative Practices with Locative Technologies* (New York: Routledge, 2014).

62. Jussi Parikka and Jaakko Suominen, "Victorian Snakes? Towards a Cultural History of Mobile Games and the Experience of Movement," *Game Studies* 6, no. 1

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

(December 2006), http://gamestudies.org/0601/articles/parikka_suominen. Parikka and Suominen quote Espen Aarseth from MGAIN, "Mobile Entertainment in Europe: Current State of the Art," MGAIN-project Deliverable D.3.1.1., 2003, with url now unavailable.

63. Mary Flanagan, *Critical Play: Radical Game Design* (Cambridge, Mass.: MIT Press, 2009).

64. Jane McGonigal, "Why *I Love Bees*," in *The Ecology of Games: Connecting Youth, Games, and Learning*, ed. Katie Salen (Cambridge, Mass.: MIT Press, 2008), 7.

65. McGonigal, "Why *I Love Bees*," 6, 7, and 9.

66. Pierre Lévy, *Collective Intelligence: Mankind's Emerging World in Cyberspace*, trans. Robert Bononno (Cambridge, Mass.: Perseus, 1997).

67. Dave Szulborski, *This Is Not a Game: A Guide to Alternate Reality Gaming* (N.p.: Fiction Publishing, 2005).

68. As McGonigal notes, immersive games are not the same as pervasive games. The latter tends to describe gaming using mobile devices and global positioning system (GPS) technology, without the necessary addition of an alternate reality game scenario. Pervasive gaming has also been more popular in Asia and Europe, while immersive gaming has been more popular in America.

69. Jane McGonigal, "'This Is Not a Game': Immersive Aesthetics and Collective Play," *Proceedings of the International Digital Arts and Culture (DAC) Conference,* Melbourne, May 2003: 2, emphasis in original.

70. McGonigal notes that "ting" can serve as either noun or verb in immersive gamer parlance, as in the This Is Not a Game credo or the following action: "To 'TING' a game now means to explicitly deny and purposefully obscure its nature as a game, a task" ("'This is Not a Game,'" 4).

71. Qtd. in Brian Caulfield, "Will Wright: Games Invade Real World," *Forbes.com*, April 2, 2009. Caulfield summarizes Wright's predictions about the future of games, quoting from an interview given at a Web 2.0 expo in San Francisco in April of 2009. In Wright's words: "We're starting to see more and more games where who you are matters. You can map things on top of that world and play games." Wright cites as an example the Nintendo Wii console, which acts as a platform for what he calls "non-immersive" games. "Wright also wants to use games as just a starting point for exploration and creativity outside of games," notes Caulfield, who then references Wright's willingness to open *Spore*'s massive creature database up to alternative inspirations.

72. Aida Eltorie, Andy Garcia, Ilse Ruiz Mercado, and Greg Niemeyer, "The Black Cloud, 2007," http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.222.7495&rep=rep1&type=pdf.

73. Greg Niemeyer, Antero Garcia, and Reza Naima, "*Black Cloud*: Patterns towards Da Future" (Paper presented to the ACM International Conference on Multimedia, October 19–24, 2009, Beijing, China), 1073–82.

74. The term "pwn" comes from gamer lingo, meaning to defeat or overcome an opponent or obstacle in such a decisive manner that you can claim to have "owned"

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

it or the person. The misspelling supposedly derives from a typo that caught on and distinguished the term from its more mundane roots in sports and other competitive arenas, making it something peculiar to online or digital discourse enacted through keyboards and typed chatter.

75. See the 2004 report entitled "Struggling to Breathe: The Epidemic of Asthma among Children and Adolescents in the San Joaquin Valley," produced by the Central California Children's Institute at California State University, Fresno. Extensive data has also been collected by the Fresno Asthmatic Children's Environment Study (FACES), over a period of eight years from 2000 to 2008, sponsored by the UC Berkeley School of Public Health.

76. While I moved to the Los Angeles area a bit too late to play the LA River, I was fortunate enough to be given one of the project's lovely card decks by environmental humanities scholar and Project 51 member Allison Carruth.

77. "At the New California Academy of Sciences, Cinnabar's Climate Change Exhibits Speak Up about State's Environment and Future," September 18, 2008, accessed December 28, 2011, http://www.blooloop.com/PressReleases/-At-the-New-California-Academy-of-Sciences-Cinnabar-s-Climate-Change-Exhibits-Speak-Up-About-State-s-Environment-and-Future/990.

78. Scott Nicholson, "Peeking behind the Locked Door: A Survey of Escape Room Facilities," last modified May 24, 2015, http://scottnicholson.com/pubs/erfacwhite.pdf.

79. Qtd. in Carly Mallenbaum, "Why Escape Rooms Have a Lock on the U.S.," *USA Today*, April 25, 2018, https://www.usatoday.com/story/life/people/2018/04/25/escape-rooms-trend-us/468181002/.

80. "Our Themes," *BranchOut*, accessed June 4, 2018, https://www.branchoutgames.com/our-themes.html.

81. Olli Leino, Hanna Wirman, and Amyris Fernandez, *Extending Experiences: Structure, Analysis, and Design of Computer Game Player Experience* (Rovaniemi: Lapland University Press, 2008).

82. Ronald T. Azuma, "A Survey of Augmented Reality," *Presence* 6, no. 4 (August 1997): 355–85.

83. See Mat Paget, "*Pokemon Go* Players in Rural Areas Upset Over Lack of Gyms and PokeStops," *GameSpot*, July 11, 2016.

84. Alenda Chang, "Where the Wi-Fi Ends," *in medias res*, October 15, 2016, http://mediacommons.futureofthebook.org/imr/2016/10/15/where-wi-fi-ends.

85. To be fair, later analysis of the same Pew data at least made the case for games' civic *potential*, pointing to the highly social nature of play and the current lack of civic engagement games.

86. Sun Joo (Grace) Ahn, Jeremy N. Bailenson, and Dooyeon Park, "Short- and Long-Term Effects of Embodied Experiences in Immersive Virtual Environments on Environmental Locus of Control and Behavior," *Computers in Human Behavior* 39 (2014): 235–45.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

87. For example, see psychologist Terry Hartig's recent work in Sweden and Roger Ulrich's seminal study on the impact of nature views on patients' recovery in a Pennsylvania hospital, "View through a Window May Influence Recovery from Surgery," *Science* 224, no. 4647 (April 27, 1984): 420–21.

88. Galloway, *Gaming*, 5.

89. Bogost, *Persuasive Games*, 188.

90. Galloway, *Gaming*, 16.

91. Countergaming bears a close resemblance to Galloway and Eugene Thacker's discussion of *The Exploit* (Minneapolis: University of Minnesota Press, 2007), itself a term derived from gaming culture. For Galloway, games are both exemplary of the Deleuzian control society and a means to resist or undermine such protocological power. See also Galloway's *Protocol: How Control Exists after Decentralization* (Cambridge, Mass.: MIT Press, 2006); and Peter Krapp's *Noise Channels* (Minneapolis: University of Minnesota Press, 2011).

92. See, for instance, Henry Jenkins's and Justine Cassell's chapter in *Beyond Barbie© and Mortal Kombat: New Perspectives on Gender and Gaming* (Cambridge, Mass.: MIT Press, 2008), entitled "From *Quake Grrls* to *Desperate Housewives*: A Decade of Gender and Computer Games," where transmedia is discussed as one way to interest girls in games.

93. McGonigal, "Why *I Love Bees*," 38.

94. Henry Jenkins, *Convergence Culture: Where Old and New Media Collide* (New York: NYU Press, 2006), 246. See also Henry Jenkins, Sangita Shresthova, Liana Gamber-Thompson, Neta Kligler-Vilenchik, and Arely Zimmerman, *By Any Media Necessary: The New Youth Activism* (New York: NYU Press, 2016).

95. Jane McGonigal, *Reality Is Broken: Why Games Make Us Better and How They Can Change the World* (New York: Penguin, 2011), 107.

2. Scale

1. See Mark J. P. Wolf, "Theorizing Navigable Space in Video Games," in *Logic and Structure of the Computer Game*, ed. Stephan Günzel, Michael Liebe, and Dieter Mersch (Potsdam: Potsdam University Press, 2010), 36–62, and "Inventing Space: Towards a Taxonomy of On and Off-Screen Space in Video Games," *Film Quarterly* 51 (1997): 11–23; Henry Jenkins, "Game Design as Narrative Architecture," in *The Game Design Reader*, ed. Katie Salen and Eric Zimmerman (Cambridge, Mass.: MIT Press, 2005); Michael Nitsche, *Video Game Spaces: Image, Play, and Structure in 3D Game Worlds* (Cambridge, Mass.: MIT Press, 2008).

2. Qtd. in Nathan F. Sayre, "Climate Change, Scale, and Devaluation: The Challenge of Our Built Environment," *Washington and Lee Journal of Energy, Climate, and the Environment* 1, no. 1 (2010): 96.

3. Ursula Heise, "Unnatural Ecologies: The Metaphor of the Environment in Media Theory," *Configurations* 10, no. 1 (Winter 2002): 149–68.

4. Lisa Parks, *Cultures in Orbit: Satellites and the Televisual* (Durham, N.C.: Duke University Press, 2005).

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

5. Willard McCarty, "Modeling: A Study in Words and Meanings," in *A Companion to Digital Humanities,* ed. Susan Schreibman, Ray Siemens, and John Unsworth (Oxford: Blackwell, 2004), par. 3, http://www.digitalhumanities.org/companion/.

6. Over the years, environmentalists have had decidedly mixed attitudes to the so-called population problem, including the many uses and abuses of Thomas Malthus's *Essay on the Principle of Population* (1798), Garrett Hardin's "The Tragedy of the Commons" (1968), Paul Ehrlich's *The Population Bomb* (1968), and Alan Weisman's *Countdown* (2013). Often, "scale" is a tempting euphemism for optimum population, or sustainable human numbers.

7. See Timothy Morton, *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2013), 1. For Morton, hyperobjects are "things that are massively distributed in time and space relative to humans" and therefore impossible to grasp in their entirety, such as radiation, black holes, and global warming.

8. For more on ecology's history and its ties to cybernetics, see Max Liboiron and Erica Robles-Anderson's essay, "Coupling Complexity: Ecological Cybernetics as a Resource for Nonrepresentational Moves to Action," in *Sustainable Media: Critical Approaches to Media and Environment*, ed. Nicole Starosielski and Janet Walker (New York: Routledge, 2016).

9. Ralph Waldo Emerson, "Nature," in *The Collected Works of Ralph Waldo Emerson*, Vol. 1: *Nature, Addresses, and Lectures*, ed. Robert E. Spiller and Alfred R. Ferguson (Cambridge, Mass.: Harvard University Press, 1971), 32.

10. Jane McGonigal calls the *FarmVille*-style busy work of games "blissful productivity" in *Reality Is Broken*.

11. Naomi Klein, *This Changes Everything: Capitalism vs. the Climate* (New York: Simon & Schuster, 2014).

12. In *A Geology of Media* (Minneapolis: University of Minnesota Press, 2015), Jussi Parikka notes that some two-thirds of disposed consumer electronics are still functional.

13. For the latter, see Chris Tong, "Ecology without Scale: Unthinking the World Zoom," *Animation* 9, no. 2 (2014): 196–211. Tong recommends jettisoning scalar models because they reify unfortunate spatial and classificatory hierarchies.

14. This according to Brody Sandel and Adam B. Smith, although they first find the more specific search phrase "spatial scal*" in an article from 1987. See Sandel and Smith, "Scale as a Lurking Factor: Incorporating Scale-Dependence in Experimental Ecology," *Oikos* 118, no. 9 (2009): 1284–91, doi: 10.1111/j.1600–0706.2009.17421.x.

15. John A. Wiens, "Spatial Scaling in Ecology," *Functional Ecology* 3, no. 4 (1989): 385.

16. Sandel and Smith, "Scale as a Lurking Factor."

17. J. L. Dungan, J. N. Perry, M.R.T. Dale, P. Legendre, S. Citron-Pousty, M.-J. Fortin, A. Jakomulska, M. Miriti, and M. S. Rosenberg, "A Balanced View of Scale in Spatial Statistical Analysis," *Ecography* 25, no. 5 (2002): 626–40.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

18. Consider Paul Martin's prehistoric overkill (of megafauna) hypothesis, described in Elizabeth Kolbert, *The Sixth Extinction: An Unnatural History* (New York: Henry Holt, 2014), 231–32.

19. Sayre, "Climate Change, Scale, and Devaluation," 88.

20. A quadrat is a sampling plot typically measuring around one square meter.

21. Göran Englund and Scott D. Cooper, "Scale Effects and Extrapolation in Ecological Experiments," *Advances in Ecological Research* 33 (2003): 170. This idea of effective scale recalls early naturalist philosopher Jakob von Uexküll's theories about organismal time and space, most notably captured in his description of the tick. See Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans,* with *A Theory of Meaning*, trans. Joseph D. O'Neil (Minneapolis: University of Minnesota Press, 2010), 44–52.

22. Wiens, "Spatial Scaling in Ecology," 389.

23. Englund and Cooper, "Scale Effects," 170. For instance, some influences that figure largely at small scales, like experimenter disturbance or predation, decrease and grow almost negligible at very large arena sizes, in what Englund and Cooper call an asymptotic or logistic relationship.

24. N. Underwood, P. Hambäck, and B. D. Inouye, "Large-Scale Questions and Small-Scale Data: Empirical and Theoretical Methods for Scaling up in Ecology," *Oecologia* 145, no. 2 (2005): 177–78.

25. I cannot help but think of Jorge Luis Borges's "On Exactitude in Science," in *Collected Fictions*, trans. Andrew Hurley (New York: Penguin, 1998). Borges's pithy story could be fruitfully applied to many contemporary projects, from genome sequencing to database-driven big-data initiatives.

26. A shorter, black-and-white "rough sketch" of the film was released in 1968, made for the Commission on College Physics. The 1977 color version was funded by IBM.

27. In actuality, the live portion of this memorable picnic scene was filmed in Los Angeles, for greater production control. The picnic scene in the 1968 sketch took place in Florida.

28. Qtd. in Philip and Phylis Morrison and the Office of Charles and Ray Eames, *Powers of Ten: A Book about the Relative Size of Things in the Universe and the Effect of Adding Another Zero* (New York: Scientific American, 1982), 145, my emphasis.

29. Morrison and Morrison, *Powers of Ten*, 101.

30. The film has inspired many reincarnations, for instance Cary and Michael Huang's web-based applications *The Scale of the Universe* and *The Scale of the Universe 2.*

31. Most notably, Stewart Brand lobbied for the release of these planetary images and used them on a number of the covers of his counterculture magazine, *The Whole Earth Catalog*, published between 1968 and 1974.

32. Zach Horton has written extensively about media and scale and the development of the cosmic zoom. See for instance his "Composing a Cosmic View: Three Alternatives for Thinking Scale in the Anthropocene," in *Size and Scale in Literature and Culture*, ed. Michael Tavel Clarke and David Wittenberg (New York: Palgrave Macmillan, 2017), 35–60.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

33. Morrison and Morrison, *Powers of Ten*, 8.

34. The daisyworld theoretical models attempted to provide support for Lovelock's Gaia hypothesis, which posited that the world and its inorganic and organic actors form a holistic, self-regulating entity greater than the sum of its parts.

35. John Bohannon, "Flunking *Spore*," *Science* 322, no. 5901 (2008): 531.

36. Qtd. in Bohannon, "Flunking *Spore*," 531.

37. Will Wright, "*Spore*, Birth of a Game" (Paper presented to TED2007, Monterey, Calif., March 9, 2007).

38. Steven E. Jones, "Performing the Social Text: Or, What I Learned From Playing *Spore*," *Common Knowledge* 17, no. 2 (2011): 284.

39. Jones, "Performing the Social Text," 287.

40. Jones, "Performing the Social Text," 289.

41. Jones, "Performing the Social Text," 283.

42. Wright, "*Spore*, Birth of a Game."

43. Joshua M. Epstein, "Why Model?" *Journal of Artificial Societies and Social Simulation* 11, no. 4 (2008), http://jasss.soc.surrey.ac.uk/11/4/12.html.

44. The Futurefarmers were granted a multiyear residency at the Berkeley Art Museum/Pacific Film Archive and the Berkeley Center for New Media at the University of California, Berkeley, beginning in 2010. Many of these observations come from personal discussion with Amy Franceschini.

45. McLuhan often touches on the scalar affordances of media technology, as in the "Roads and Paper Routes" section of *Understanding Media: The Extensions of Man* (Cambridge, Mass.: MIT Press, 1994).

46. Mitchell Thomashow, *Bringing the Biosphere Home: Learning to Perceive Global Environmental Change* (Cambridge, Mass.: MIT Press, 2003), 139.

47. Thomashow, *Bringing the Biosphere Home*, 141.

48. Thomashow, *Bringing the Biosphere Home*, 140.

49. Thomashow, *Bringing the Biosphere Home*, 160–61.

50. Thomashow, *Bringing the Biosphere Home*, 148.

51. Thomashow, *Bringing the Biosphere Home*, 155.

52. Ursula K. Heise, *Sense of Place and Sense of Planet: The Environmental Imagination of the Global* (Oxford: Oxford University Press, 2008); and Morton, *The Ecological Thought*.

53. Heise, *Sense of Place*, 10.

54. Heise, *Sense of Place*, 9.

55. Heise, *Sense of Place*, 10, 13.

56. Many environmental specialists, among them Lowell Monke, David Sobel, and Mitchell Thomashow, have expressed serious misgivings about digital media, aligning them with a distracted inattention to lived space.

57. See Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007), 46; Colin Milburn, *Nanovision: Engineering the Future* (Durham, N.C.: Duke University Press, 2008). In Daston and Galison's words, "Practitioners of trained judgment professed themselves unable to distinguish between work and play—or, for that

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

matter, between art and science . . . surrendering themselves to the quasi-ludic promptings of well-honed intuitions." Milburn's nanotechnology professionals are no exception; some of the most iconic images to emerge from nanoscience have had less to do with function and "serious" research than an artistic sense of play, for example Donald Eigler and Erhard Schweizer's now-famous creation of the IBM logo using xenon on nickel.

58. Stephanie E. Hampton, Carly A. Strasser, Joshua J. Tewksbury, Wendy K. Gram, Amber E. Budden, Archer L. Batcheller, Clifford S. Duke, and John H. Porter, "Big Data and the Future of Ecology," *Frontiers in Ecology and the Environment* 11, no. 3 (2013): 156–62, doi: 10.1890/120103.

59. Mary Gray, "Anthropology as BIG DATA: Making the Case for Ethnography as a Critical Dimension in Digital Media and Technology Studies" (Talk given at UC Berkeley, November 13, 2012); danah boyd and Kate Crawford, "Six Provocations for Big Data" (Paper presented to A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society, Oxford, September 21, 2011), 2.

60. Englund and Cooper, "Scale Effects," 162–63.

61. Englund and Cooper, "Scale Effects," 182.

62. Englund and Cooper, "Scale Effects," 164.

63. Interestingly enough, sometimes aerial photography falls on the side of ground-truthing, while at other times it falls on the side of remote sensing, depending on whose definition you consult.

64. Tina Rogerson, "SCOOL Project," National Aeronautics and Space Administration Langley Research Center, last updated March 25, 2019, https://scool.larc.nasa.gov/. S'COOL is now NASA GLOBE Clouds, having joined with the Global Learning and Observations to Benefit the Environment (GLOBE) Program.

65. S.v. "failure, n.," *OED Online*, March 2018, Oxford University Press.

66. Jesper Juul, *The Art of Failure: An Essay on the Pain of Playing Video Games* (Cambridge, Mass.: MIT Press, 2013), 24.

67. Juul, *The Art of Failure*, 64.

68. Kim Stanley Robinson, *Forty Signs of Rain* (New York: Bantam Books, 2004); *Fifty Degrees Below* (New York: Bantam Books, 2005); and *Sixty Days and Counting* (New York: Bantam Books, 2007).

69. Stephanie Boluk and Patrick LeMieux, *Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Breaking Videogames* (Minneapolis: University of Minnesota Press, 2017).

70. S.v. "spore, n.," *OED Online*, March 2018, Oxford University Press.

71. Microsoft Research, "ChronoZoom," http://research.microsoft.com/en-us/projects/chronozoom/.

72. "No Man's Sky," Hello Games, http://www.nomanssky.com/.

73. Daniel Rosenberg and Anthony Grafton, *Cartographies of Time: A History of the Timeline* (Princeton, N.J.: Princeton University Press, 2012).

74. See the "Introducing Big History and ChronoZoom" brochure, designed by Nancy Crowe for the 2010 Geological Society of America conference; and Roland Saekow and Walter Alvarez, "ChronoZoom Project Information," Earth and Planetary

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Science website, University of California, Berkeley, 2009–12. ChronoZoom lives online at www.chronozoom.com.

75. An equally massive amount has been written about MMOGs, but consistent research has come from the likes of Nicolas Ducheneaut, Nick Yee, and Constance Steinkuehler.

76. "Procedural Generation," GiantBomb concept wiki, last updated May 22, 2014.

77. Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1984), 309.

78. boyd and Crawford, "Six Provocations for Big Data."

79. Cixin Liu, "Beyond Narcissism: What Science Fiction Can Offer Literature," trans. Holger Nahm and Gabriel Ascher, *Science Fiction Studies* 40, no. 1 (2013): 22–32.

80. Liu, "Beyond Narcissism," 24.

81. Liu, "Beyond Narcissism," 26.

82. Liu, "Beyond Narcissism," 24.

83. Liu, "Beyond Narcissism," 27.

84. Liu, "Beyond Narcissism," 26.

3. Nonhuman

1. Jacques Derrida, "The Animal That Therefore I Am (More to Follow)," trans. David Wills, *Critical Inquiry* 28, no. 2 (2002): 369–418.

2. Specifically, chapter 11, entitled "Waking," goes as follows: "—and it really *was* a kitten, after all" (emphasis in original).

3. *The Aesthetics and Affects of Cuteness*, ed. Joshua Paul Dale, Joyce Goggin, Julia Leyda, Anthony P. McIntyre, and Diane Negra (New York: Routledge, 2017).

4. Berger's "Why Look at Animals?" in *About Looking* (New York: Vintage, 1991) always pierces with its damning commentary on everything from zoos to stuffed animals, while Grandin has warned that children who become hooked on video games lose touch with the outdoors ("Different Kinds of Minds Contribute to Society," May 10, 2016, Santa Barbara, Calif.).

5. Sherry Turkle, *The Second Self: Computers and the Human Spirit*, rev. ed. (Cambridge, Mass.: MIT Press, 2005).

6. Not surprisingly, game bestiaries overlap with those of literature and other arts, perhaps foremost mythology, science fiction, and fantasy. Take, for example, the sentient cats charged with running the internet gift economy in the Bruce Sterling short story "Maneki Neko" (1998).

7. Katherine Isbister, *How Games Move Us: Emotion by Design* (Cambridge, Mass.: MIT Press, 2016).

8. Gilles Deleuze and Félix Guattari, "Becoming Animal," in *The Animals Reader: The Essential Classical and Contemporary Writings*, ed. Linda Kalof and Amy Fitzgerald (Oxford: Berg, 2007), 37–50.

9. "SOMNIACS—Birdly®," SOMNIACS SA, Zurich, Switzerland, 2015–18, http://www.somniacs.co/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

10. *Euglena* contain chloroplasts that produce sugar from sunlight, but also ingest algae and other organisms via phagocytosis.

11. Seung Ah Lee, Engin Bumbacher, Alice M. Chung, Nate Cira, Byron Walker, Ji Young Park, Barry Starr, Paulo Blikstein, and Ingmar H. Riedel-Kruse, "Trap It!: A Playful Human-Biology Interaction for a Museum Installation," CHI 2015, April 18–23, 2015, Seoul, Republic of Korea, ACM, 9, doi: 10.1145/2702123.2702220.

12. Aarseth, *Cybertext.* In early MUDs, using the colon in the command line allowed players to linguistically attach any imaginable action or state to their person, as in ": walks through the door wearing a green bowler hat." In the case of *Faunasphere*, we are fortunate that Mia Consalvo and Jason Begy chronicled much of its unique run, now available in *Players and Their Pets: Gaming Communities from Beta to Sunset* (Minneapolis: University of Minnesota Press, 2015).

13. While the deer cam is now offline and no longer available on Watanabe's Twitch.tv page, you can view previously recorded footage at the vaguely official-looking site http://sanandreasanimalcams.com/. Notably, on January 20, 2017, upon the inauguration of Donald Trump, Watanabe released a new hack of *GTA V* called *San Andreas Community Cam* that showed the citizens of San Andreas weeping disconsolately.

14. See Paddy Johnson's Art F City response (http://artfcity.com/2016/03/22/i-watched-the-grand-theft-auto-deer-cam-for-48-hours/), the Metafilter community narration at http://www.metafilter.com/158032/San-Andreas-Streaming-Deer-Cam, and Katy Peplin, "Live Cuteness 24/7: Performing Boredom on Animal Live Streams," in *The Aesthetics and Affects of Cuteness*.

15. Anna Tsing, "More-Than-Human Sociality: A Call for Critical Description," in *Anthropology and Nature*, ed. Kirsten Hastrup (New York: Routledge, 2013).

16. This corner of speculative thinking is well occupied by philosophers like Michael Marder (*Plant-Thinking: A Philosophy of Vegetal Life* [New York: Columbia University Press, 2013]) and forest ecologists like Suzanne Simard, who popularized the notion that trees can communicate with each other via mycorrhizal networks, or what *The Atlantic* dubbed "The Wood Wide Web" (Ed Yong, April 14, 2016).

17. Ian Bogost, *How to Do Things with Videogames* (Minneapolis: University of Minnesota Press, 2011).

18. Gary Snyder, "Walking the New York Bedrock Alive in the Sea of Information," in *Mountains and Rivers without End* (Washington, D.C.: Counterpoint, 1996).

19. Oliver Deussen and Bernd Lintermann, *Digital Design of Nature: Computer-Generated Plants and Organics* (Berlin: Springer Verlag, 2010).

20. Noah Berry, "A Brief History of Cyrodiil," http://www.elderscrolls.com/community/brief-history-cyrodiil/.

21. Xfrog, "About: Background and Philosophy," http://xfrog.com/company/about/.

22. Przemyslaw Prusinkiewicz, Aristid Lindenmeyer, James S. Hanan, F. David Fracchia, Deborah Fowler, Martin J. M. de Boer, and Lynn Mercer, *The Algorithmic Beauty of Plants* (New York: Springer-Verlag, 1990 [2004 electronic edition]), vi.

23. Deussen and Lintermann, *Digital Design of Nature*, 1.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

24. Deussen and Lintermann, *Digital Design of Nature*, 43.

25. Rosi Braidotti, *The Posthuman* (Cambridge: Polity, 2013).

26. Lev Manovich, *The Language of New Media* (Cambridge, Mass.: MIT Press, 2001), 30.

27. D'Arcy Wentworth Thompson, *On Growth and Form* (1917; rpt., Cambridge: Cambridge University Press, 1992).

28. Daniel Sánchez-Crespo Dalmau, "Product Review: SpeedTree RT & NatFX/RealNAT," *Gamasutra,* October 1, 2003, http://www.gamasutra.com/view/feature/2797/product_review_speedtree_rt__.php, my emphasis.

29. Eugene Thacker, *Biomedia* (Minneapolis: University of Minnesota Press, 2004).

30. See for instance Casey O'Donnell, *Developer's Dilemma: The Secret World of Videogame Creators* (Cambridge, Mass.: MIT Press, 2014) and Jennifer R. Whitson, Bart Simon, and Felan Parker, "The Missing Producer: Rethinking Indie Cultural Production in Terms of Entrepreneurship, Relational Labour, and Sustainability," *European Journal of Cultural Studies* 21 (2018).

31. Nick Montfort and Ian Bogost, *Racing the Beam: The Atari Video Computer System* (Cambridge, Mass.: MIT Press, 2009).

32. Dalmau, "Product Review."

33. "Unity Asset Store Expands to Become the #1 Global Marketplace for Developers," 2018, https://unity3d.com/company/public-relations/news/unity-asset-store-expands-become-1-global-marketplace-developers.

34. Paul Frosh, *The Image Factory: Consumer Culture, Photography and the Visual Content Industry* (Oxford: Berg, 2003), 7–8, emphasis in original.

35. Lisa Parks, "Around the Antenna Tree: The Politics of Infrastructural Visibility," *Flow* 9, no. 8, March 6, 2009, http://www.flowjournal.org/2009/03/around-the-antenna-tree-the-politics-of-infrastructural-visibilitylisa-parks-uc-santa-barbara/. Parks echoes Frosh when she warns that "By disguising infrastructure as part of the natural environment, concealment strategies keep citizens naive and uninformed about the network technologies they subsidize and use each day."

36. Przemyslaw Prusinkiewicz, Mark Hammel, Jim Hanan, and Radomir Mech, "L-Systems: from the Theory to Visual Models of Plants," in *Proceedings of the 2nd CSIRO Symposium on Computational Challenges in Life Sciences*, ed. M. T. Michalewicz (Clayton, Australia: CSIRO Publishing, 1996).

37. Emanuel Maiberg, "How to Win an Academy Award for Planting Trees in Video Games," *Motherboard*, January 20, 2015, http://motherboard.vice.com/read/video-game-arborists.

38. Deussen and Lintermann, *Digital Design of Nature*, 227.

39. ElemenTerra VR sprang out of a student project at USC (http://www.elementerravr.com/), and has led one reviewer to comment that, while using it, he "kind of felt like a supernatural Bob Ross." For more on "room" VR, see Joseph Flaherty on Immersis, "A Pixar-Inspired Projector That Beams VR into an Entire Room," *Wired.com*, February 12, 2015, http://www.wired.com/2015/02/pixar-inspired-projector-beams-vr-entire-room/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

40. Jake Kosek, *Understories: The Political Life of Forests in Northern New Mexico* (Durham, N.C.: Duke University Press, 2006).

41. Robert Hass, "The Problem of Describing Trees," *The New Yorker*, June 27, 2005.

42. Christina Lupton, "The Knowing Book: Authors, It-Narratives, and Objectification in the Eighteenth Century," *NOVEL: A Forum on Fiction*, 39, no. 3 (Summer 2006): 402–20, at 403.

43. Leah Price, *How to Do Things with Books in Victorian Britain* (Princeton, N.J.: Princeton University Press, 2012).

44. Lupton, "The Knowing Book," 404.

45. Lupton, "The Knowing Book," 404, 411.

46. Daniel Hack, review of *How to Do Things with Books in Victorian Britain*, by Leah Price, *Review 19*, September 4, 2012.

47. Workers in the Guangdong Province of China face notoriously harsh conditions assembling products like Apple's iPhone, brought to light by the string of "Foxconn suicides" in Shenzhen. See, for instance, Aditya Chakrabortty, "The Woman Who Nearly Died Making Your iPad," *The Guardian*, August 5, 2013, http://www.theguardian.com/commentisfree/2013/aug/05/woman-nearly-died-making-ipad.

48. "*Planet Money* Makes a T-Shirt," Executive Producer Alex Blumberg, National Public Radio, December 2, 2013, http://apps.npr.org/tshirt/#/title.

49. Pietra Rivoli, *The Travels of a T-Shirt in the Global Economy: An Economist Examines the Markets, Power, and Politics of World Trade* (Hoboken, N.J.: John Wiley, 2005).

50. Donovan Hohn, *Moby-Duck: The True Story of 28,800 Bath Toys Lost at Sea and of the Beachcombers, Oceanographers, Environmentalists, and Fools, Including the Author, Who Went in Search of Them* (New York: Penguin, 2012).

51. We might trace them back to Rachel Carson's *Silent Spring* (1962) with its unstinting attention to the chemical origins of everyday lawn-care products and insecticides.

52. Bits (logarithmic base 2) are mentioned by Claude Shannon in 1948, but coined by J. W. Tukey. *Merriam-Webster* defines a bit as "a unit of computer information equivalent to the result of a choice between two alternatives (as *yes* or *no, on* or *off*)," or "the physical representation of a bit by an electrical pulse, a magnetized spot, or a hole whose presence or absence indicates data," while the *OED* defines it as "a unit of information derived from a choice between two equally probable alternatives or 'events'; such a unit stored electronically in a computer."

53. Neal Stephenson, "Mother Earth Mother Board," *Wired*, December 1, 1996. https://www.wired.com/1996/12/ffglass/.

54. Stephenson, "Mother Earth Mother Board," 27.

55. Stephenson, "Mother Earth Mother Board," 55.

56. The storefront featured an Apple logo in the original game. Not surprisingly, the game was pulled from Apple's virtual shelves a mere seven hours after it debuted, but you can still play a version online or on Android phones.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

57. Bill Brown, *A Sense of Things: The Object Matter of American Literature* (Chicago: University of Chicago Press, 2003), 3.

58. Ian Bogost, *Alien Phenomenology; or, What It's Like to Be a Thing* (Minneapolis: University of Minnesota Press, 2012).

59. See Scott C. Richmond, "Thought, Untethered: A Review Essay," *Postmodern Culture* 21, no. 1 (September 2010), doi: 10.1353/pmc.2010.0032, and "Speculative Realism Is Speculative Aesthetics (Three New Books on Speculative Realism)," *Configurations* 23, no. 3 (Fall 2015): 399–403; and Katherine Behar, ed., *Object-Oriented Feminism* (Minneapolis: University of Minnesota Press, 2016).

60. Neil Leach, "Digital Tool Thinking: Object-Oriented Ontology versus New Materialism," *Acadia* (2016): 344–51, in Kathy Velikov, Sean Ahlquist, Matias del Campo, and Geoffrey Thün, eds., *Proceedings of the 36th Annual Conference of the Association for Computer-Aided Design in Architecture (Posthuman Frontiers: Data, Designers, and Cognitive Machines)*, October 27–29, 2016 (Ann Arbor: University of Michigan Taubman College of Architecture and Urban Planning, 2016).

61. Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, N.C.: Duke University Press, 2010).

62. Richard Bartle, "Hearts, Clubs, Diamonds, Spades: Players Who Suit MUDs," in *The Game Design Reader: A Rules of Play Anthology*, ed. Katie Salen and Eric Zimmerman (Cambridge, Mass.: MIT Press, 2005), 754–87.

63. "Climbing Mount Everest Is Work for Supermen," *New York Times*, March 18, 1923, The Times Machine. Also referenced in David Breashears and Audrey Salkeld, *Last Climb: The Legendary Everest Expeditions of George Mallory* (Washington, D.C.: National Geographic Society, 1999).

64. "Journey," thatgamecompany, http://thatgamecompany.com/games/journey/.

65. Irene Chien provides a much fuller analysis of the game's blending of Arabic and Asian cultures in "Journey into the Techno-Primitive Desert," in *Gaming Representation: Race, Gender, and Sexuality in Video Games*, ed. Jennifer Malkowski and TreaAndrea M. Russworm (Bloomington: Indiana University Press, 2017).

66. For my introduction to shan-shui-hua, I am indebted to Xinmin Liu (Washington State University) and his presentation on the "Green Media Studies: Integrating Environmental and Media Studies in the Classroom and Beyond" panel at the 2014 Society for Cinema and Media Studies conference in Seattle.

67. Sherman Lee, "Chinese Landscape Painting," *Bulletin of the Cleveland Museum of Art* 41, no. 9 (1954): 199–201.

68. Robert J. Maeda, "The 'Water' Theme in Chinese Painting," *Artibus Asiae* 33, no. 4 (1971): 247–90.

69. Kristen Whissel, *Spectacular Digital Effects: CGI and Contemporary Cinema* (Durham, N.C.: Duke University Press, 2014).

70. Gaston Bachelard, *The Poetics of Space* (New York: Penguin, 2014). As many have noted in relation to Roger Ebert's famous declaration that video games can never be art, attempting to promote a controversial media form as art is a fool's errand, since there is no universal definition for art, let alone game art. See Roger Ebert, "Video

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Games Can Never Be Art," *Roger Ebert's Journal*, April 16, 2010, http://www.rogerebert.com/rogers-journal/video-games-can-never-be-art. Yet in 2012, I conducted a research visit to the Smithsonian American Art Museum's "The Art of Video Games" exhibit, and spoke with Michael Mansfield, curator of film and media arts, exhibition coordinator Georgina Goodlander, and Chris Melissinos, the exhibit's curator.

71. Sarah Whatmore, "Materialist Returns: Practising Cultural Geography in and for a More-Than-Human World," *Cultural Geographies* 13 (2006): 600–609; Tsing, "More-Than-Human Sociality," 27.

72. Christin Bolewski, "Detour Over China—Chinese Philosophy and Aesthetics Applied to Western Digital Art," *Copenhagen Working Papers on Design* 1 (2010): 1–3. Bolewski's project was a "Single screen video installation presented on vertical wall-mounted 16:9 flat screen; 2D/3D Animation, HDV-PAL, Color 15, 19 min video loop."

73. "MOUNTAIN—now available for PC, Mac, Linux, iOS & tvOS #mountain-game," http://mountain-game.com/.

74. Bo Moore, "Nothing You Do Matters in This Game, But You'll Still Obsess Over It," *Wired*, July 18, 2014, https://www.wired.com/2014/07/mountain-game/.

75. Andrew Webster, "Playing a Mountain Simulator Is Surprisingly Emotional," *The Verge,* July 1, 2014, http://www.theverge.com/2014/7/1/5857458/mountain-game.

76. Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans,* with *A Theory of Meaning*, trans. Joseph D. O'Neil (Minneapolis: University of Minnesota Press, 2010).

77. Uexküll, *Foray*, 53.

78. Uexküll, *Foray*, 52.

79. Uexküll, *Foray*, 69.

80. Uexküll, *Foray*, 52.

81. Uexküll, *Foray*, 86.

82. Yi-Fu Tuan, *Topophilia: A Study of Environmental Perception, Attitudes, and Values* (1974; rpt., New York: Columbia University Press, 1990), 4.

83. Tuan, *Topophilia*, xii.

84. Tuan, *Topophilia*, 70.

85. Min-maxing refers to the strategy of maximizing certain character attributes as strengths and minimizing others to avoid weaknesses.

86. Colin Milburn, "Green Gaming: Video Games and Environmental Risk," in *The Anticipation of Catastrophe: Environmental Risk in North American Literature and Culture,* ed. Sylvia Mayer and Alexa Weik von Mossner (Heidelberg: Universitätsverlag Winter, 2014), 201–19.

87. Milburn, "Green Gaming," 212.

88. Milburn, "Green Gaming," 204.

89. Jake Kosek, "Ecologies of Empire: On the New Uses of the Honeybee," *Cultural Anthropology* 25, no. 4 (2010): 650–78.

90. Sarah Whatmore, "Materialist Returns: Practising Cultural Geography in and for a More-Than-Human World," *Cultural Geographies* 13 (2006): 600–609.

91. Tuan, *Topophilia*, xiv.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

92. Tuan, *Topophilia*, 120.

93. Tsing, "More-than-Human Sociality," 33.

94. Tsing, "More-than-Human Sociality," 34.

95. Elizabeth Swanstrom, *Animal, Vegetable, Digital: Experiments in New Media Aesthetics and Environmental Poetics* (Tuscaloosa: University of Alabama Press, 2016).

4. Entropy

1. See, for instance, the feminist game studies issue (no. 2) of *Ada: A Journal of Gender, New Media, and Technology*; Jennifer Malkowski and TreaAndrea M. Russworm, eds., *Gaming Representation*; Kishonna L. Gray and David J. Leonard, eds., *Woke Gaming: Digital Challenges to Oppression and Social Injustice* (Seattle: University of Washington Press, 2018); and John Vanderhoef and Michael Curtin, "The Crunch Heard 'Round the World: The Global Era of Digital Game Labor," in *Production Studies: The Sequel!*, ed. Miranda Banks, Bridget Conor, and Vicki Mayer (New York: Routledge, 2015), 196–209.

2. For example, see Edmond Y. Chang, "A Game Chooses, a Player Obeys: *BioShock*, Posthumanism, and the Limits of Queerness," in *Gaming Representation: Race, Gender, and Sexuality in Video Games*, ed. Jennifer Malkowski and TreaAndrea M. Russworm (Bloomington: Indiana University Press, 2017); Bonnie Ruberg and Adrienne Shaw, eds., *Queer Game Studies* (Minneapolis: University of Minnesota Press, 2017); Debra Ferreday, "Becoming Deer: Nonhuman Drag and Online Utopias," *Feminist Theory* 12, no. 2 (2011): 219–25, doi: 10.1177/1464700111404288; and Weihua Wu, Steve Fore, Xiying Wang, and Petula Sik Ying Ho, "Beyond Virtual Carnival and Masquerade: In-Game Marriage on the Chinese Internet," *Games and Culture* 2, no. 1 (2007): 59–89.

3. Nick Dyer-Witheford and Greig de Peuter, *Games of Empire: Global Capitalism and Video Games* (Minneapolis: University of Minnesota Press, 2009); Raiford Guins, *Game After: A Cultural Study of Video Game Afterlife* (Cambridge, Mass.: MIT Press, 2014); and James Newman, *Best Before: Videogames, Supersession and Obsolescence* (New York: Routledge, 2012).

4. J. Roy, "'Polis' and 'Oikos' in Classical Athens," *Greece & Rome* 46, no. 1 (1999): 1–18.

5. See Aarseth's *Cybertext* or Alison Harvey, "Seeking the Embodied Mind in Video Game Theory: Embodiment in Cybernetics, Flow, and Rule Structures," *Loading . . .* 3, no. 4 (2009), http://journals.sfu.ca/loading/index.php/loading/article/view/57/54.

6. Galloway, *Gaming*.

7. For more on gamification, or the use of gamelike design in areas other than games, see Ian Bogost's August 9, 2011 essay "Gamification Is Bullshit" in *The Atlantic*, https://www.theatlantic.com/technology/archive/2011/08/gamification-is-bullshit/243338/) or Steffen P. Walz and Sebastian Deterding, eds., *The Gameful World: Approaches, Issues, Applications* (Cambridge, Mass.: MIT Press, 2014).

8. Shu-Kun Lin, "Diversity and Entropy," *Entropy* 1, no. 1 (1999): 1–3, doi: 10.3390/e1010001.

This content downloaded from
10:ffff:ffff:ffff:ffff:ffff on Thu, 01 Jan 1976 12:34:56 UTC
All use subject to https://about.jstor.org/terms

9. For more on deep time, see Siegfried Zielinski's *Deep Time of the Media: Toward an Archaeology of Seeing and Hearing by Technical Means* (Cambridge, Mass.: MIT Press, 2006); for deep history, a good place to begin is Dipesh Chakrabarty's "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (Winter 2009): 197–222.

10. Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, N.J.: Princeton University Press, 2017).

11. Raiford Guins, "Concrete and Clay: The Life and Afterlife of *E.T. The Extra-Terrestrial* for the Atari 2600," *Design and Culture* 1, no. 3 (2009): 345–64, https://10.1080/17547075.2009.11643295.

12. On the decline of print obituaries, see *Obit.: Life on Deadline*, directed by Vanessa Gould (Green Fuse Films, 2016), counterpoised by the growing literature on extinction studies by scholars such as Deborah Bird Rose, Thom van Dooren, and Ursula Heise.

13. Jennifer Gabrys, *Digital Rubbish: A Natural History of Electronics* (Ann Arbor: University of Michigan Press, 2011).

14. Greenpeace has demonstrated outside of HP's offices in Geneva, Switzerland, and Beijing and even managed to paint the words "HAZARDOUS PRODUCTS" on top of HP's headquarters in Palo Alto, California.

15. Commission for Environmental Cooperation, "Quantitative Characterization of Domestic and Transboundary Flows of Used Electronic Products | Case Study: Used Computers and Monitors in North America" (Montreal: Commission for Environmental Cooperation, September 2016).

16. Nathaniel Mills and Evan Mills, "Taming the Energy Use of Gaming Computers," *Energy Efficiency* 9, no. 2 (2016): 321–38.

17. "Guide to Greener Electronics—6th edition," Greenpeace.org, November 27, 2007, http://www.greenpeace.org/international/en/publications/reports/guide-to-greener-electronics-2/.

18. Conor Murphy, "Environmental Impacts of Video Games," June 28, 2012, http://www.bigfishgames.com/blog/environmental-impact-of-video-games/.

19. Devin N. Perkins, Marie-Noel Brune Drisse, Tapiwa Nxele, and Peter D. Sly, "E-Waste: A Global Hazard," *Annals of Global Health* 80 (2014): 286–29.

20. See *Waste Land*, directed by Lucy Walker, João Jardim, and Karen Harley, starring Vik Muniz (Almega Projects and O2 Filmes, 2010); and "Ghana: Digital Dumping Ground," reported by Peter Klein (Frontline/World, 2009).

21. United States Environmental Protection Agency, "International Agreements on Transboundary Shipments of Hazardous Waste," https://www.epa.gov/hwgenerators/international-agreements-transboundary-shipments-hazardous-waste. See also Secretariat of the Basel Convention, "Overview," 2011, http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx.

22. For a small sampling of infrastructure studies work, see Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems," in *Modernity and Technology*, ed. Thomas J. Misa, Philip Brey, and Andrew Feenberg (Cambridge, Mass.: MIT Press, 2003), 185–225; Paul N. Edwards, Steven J. Jackson, Geoffrey C. Bowker, and Robin Williams, "Introduction: An Agenda for Infrastructure Studies," *Journal of the Association for Information Systems*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

10, no. 5 (2009): 364–74; and Lisa Parks, "Where the Cable Ends: Television beyond Fringe Areas," in *Cable Visions: Television beyond Broadcasting*, ed. Sarah Banet-Weiser, Cynthia Chris, and Anthony Freitas (New York: NYU Press, 2007), 103–26.

23. Globally, the movie industry is still likely to surpass the game industry in terms of its carbon footprint and overall environmental impact, given location shooting, extensive plane travel, and enormous sets and crews, in addition to extensive digital processing, but from the consumer side, gameplay and video streaming are both exceedingly energy intensive. For now, Kaleem Aftab claims that "a film eats up energy like no other art form," in "Emission Impossible: Why Hollywood Is One of the Worst Polluters," *Independent*, November 16, 2007, http://www.independent.co.uk/arts-entertainment/films/features/emission-impossible-why-hollywood-is-one-of-the-worst-polluters-400493.html.

24. Consider, for instance, Paul Edward's estimate that one of the first modern computers, the massive Electronic and Numerical Integrator and Computer (ENIAC) at the University of Pennsylvania, used 1400 kWH, while contemporary computers use somewhere around 100–200 watts!

25. Donald Mackenzie, *An Engine, Not a Camera: How Financial Models Shape Markets* (Cambridge, Mass.: MIT Press, 2006).

26. Newman, *Best Before.*

27. Lisa Parks, "'Stuff You Can Kick': Toward a Theory of Media Infrastructures," in *Between Humanities and the Digital*, ed. Patrik Svensson and David Theo Goldberg (Cambridge, Mass.: MIT Press, 2015), 355–73.

28. According to the Entertainment Software Association's 2016 "Essential Facts About the Computer and Video Game Industry" report, "65% of U.S. households own a device used to play video games" and 48% own a dedicated game console. We can compare this to Nielsen's estimate of 118.4 million "TV homes" in 2016–17 (out of approximately 136 million housing units, according to the U.S. Census Bureau).

29. PlayStation 3 and Legacy Consoles Forum, October 24, 2009, accessed June 9, 2017, http://www.psu.com/forums/archive/index.php/t-213371.html.

30. Yefim Sheynkin, Robert Welliver, Andrew Winer, Farshid Hajimirzaee, Hongshik Ahn, and Kyewon Lee, "Protection from Scrotal Hyperthermia in Laptop Computer Users," *Fertility and Sterility* 95, no. 2 (February 2011): 647–51.

31. Finn Brunton, "Heat Exchanges," in *The MoneyLab Reader: An Intervention in Digital Economy*, ed. Geert Lovink, Nathaniel Tkacz, Patricia de Vries (Amsterdam: Institute of Network Cultures, 2015), 159.

32. Nicole Starosielski, "Thermocultures of Geological Media," *Cultural Politics* 12, no. 3 (2016): 293–309, doi: 10.1215/17432197–3648858.

33. Guins, "Concrete and Clay," 355.

34. DuPont, "Engineering Thermoplastics," 2018, http://www.dupont.com/products-and-services/plastics-polymers-resins/thermoplastics.html.

35. See *Energy Humanities: An Anthology*, ed. Imre Szeman and Dominic Boyer (Baltimore: Johns Hopkins University Press, 2017); Stephanie Lemenager, *Living Oil: Petroleum Culture in the American Century* (New York: Oxford University Press, 2013);

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

and Hannah Appel, Arthur Mason, and Michael Watts, eds., *Subterranean Estates: Life Worlds of Oil and Gas* (Ithaca, N.Y.: Cornell University Press, 2015).

36. Tsing, *The Mushroom at the End of the World.*

37. Tung-Hui Hu's *A Prehistory of the Cloud* (Cambridge, Mass.: MIT Press, 2015) helpfully constructs a less relentlessly modern account of contemporary networks, and John Durham Peters's *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (Chicago: University of Chicago Press, 2015) makes a similar, but even more radical connection to classical thinking on the elements. See also Jennifer Holt and Patrick Vonderau, "'Where the Internet Lives': Data Centers as Cloud Infrastructure," in *Signal Traffic: Critical Studies of Media Infrastructures*, ed. Lisa Parks and Nicole Starosielski (Champaign: University of Illinois Press, 2015), 71–93; and Mél Hogan, "Facebook Data Storage Centers as the Archive's Underbelly," *Television & New Media* 16, no. 1 (2015): 3–18, doi: 10.1177/1527476413509415.

38. Gary Cook, "How Clean Is Your Cloud?" April 2012, Greenpeace International, https://www.greenpeace.org/international/publication/6986/how-clean-is-your-cloud/.

39. Mark P. Mills, "The Cloud Begins with Coal: Big Data, Big Networks, Big Infrastructure, and Big Power: An Overview of the Electricity Used by the Global Digital Ecosystem," Digital Power Group, sponsored by National Mining Association and American Coalition for Clean Coal Electricity, August 2013, https://www.tech-pundit.com/wp-content/uploads/2013/07/Cloud_Begins_With_Coal.pdf?c761ac.

40. Bryan Walsh, "The Surprisingly Large Energy Footprint of the Digital Economy," *Time.com*, August 14, 2013, http://science.time.com/2013/08/14/power-drain-the-digital-cloud-is-using-more-energy-than-you-think/.

41. McLuhan, *Understanding Media.*

42. Put another way, "The same amount of data carried on wireless networks consumes far more energy than when transported on 'wires' (fiber optics)" (Mills, "The Cloud Begins with Coal," 26).

43. Mills, "The Cloud Begins with Coal," 39.

44. Mills, "The Cloud Begins with Coal," 38.

45. G. I. Meijer, "Cooling Energy-Hungry Data Centers," *Science* 328 (2010): 318–19.

46. Meijer, "Cooling Energy-Hungry Data Centers," 318.

47. Holt and Vonderau, "Where the Internet Lives"; and Tony Kontzer, "Data Center Operators Flock to Cold Climates," *Network Computing*, September 30, 2013, http://www.networkcomputing.com/data-centers/data-center-operators-flock-cold-climates/1697156413.

48. Google, "The Dalles, Oregon," https://www.google.com/about/datacenters/inside/locations/the-dalles/. The Dalles lies just outside Portland in rural Wasco County, best known as the former terminus of the Oregon Trail.

49. Microsoft, "Project Natick Phase 2," https://natick.azurewebsites.net/.

50. Kris De Decker, "Why We Need a Speed Limit for the Internet," October 21, 2015, originally published in *Low-Tech Magazine*, http://www.resilience.org/stories/2015–10–21/why-we-need-a-speed-limit-for-the-internet/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

51. Mills, "The Cloud Begins with Coal." Although some studies have pointed to the energy savings of, say, teleconferencing versus flying to meet in person, or streaming video rather than ordering the DVD, De Decker ("Why We Need a Speed Limit for the Internet") points to the general problem of these findings being based on how one measures the energy use of the internet, a task so enormous that researchers generally only tackle a portion of the actuality. Embedded in these conclusions are also assumptions about lengths of calls, types of planes, frequency of use, and so on. In general, De Decker suggests that the wired internet is most efficient, followed by a small increase for Wi-Fi, and a substantial increase for wireless traffic via cellular networks. High speeds and bigger bit rates all translate to more energy needed.

52. Mills, "The Cloud Begins with Coal."

53. Chris Kohler, "The 15 Most Influential Games of the Decade," *Wired*, December 24, 2009, http://www.wired.com/gamelife/2009/12/the-15-most-influential-games-of-the-decade/.

54. Randall Munroe, "Online Communities 2," *xkcd*, October 6, 2010, http://xkcd.com/802/.

55. "FarmVille—Facebook Application Metrics from AppData," http://www.appdata.com/apps/facebook/102452128776.

56. See, for instance, "'Happy Farms' Game Destroys Chinese Jobs, Relationships," posted by jessie, October 21, 2009, https://www.chinasmack.com/happy-farms-popular-online-game, or "失落还是寂寞？开心偷菜背后埋焦虑," August 7, 2009, 重庆晚报, http://tech.163.com/09/0807/15/5G4F8HAG000915BF.html.

57. U.S. Environmental Protection Agency, "Demographics | Ag 101 | Agriculture," last modified July 9, 2015, https://www.epa.gov/sites/production/files/2015–07/documents/ag_101_agriculture_us_epa_0.pdf.

58. Alenda Y. Chang, "Back to the Virtual Farm: Gleaning the Agriculture-Management Game," *Interdisciplinary Studies in Literature and Environment* 19, no. 2 (2012): 237–52.

59. Ted Friedman, "*FarmVille*: The Garden in the Machine," *In Media Res*, December 8, 2010, http://mediacommons.futureofthebook.org/imr/2010/12/08/farmville-garden-machine.

60. Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (1964; rpt., Oxford: Oxford University Press, 2000).

61. Marx, *The Machine in the Garden*, 5.

62. Marx, *The Machine in the Garden*, 11.

63. Paul K. Conkin, *A Revolution Down on the Farm: The Transformation of American Agriculture since 1929* (Lexington: University Press of Kentucky, 2008), 100.

64. Williams, *The Country and the City*, 21.

65. EPA, "Demographics," 2.

66. Ethel Alderete, William Armando Vega, Bohdan Kolody, and Sergio Aguilar-Gaxiola, "Lifetime Prevalence of and Risk Factors for Psychiatric Disorders among Mexican Migrant Farmworkers in California," *American Journal of Public Health* 90,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

no. 4 (April 2000): 608–14. Alderete et al. draw from the National Agricultural Workers Survey (NAWS), conducted by the U.S. Department of Labor.

67. Conkin, *Revolution Down on the Farm*, 147–48.

68. Ashley Southall, "Black Farmers Settlement Approved," *The Caucus: The Politics and Government Blog of the Times*, November 30, 2010, http://thecaucus.blogs.nytimes.com/2010/11/30/black-farmers-settlement-approved/.

69. Conkin, *Revolution Down on the Farm*, 166.

70. Jesper Juul, *A Casual Revolution: Reinventing Video Games and Their Players* (Cambridge, Mass.: MIT Press, 2010).

71. According to Nevosoft's English-language website, the company's games are successful both domestically in Russia and worldwide in North American and European markets. Today, most of their games are available in "English, German, French, Spanish, Dutch, Italian, Japanese, Korean, Portuguese, Swedish, Traditional Chinese and Danish" ("Distributors | Nevosoft," 2002–2014, http://company.nevosoft.com/partner).

72. Giovanni Federico, *Feeding the World: An Economic History of Agriculture, 1800–2000* (Princeton, N.J.: Princeton University Press, 2005), xiii; John Berger, *Pig Earth* (New York: Vintage International, 1992); Thomashow, *Bringing the Biosphere Home*, 31.

73. For example, see Vandana Shiva's *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics* (Lexington: University Press of Kentucky, 2016), and *Who Really Feeds the World? The Failures of Agribusiness and the Promise of Agroecology* (Berkeley, Calif.: North Atlantic Books, 2016).

74. Tsing, *The Mushroom at the End of the World*, 35. Richard White, "'Are You an Environmentalist or Do You Work for a Living?': Work and Nature," in *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon (New York: W. W. Norton, 1995).

75. Herman E. Daly, *Beyond Growth: The Economics of Sustainable Development* (Boston: Beacon, 1996).

76. Daly, *Beyond Growth*, 4.

77. Most concede that sunlight and the benefits it provides through heat and photosynthesis are technically finite but for all practical purposes infinite.

78. Morton, *The Ecological Thought.*

79. In *FarmVille*, farm animals are glorified pets that can be bought and sold but never slaughtered for food. Many yield nonsensical products (horses are brushed for horsehair and penguins produce ice cubes). In *FrontierVille*, harvested animals do yield the relevant food products (pigs produce bacon, pork chops, etc.), but still come to no visible harm. In this respect, virtual farm animals are more like fruiting trees than livestock.

80. Darwin famously closes *On the Origin of Species* (1859) with this image.

81. Conkin, *Revolution Down on the Farm*, 169.

82. Conkin, *Revolution Down on the Farm*, 185.

83. Tsing, *The Mushroom at the End of the World*, 4–5.

84. Either way, the assumption is that farming can only begin after fields have been scraped clean of contours and organic life. Unfortunately, this premise replicates costly

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

real-world mistakes committed by industrial agriculture and forestry via clear-cutting and monoculture.

85. Stephen Mandiberg, "Translation (Is) Not Localization: Language in Gaming," *Proceedings of the Digital Arts and Culture Conference*, Irvine, Calif., 2009, https://escholarship.org/uc/item/6jq2f8kw.

86. For representative samples, see Max Liboiron, "Why Discard Studies?" May 7, 2014, discardstudies.com; Charles R. Acland, ed., *Residual Media* (Minneapolis: University of Minnesota Press, 2006); and Jennifer Gabrys, Gay Hawkins, and Mike Michael, eds., *Accumulation: The Material Politics of Plastic* (New York: Routledge, 2013).

87. "Game Design Flux, or How I Learned Virtual Crop Rotation Isn't Fun," Shining Rock Software, May 7, 2013, http://www.shiningrocksoftware.com/2013–05–07-game-design-flux-or-how-i-learned-virtual-crop-rotation-isnt-fun/.

88. See Patrice Petro's discussion of hoarding in "Austerity Media," in *After Capitalism: Horizons of Finance, Culture, and Citizenship*, ed. Kennan Ferguson and Patrice Petro (New Brunswick, N.J.: Rutgers University Press, 2016). For a relevant hidden-object game, consider *Antique Road Trip: American Dreamin'* (2013), by BoomZap Entertainment.

89. Kyle Matthew Bohunicky, "Ecomods: An Ecocritical Approach to Game Modification," *Ecozon@: European Journal of Literature, Culture and Environment* 8, no. 2 (2017): 72–87.

90. All quotations in this paragraph and the next from Nicholas Lovell, "What Is a Social Game?" *Gamesbrief*, January 11, 2011, http://www.gamesbrief.com/2011/01/what-is-a-social-game/.

91. Henry Lowood, "'It's Not Easy Being Green': Real-Time Game Performance in *Warcraft*," in *Videogame, Player, Text*, ed. Barry Atkins and Tanya Krzywinska (Manchester: Manchester University Press, 2007): 83–100.

92. McGonigal, *Reality Is Broken*, 80.

93. McGonigal, *Reality Is Broken*, 81, 82.

94. McGonigal, *Reality Is Broken*, 98.

5. Collapse

1. Kristen Whissel, "Tales of Upward Mobility: The New Verticality and Digital Special Effects," *Film Quarterly* 59, no. 4 (2006): 23–34, doi: 10.1525/fq.2006.59.4.23.

2. Jack (Judith) Halberstam, *The Queer Art of Failure* (Durham, N.C.: Duke University Press, 2011), 3. While *The Queer Art of Failure* does not mention games, Halberstam gave a related keynote address at the first annual Queerness and Games conference in 2013, at the University of California, Berkeley.

3. Naomi Klein, *The Shock Doctrine: The Rise of Disaster Capitalism* (New York: Picador, 2007). Klein also discusses disaster capitalism in *This Changes Everything: Capitalism vs. the Climate* (New York: Simon & Schuster, 2014).

4. Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago: University of Chicago Press, 2016).

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

5. Greg Garrard, "Worlds without Us: Some Types of Disanthropy," *SubStance* 41, no. 1, iss. 127 (2012): 43–44.

6. Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone, 2007).

7. Emma Marris, *The Rambunctious Garden: Saving Nature in a Post-Wild World* (New York: Bloomsbury, 2011).

8. Ubisoft, "*From Dust*," https://www.ubisoft.com/en-US/game/from-dust/.

9. Common Sense Media, "*From Dust* Game Review," https://www.commonsensemedia.org/game-reviews/from-dust.

10. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, Mass.: Harvard University Press, 2011).

11. Stephen Totilo, "After a Year of Natural Disasters, a Game That Lets Us Fight Back," July 27, 2011, https://kotaku.com/5825204/i-have-battled-the-tsunami-i-have-tried-to-turn-the-volcano-to-protect-my-people.

12. Tanner Higgin, "Blackless Fantasy: The Disappearance of Race in Massively Multiplayer Online Role-Playing Games," *Games and Culture* 4, no. 1 (2009): 3–26.

13. Wowprecatarchive, "Auberdine, Darkshore—Pre-Cataclysm," August 18, 2010, https://www.youtube.com/watch?v=kfN_oMcrBEk.

14. Nancy M. Wells and Kristi S. Lekies, "Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism," *Children, Youth, and Environments* 16, no. 1 (2006): 1–24, my emphasis.

15. Ban Ki Moon, "A Climate Culprit in Darfur," *Washington Post,* June 16, 2007, http://www.washingtonpost.com/wp-dyn/content/article/2007/06/15/AR2007061501857.html. See also Mark Notaras, "Does Climate Change Cause Conflict?" *Our World*, United Nations University, November 27, 2009, https://ourworld.unu.edu/en/does-climate-change-cause-conflict.

16. Marshall B. Burke, Edward Miguel, Shanker Satyanath, John A. Dykema, and David B. Lobell, "Warming Increases the Risk of Civil War in Africa," *PNAS* 106, no. 49 (2009): 20673.

17. Gerhard J. Falk, "The Influence of the Seasons on the Crime Rate," *Journal of Criminal Law and Criminology* 43, no. 2 (1952): 199–213; Janet L. Lauritsen and Nicole White, "Seasonal Patterns in Criminal Victimization Trends," U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics, June 2014.

18. You can also find games tagged as PvE or PvP on distribution platforms like Steam or itch.io. As of writing, 36 games were tagged PvE on Steam, versus 201 tagged as PvP.

19. The TV Tropes wiki (tvtropes.org) includes many entertaining entries on gaming, and relevant here are the "Die, Chair! Die," "Crate Expectations," and related "tropes." The list of games that feature destructible objects as conduits for power-ups is far too long to enumerate here, but for exemplary samples see *The Legend of Zelda* series or *Marvel: Ultimate Alliance* (2006). Since 2012, an online service called Loot Crate™, Inc. has also specialized in assembling fandom-related gift boxes, describing itself as "the worldwide leader in fan subscription boxes." To learn how to build your very own destructible crate using Unreal Engine, see Ryan M. Hoss and Todd B.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Emma, "Methods of Creating Destructible Assets for Video Games," *GSTF Journal on Computing* 2, no. 3 (October 2012): 32–34, doi: 10.5176/2010–3043_2.3.182.

20. George Reith, "10 Games with Great Destructible Environments," *GamingBolt*, September 2, 2011, http://gamingbolt.com/10-games-with-great-destructible-environments.

21. Lorenzo Veloria, "12 Games That Do Destructible Environments Right," *GamesRadar+*, June 23, 2014, http://www.gamesradar.com/games-incredible-destructible-environments/.

22. Electronic Arts, "*Battlefield 4*," 2017, https://www.battlefield.com/games/battlefield-4.

23. W. J. Hennigan, "Climate Change Is Real: Just Ask the Pentagon," *Los Angeles Times*, November 11, 2016, http://www.latimes.com/nation/la-na-military-climate-change-20161103-story.html.

24. Erika Spanger-Siegfried, Kristina Dahl, Astrid Caldas, and Shana Udvardy, "The US Military on the Front Lines of Rising Seas," Union of Concerned Scientists, 2016, https://www.ucsusa.org/global-warming/science-and-impacts/impacts/sea-level-rise-flooding-us-military-bases.

25. Robin L. Murray and Joseph K. Heumann, *Monstrous Nature: Environment and Horror on the Big Screen* (Lincoln: University of Nebraska Press, 2016).

26. Richard Grusin, *Premediation: Affect and Mediality after 9/11* (New York: Palgrave Macmillan, 2010).

27. Richard Grusin, "Premediating Sandy," blog, October 29, 2012, http://premediation.blogspot.com/2012/10/premediating-sandy.html.

28. See Kurt Squire's many writings on sandbox games, as well as Mark Sample's "Criminal Code: The Procedural Logic of Crime in Videogames," *@samplereality*, January 14, 2011, http://www.samplereality.com/2011/01/14/criminal-code-the-procedural-logic-of-crime-in-videogames/; and Matt Barton's "How's the Weather: Simulating Weather in Virtual Environments," *Game Studies* 8, no. 1 (2008), http://gamestudies.org/0801/articles/barton. We could also consider Republican Herman Cain's short-lived run for the 2012 presidency, during which his proposed "999" tax plan looked suspiciously like it came from *SimCity* (see Amanda Terkel, "Herman Cain 999 Plan: Did It Come from *SimCity*?" *HuffPost*, October 13, 2011, updated December 13, 2011, http://www.huffingtonpost.com/2011/10/13/herman-cain-999-sim-city_n_1008952.html).

29. Robert MacDougall and Lisa Faden, "Simulation Literacy: The Case for Wargames in the History Classroom," in *Zones of Control: Perspectives on Wargaming*, ed. Pat Harrigan and Matthew G. Kirschenbaum (Cambridge, Mass.: MIT Press, 2016), 447–54.

30. Timothy Welsh, *Mixed Realism: Video Games and the Violence of Fiction* (Minneapolis: University of Minnesota Press, 2017).

31. Kurt Squire, "Cultural Framing of Computer/Video Games," *Game Studies* 2, no. 1 (2002), http://www.gamestudies.org/0102/squire/.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

32. Adam Sneed, "What *SimCity* Teaches Us About Real Cities of the Future," *Slate.com*, March 6, 2013, http://www.slate.com/articles/technology/future_tense/2013/03/simcity_2013_what_the_urban_planning_game_tells_us_about_future_cities.html.

33. Sample, "Criminal Code." A published version of Sample's presentation can be found as "Criminal Code: Procedural Logic and Rhetorical Excess in Videogames," *Digital Humanities Quarterly* 7, no. 1 (2013).

34. *SimCity 2000* features "No Disasters" as an option on a dropdown menu labeled "Disasters." Later versions of the game allow you to check "sandbox mode" for gameplay "without random disasters." This has set a lasting precedent that other sandbox games, like *Banished*, now follow. Curiously, Sid Meier's *Civilization* games do not include natural disasters, a missing component that fans often bemoan. A more recent city-building game, Paradox Interactive's *Cities: Skylines* (2015), did not include natural disasters at first, but later added them in a downloadable expansion.

35. Mary Ann Doane, "Information, Crisis, Catastrophe," in *New Media, Old Media: A History and Theory Reader*, ed. Wendy Hui Kyong Chun and Thomas Keenan (New York: Routledge, 2006), 257.

36. Doane, "Information, Crisis, Catastrophe," 255.

37. Doane, "Information, Crisis, Catastrophe," 257.

38. Doane, "Information, Crisis, Catastrophe," 253.

39. As quoted in Doane, "Information, Crisis, Catastrophe," 258; and Wendy Hui Kyong Chun, *Habitual New Media: Updating to Remain the Same* (Cambridge, Mass.: MIT Press, 2016), respectively.

40. Alan Weisman, *The World without Us* (New York: Picador, 2007).

41. Jared Diamond, *Guns, Germs, and Steel: The Fates of Human Societies* (New York: W. W. Norton, 1999), and *Collapse: How Societies Choose to Fail or Succeed* (New York: Penguin, 2011).

42. A condensed version of this research can be found as a TED talk: Jared Diamond, "Why Do Societies Collapse?" *TED.com*, February 2003, accessed April 24, 2017.

43. Diamond notes that imported values or belief systems like religion or patriotism may work against sensible land use, for example in Australia's lingering attachment to a British pastoralist tradition despite the devastation wrought by introduced sheep on the continent's native landscapes.

44. Clive Ponting, *A New Green History of the World: The Environment and the Collapse of Great Civilisations* (London: Vintage, 2007).

45. Ponting, *A New Green History of the World*, 35.

46. Ponting, *A New Green History of the World*, 36.

47. Diamond, *Collapse*, 378.

48. Garrett Hardin, "The Tragedy of the Commons," *Science* 162, no. 3859 (December 13, 1968): 1243–48.

49. Ponting, *A New Green History of the World*, 423.

50. For a taste of the ongoing debate over Easter Island's history, see Robert Krulwich, "What Happened on Easter Island—A New (Even Scarier) Scenario," National

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Public Radio, December 10, 2013, http://www.npr.org/sections/krulwich/2013/12/09/249728994/what-happened-on-easter-island-a-new-even-scarier-scenario.

51. There is a long tradition of island study in Caribbean and postcolonial literature and theory (C.L.R. James, Édouard Glissant, Jamaica Kincaid), and a fascinating recent upwelling of scholarship on humanmade and melting islands, from Marc Shell, *Islandology: Geography, Rhetoric, Politics* (Stanford, Calif.: Stanford University Press, 2014); to Julie Sze, *Chinese Dreams and Ecological Fears in an Age of Climate Crisis* (Berkeley: University of California Press, 2015).

52. See J. Bristol Foster, "Evolution of Mammals on Islands," *Nature* 202 (April 18, 1964): 234–35, doi:10.1038/202234a0; MacArthur and Wilson, *The Theory of Island Biogeography*; and Peter Tyson, "Gigantism and Dwarfism on Islands," *NOVA*, November 1, 2008, http://www.pbs.org/wgbh/nova/evolution/gigantism-and-dwarfism-islands.html.

53. Eugene Thacker, *After Life* (Chicago: University of Chicago Press, 2010), 268, emphasis in original.

54. Steve Mirsky, "*The World without Us*: Suppose Humans Just Vanished—Then What?" Science Talk podcast, *Scientific American*, June 27, 2007, https://www.scientificamerican.com/podcast/episode/6d007b15-e7f2-99df-3b37c740c915b3ce/.

55. Richard A. Bartle, *Designing Virtual Worlds* (Boston: New Riders, 2003).

56. Richard A. Bartle, *MMOs from the Inside Out: The History, Design, Fun, and Art of Massively-Multiplayer Online Role-Playing Games* (New York: Apress, 2015), 88.

57. Rob Parker, "The Culture of Permadeath: Roguelikes and Terror Management Theory," *Journal of Gaming & Virtual Worlds* 9, no. 2 (2017): 127.

58. Braxton Soderman, "No Time to Dream: Killing Time, Casual Games, and Gender," in *Gaming Representation: Race, Gender, and Sexuality in Video Games*, ed. Jennifer Malkowski and TreaAndrea M. Russworm (Bloomington: Indiana University Press, 2017).

59. Examples abound, but my favorites include Edward Abbey's failure to mention the occasional presence of his wife and newborn son in *Desert Solitaire* and Thoreau's much ballyhooed stint at Walden Pond, within walking distance of his mother's apple pies and helpful laundering. See Thomas Lynch, "Nativity, Domesticity, and Exile in Edward Abbey's 'One True Home,'" in *Coyote in the Maze: Tracking Edward Abbey in a World of Words*, ed. Peter Quigley (Salt Lake City: University of Utah Press, 1998), 88–105; and Paul Theroux's introduction to Henry David Thoreau's *The Maine Woods*, ed. Joseph J. Moldenhauer (Princeton, N.J.: Princeton University Press, 1983).

60. Marcus Carter and Fraser Allison, "Fear, Loss, and Meaningful Play: Permadeath in *DayZ*," *Journal of Gaming & Virtual Worlds* 9, no. 2 (2017): 143–58.

61. Carter and Allison, "Fear, Loss, and Meaningful Play," 154.

62. Bartle, *MMOs from the Inside Out*, 88, emphasis in original.

63. Brendan Keogh, "*Towards Dawn*," *Critical Damage* blog, September 21, 2010, http://critdamage.blogspot.com/2010/09/towards-dawn.html.

64. At this time, you can still download Ben Abraham's compilation of the run at "Permanent Death—The Complete Saga," *SLRC—Subterranean Loner Rendered*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Comatose blog, December 4, 2009, http://drgamelove.blogspot.com/2009/12/permanent-death-complete-saga.html.

65. Brendan Keogh, "When Game Over Means Game Over: Using Permanent Death to Craft Living Stories in *Minecraft*," *Proceedings of the 9th Australasian Conference on Interactive Entertainment: Matters of Life and Death*, September 30–October 1, 2013, Melbourne, Australia, 5, doi: 10.1145/2513002.2513572.

66. My coauthors and I have explored the financial, material, and environmental aspects of permadeath in our introduction to a special issue of the *Journal of Gaming & Virtual Worlds.* See Alenda Chang, Jesús Costantino, and Braxton Soderman, "Introduction: The Multiple Lives of Permadeath," *Journal of Gaming & Virtual Worlds* 9, no. 2 (2017): 103–21.

67. Amra Copcic, Sophie McKenzie, and Michael Hobbs, "Permadeath: A Review of Literature" (Paper presented to the Games Innovation Conference [IGIC], 2013 IEEE International, September 23–25, 2013, Vancouver, BC, Canada), 40–47.

68. Thomas Henry Rousse, "On Permadeath: The State of Death in the Age of Electronic Resurrection," SSRN, December 19, 2011, doi: 10.2139/ssrn.2001550.

69. Qtd. in Copcic, McKenzie, and Hobbs, "Permadeath: A Review of Literature."

70. I am particularly indebted here to the many proposals submitted for our special issue on permadeath and precarity in games (*Journal of Gaming & Virtual Worlds* 9, no. 2 [2017], ed. Alenda Y. Chang, Jesús Costantino, and Braxton Soderman), particularly those from Ivan Mussa and Robbie Fordyce.

71. Brendan Keogh, "Day Fifty-eight (and Onwards)," March 31, 2012, *Towards Dawn: Leaving the Miner's Life Behind* blog, http://towardsdawns.blogspot.com/2012/03/day-fifty-eight-and-onwards.html, emphasis in original.

72. Parker, "The Culture of Permadeath."

73. See, for example, Phil Hartup, "Searching for the Endgame: Is *No Man's Sky* the Last Game You'll Ever Need?" *New Statesman*, August 8, 2016, http://www.newstatesman.com/culture/games/2016/08/searching-endgame-no-man-s-sky-last-game-you-ll-ever-need. Of course, if such a game existed, it would lead to the veritable collapse of the game industry.

74. Rousse, "On Permadeath," 13.

75. Given that we have yet to fully assess the world's biota and can never be entirely sure about our conclusions, proclaiming species' extinctions is arguably always tinged with uncertainty. For a consideration of strategic de-extinction decision-making, see Douglas J. McCauley, Molly Hardesty-Moore, Benjamin S. Halpern, and Hillary S. Young, "A Mammoth Undertaking: Harnessing Insight from Functional Ecology to Shape De-extinction Priority Setting," *Functional Ecology* 31 (2017): 1003–11, doi: 10.1111/1365–2435.12728.

76. Ursula Heise, *Imagining Extinction: The Cultural Meanings of Endangered Species* (Chicago: University of Chicago Press, 2016).

77. Thom van Dooren, "Mourning Crows: Grief and Extinction in a Shared World," in *The Handbook of Human-Animal Studies*, ed. Susan McHugh and Garry Marvin (New York: Routledge, 2014).

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

78. Vinciane Despret, "Afterword: It Is an Entire World That Has Disappeared," trans. Matthew Chrulew, in *Extinction Studies: Stories of Time, Death, and Generations*, ed. Deborah Bird Rose, Thom van Dooren, and Matthew Chrulew (New York: Columbia University Press, 2017).

79. Doane, "Information, Crisis, Catastrophe," 253.

80. John Krajewski (CEO, Strange Loop Games) in discussion with the author, Seattle, Wash., August 7, 2017. I became a registered alpha/beta supporter in 2015, including access to the game's dev forums and source code.

81. John Krajewski, "'Eco—Global Survival Game'—Pollution and Hydrology Simulation," September 4, 2015, https://www.youtube.com/watch?v=qiUSODHtozA.

82. Team Eco, "How to Save the Environment by Letting Kids Destroy It," April 24, 2017, https://www.strangeloopgames.com/how-to-save-the-environment-by-letting-kids-destroy-it/.

83. Ivan Mosca, "Legacy's Legacy: Irreversibility and Permadeath in Legacy Games," *Analog Game Studies* 4, no. 1 (January 23, 2017), http://analoggamestudies.org/2017/01/legacys-legacy-irreversibility-and-permadeath-in-legacy-games/.

84. Andrew Doull, "Analysis: The Game Design Lessons of Permadeath," *Gamasutra*, July 27, 2009, http://www.gamasutra.com/view/news/115412/Analysis_The_Game_Design_Lessons_Of_Permadeath.php.

85. Keogh, "*Towards Dawn*."

86. Keogh, "Day Fifty-eight (and Onwards)."

87. Zach Gage, "lose/lose," http://www.stfj.net/art/2009/loselose/.

88. See Owen S. Good, "Gamer Leaves SNES Powered On for 20 Years to Keep His Gamesave Alive," *Polygon.com*, January 2, 2016, https://www.polygon.com/nintendo/2016/1/2/10701068/snes-powered-on-20-years-gamesave-data.

89. "Overview—*Chronicles of Elyria*," https://chroniclesofelyria.com/game/overview.

90. Daniel J. White and Michael Lee Grossfeld, *Irrevocability in Games*, https://digitalcommons.wpi.edu/iqp-all/2947.

91. Dan Dixon, "Death; A Minor Annoyance or an Invitation to Play?" (Paper presented at Breaking the Magic Circle conference, University of Tampere, Finland, April 10–11, 2008), http://eprints.uwe.ac.uk/12780. Qtd. in Copcic, McKenzie, and Hobbs, "Permadeath: A Review of Literature," 4.

92. Bonnie Ruberg, "Permalife: Video Games and the Queerness of Living," *Journal of Gaming & Virtual Worlds* 9, no. 2 (2017): 159–73.

93. Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, N.C.: Duke University Press, 2016).

94. Steven J. Jackson, "Rethinking Repair," in *Media Technologies: Essays on Communication, Materiality and Society*, ed. Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot (Cambridge, Mass.: MIT Press, 2014).

95. Jackson, "Rethinking Repair," 223.

96. Alenda Y. Chang, "Environmental Remediation," *electronic book review*, June 7, 2015.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

97. Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (Minneapolis: University of Minnesota Press, 2016).

98. Jonathan Liew, "Sport Must Prepare for Irreversible Changes Due to Climate Change Unless It Becomes Part of the Solution," *Independent*, February 9, 2018.

99. Hockey's 2018 Stanley Cup Finals between the Vegas Golden Knights and the Washington Capitals were played in the T-Mobile Arena in Las Vegas and the Capitol One Arena in Washington, D.C. During the Vegas games, high outside temperatures made for noticeably inconsistent ice surface inside ("Ice Melting to Slush in Vegas Heat at Stanley Cup Final," Associated Press, May 30, 2018). The $1.3 billion Levi's Stadium was opened in 2014 in Santa Clara, California, as the new home to the San Francisco 49ers, but has already faced mounting complaints about heat discomfort on its sunny east side (Ann Killion, "49ers Have Temperature Issues: Is a Fix in Store at Levi's Stadium?" *San Francisco Chronicle*, September 11, 2017). Some teams, like the Miami Dolphins, have paid to retrofit their older stadiums with shade canopies (Craig Davis, "Dolphins' New Grass Field Designed to Thrive While Canopy Keeps Fans Cool in Shade," *South Florida Sun-Sentinel*, August 4, 2016).

100. See Daniel Scott, Robert Steiger, Michelle Rutty, and Yan Fang, "The Changing Geography of the Winter Olympic and Paralympic Games in a Warmer World," *Current Issues in Tourism* (2018), doi: 10.1080/13683500.2018.1436161; and D. Scott, R. Steiger, M. Rutty, and P. Johnson, "The Future of the Olympic Winter Games in an Era of Climate Change," *Current Issues in Tourism* 18, no. 10 (2015): 913–30, doi: 10.1080/13683500.2014.887664. Although soccer's world championship is typically held in June–July, FIFA officials decided that those months would be too hot for the 2022 events in host city Qatar, ultimately moving the games to November ("FIFA: April-May Too Hot for 2022 WC in Qatar," Associated Press, November 13, 2013, https://www.sportsnet.ca/soccer/fifa-april-may-too-hot-for-2022-wc-in-qatar/).

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:20 UTC
All use subject to https://about.jstor.org/terms

Gameography

Abzû. PlayStation 4, Xbox One, Microsoft Windows. Developed by Giant Squid Studios. 505 Games, 2016.

Adventure (also known as *ADVENT* or *Colossal Cave*). PDP-10. Developed by William Crowther. 1975–76.

AirQuest. iOS. Developed by Berkeley Social Apps Lab. Unreleased, 2012–13.

America's Army. Microsoft Windows. Developed by the United States Army. United States Army, 2002.

ARMA II. Microsoft Windows. Developed by Bohemia Interactive. Bohemia Interactive and 505 Games, 2009.

Assassin: The Game. iOS, Android, LyteShot. Developed by LyteShot. Lyteshot, 2015.

Asteroids. Arcade. Developed by Atari, Inc. (Lyle Rains and Ed Logg). Atari, Inc., 1979.

Banished. Microsoft Windows. Developed by Shining Rock Software (Luke Hodorowicz). Shining Rock Software, 2014.

Battlefield 4. Microsoft Windows, PlayStation 3, Xbox 360, PlayStation 4, Xbox One. Developed by EA DICE. Electronic Arts, 2013.

Battlefield: Bad Company. PlayStation 3, Xbox 360. Developed by EA DICE. Electronic Arts, 2008.

The Beast. Alternate-reality game. Developed by Elan Lee, Sean Stewart, and Jordan Weisman. Microsoft, 2001.

Bejeweled Blitz. Facebook. Developed by PopCap Games. PopCap Games, 2008.

The Binding of Isaac. Microsoft Windows. Developed by Edmund McMillen. Edmund McMillen, 2011.

Bioshock. Microsoft Windows, Xbox 360. Developed by 2K Boston and 2K Australia. 2K Games, 2007.

Black & White. Microsoft Windows (2001), Macintosh (2002). Developed by Lionhead Studios. Electronic Arts, 2001.

Black Cloud. Alternate-reality game. Developed by Greg Niemeyer, Antero Garcia, and Reza Naima. MacArthur Foundation Digital Media and Learning grant, 2008.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

BranchOut: Unlock the Outdoors. Outdoor escape room. Developed by Rick Thomas, Nicole Poletto, and Lindsay Martien. BranchOut, 2017.

Call of Duty. Microsoft Windows. Developed by Infinity Ward. Activision, 2003.

Chasing the Wish. Alternate-reality game. Developed by Dave Szulborski. Dave Szulborski, 2003.

Chicken Chase. Microsoft Windows. Developed by PosITive Solutions. Big Fish Games, 2007.

Chronicles of Elyria. Microsoft Windows. Developed by Soulbound Studios. Projected release date of 2020.

CityVille. Browser. Developed by Zynga. Facebook, 2010.

Cow Clicker. Browser. Developed by Ian Bogost. Facebook, 2010.

Crash Bandicoot. PlayStation. Developed by Naughty Dog. Sony Computer Entertainment, 1996.

Darfur Is Dying. Flash. Developed by Susana Ruiz. mtvU, 2006.

DayZ. Microsoft Windows, Xbox One. Developed by Bohemia Interactive. Bohemia Interactive, 2013.

Dear Esther. Microsoft Windows, Macintosh OS X, Linux, PlayStation 4, Xbox One. Developed by the Chinese Room. The Chinese Room and Curve Digital, 2012.

Diablo. Microsoft Windows. Developed by Blizzard North. Blizzard Entertainment, 1996.

Diner Dash. Microsoft Windows. Developed by Gamelab. PlayFirst, 2004.

Don't Starve. Microsoft Windows, Macintosh OS X, Linux. Developed by Klei Entertainment. Steam, 2013.

Doom. MS-DOS. Developed by id Software. id Software, 1993.

Dragon Age: Origins. Microsoft Windows, PlayStation 3, Xbox 360, Macintosh OS X. Developed by BioWare. Electronic Arts, 2009.

Duck Hunt. Nintendo Entertainment System. Developed by Nintendo. Nintendo, 1984.

Dune II: The Building of a Dynasty. MS-DOS. Developed by Westwood Studios. Virgin Games, 1992.

Dungeons and Dragons (5th edition). Developed by Gary Gygax and Dave Arneson. Wizards of the Coast, 2014.

Dwarf Fortress (aka *Slaves to Armok: God of Blood Chapter II: Dwarf Fortress*). Microsoft Windows, Macintosh OS X, Linux. Developed by Tarn and Zach Adams. Bay 12 Games, 2006.

Ecco the Dolphin. Sega Genesis. Developed by Ed Annunziata and Novotrade International. Sega, 1992.

Eco. Microsoft Windows, Macintosh OS, Linux. Developed by Strange Loop Games. Steam, 2018.

The Elder Scrolls IV: Oblivion. Microsoft Windows, Xbox 360. Developed by Bethesda Game Studios. Bethesda Softworks and 2K Games, 2006.

The Elder Scrolls V: Skyrim. Microsoft Windows, PlayStation 3, Xbox 360. Developed by Bethesda Game Studios. Bethesda Softworks, 2011.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

The Endless Forest. Microsoft Windows. Developed by Tale of Tales. Tale of Tales, 2006.

EverQuest. Microsoft Windows. Developed by Verant Interactive and 989 Studios. Sony Online Entertainment, 1999.

Everything. Microsoft Windows, Macintosh OS, Linux, PlayStation 4. Developed by David OReilly. Double Fine Presents & David OReilly, 2017.

Fallout 3. Microsoft Windows, PlayStation 3, Xbox 360. Developed by Bethesda Game Studios. Bethesda Softworks, 2008.

Fantastic Farm. Microsoft Windows, Macintosh OS. Developed by Kristanix Games. Big Fish Games, 2009.

Far Cry 2. Microsoft Windows, PlayStation 3, Xbox 360. Developed by Ubisoft Montreal. Ubisoft, 2008.

Farm Craft. Microsoft Windows. Developed by Nevosoft. Big Fish Games, 2008.

Farm Craft 2: Global Vegetable Crisis. Microsoft Windows, Macintosh OS, iOS, Android. Developed by Nevosoft. Big Fish Games, 2011.

Farmer Jane. Microsoft Windows. Developed by RTS Casual. Big Fish Games, 2008.

Farming Simulator 2011. Microsoft Windows. Developed by Giants Software. Giants Software and Steam, 2010.

Farm Mania. Microsoft Windows, Macintosh OS, iOS. Developed by Realore Studios. Big Fish Games, 2008.

Farm Town. Browser. Developed by SlashKey. Facebook and Myspace, 2009.

FarmVille. Browser. Developed by Zynga. Facebook, 2009.

FarmVille 2. Browser. Developed by Zynga. Facebook, 2012.

FarmVille 2: Tropic Escape. Browser, iOS, Android. Developed by Zynga. Facebook and Amazon, 2016.

Faunasphere. Browser. Developed by Big Fish Games. Big Fish Games and Facebook, 2009–11.

Firewatch. Microsoft Windows, Macintosh OS X, Linux, PlayStation 4, Xbox One. Developed by Campo Santo. Campo Santo and Panic, 2016.

The Flame in the Flood. Microsoft Windows, Macintosh OS, Xbox One. Developed by the Molasses Flood. Curve Digital, 2016.

flOw. PlayStation 3. Developed by thatgamecompany. Sony Computer Entertainment, 2007.

Flower. PlayStation 3. Developed by thatgamecompany. Sony Computer Entertainment, 2009.

Foldit. Microsoft Windows, Macintosh OS X, Linux. Developed by the University of Washington Center for Game Science and Department of Biochemistry. Freeware (fold.it/), 2008.

Forbidden Island. Board game. Developed by Matt Leacock. Gamewright Games, 2010.

Frogger. Arcade. Developed by Konami. Sega, 1981.

From Dust. Microsoft Windows, PlayStation 3, Xbox 360. Developed by Ubisoft Montpellier. Ubisoft, 2011.

FrontierVille (later renamed *The Pioneer Trail*). Browser. Developed by Zynga. Facebook, 2010.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Gone Home. Microsoft Windows, Macintosh OS X, Linux. Developed by the Fullbright Company. The Fullbright Company, 2013.

Grand Theft Auto III. PlayStation 2. Developed by DMA Design. Rockstar Games, 2001.

Grand Theft Auto IV. PlayStation 3, Xbox 360. Developed by Rockstar North. Rockstar Games, 2008.

Grand Theft Auto V. PlayStation 3, PlayStation 4, Xbox 360, Xbox One. Developed by Rockstar North. Rockstar Games, 2013-2014.

Half-Life. Microsoft Windows. Developed by Valve Corporation. Sierra Entertainment, 1998.

Halo 2. Xbox. Developed by Bungie. Microsoft Game Studios, 2004.

Happy Farm. Microsoft Windows, Macintosh OS. Developed by Five Minutes. Facebook and Tencent QQ, 2008.

Harvest Moon: Save the Homeland. PlayStation 2. Developed by Victor Interactive Software. Natsume, 2001.

Hay Day. iOS, Android. Developed by Supercell. Supercell, 2012.

Heavy Rain. PlayStation 3. Developed by Quantic Dream. Sony Computer Entertainment, 2010.

Hush. Microsoft Windows, Macintosh OS. Developed by Jamie Antonisse and Devon Johnson. Jamie Antonisse and Devon Johnson, 2008.

I Love Bees. Alternate-reality game. Developed by 42 Entertainment. Microsoft, 2008.

Ingress. Android (2013), iOS (2014). Developed by Niantic. Niantic, 2013.

Jenga. Board game. Developed by Leslie Scott. Hasbro, 1983.

John Deere: American Farmer. Microsoft Windows. Developed by Gabriel Entertainment. Destineer Studios, 2004.

Journey. PlayStation 3. Developed by thatgamecompany. Sony Computer Entertainment, 2012.

Katamari Forever. PlayStation 3. Developed by Genki. Namco Bandai Games, 2009.

King's Quest. IBM PCjr (1984), Tandy 1000 and Apple II (1985). Developed by Sierra On-Line. Sierra On-Line, 1984.

The Last of Us. PlayStation 3. Developed by Naughty Dog. Sony Computer Entertainment, 2013.

The Legend of Zelda: Ocarina of Time. Nintendo 64 (1998), Nintendo GameCube (2002), iQue Player (2003). Developed by Nintendo. Nintendo, 1998.

The Long Dark. Microsoft Windows, Macintosh OS, Linux, Xbox One, PlayStation 4. Developed by Hinterland Studio. Hinterland Studio, 2017.

lose/lose. Developed by Zach Gage. Zach Gage, 2009.

Mainichi. Microsoft Windows, Macintosh OS. Developed by Mattie Brice. Mattie Brice, 2012.

Majestic. Alternate-reality game. Developed by Electronic Arts. Electronic Arts, 2001.

Mario Kart 8. Nintendo Wii U. Developed by Nintendo. Nintendo, 2014.

Marvel: Ultimate Alliance. PlayStation 2, PlayStation 3, Xbox, Xbox 360. Developed by Raven Software. Activision, 2006.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Meadow. Microsoft Windows, Macintosh OS X, Linux. Developed by Might and Delight. Might and Delight, 2016.

Micropolis. Microsoft Windows, Linux. Developed by Will Wright and Electronic Arts. Don Hopkins, 2008.

Minecraft. Microsoft Windows, Macintosh OS X, Linux. Developed by Mojang. Mojang, 2011.

Mountain. Microsoft Windows, Macintosh OS X, Linux, iOS, Android. Developed by David OReilly. Double Fine Productions, 2014.

Neko Atsume: Kitty Collector. iOS, Android. Developed by Hit-Point Co. Hit-Point Co. Ltd., 2015.

Nethack. IBM PC, Amiga, Microsoft Windows, Macintosh OS. Developed by Mike Stephenson and the NetHack Dev Team. www.nethack.org, 1987.

Never Alone (*Kisima Inŋitchuŋa*). Microsoft Windows, PlayStation 4, Xbox One. Developed by Upper One Games. E-Line Media, 2014.

9.03m. Microsoft Windows. Developed by Space Budgie. Steam, 2013.

No Man's Sky. Microsoft Windows, PlayStation 4, Xbox One, PlayStation VR, HTC Vive, Oculus Rift. Developed by Hello Games. Hello Games, 2016.

The Novelist. Microsoft Windows, Macintosh OS X, Linux. Developed by Kent Hudson. Orthogonal Games, 2013.

Ōkami. PlayStation 2 (2006), Nintendo Wii (2008). Developed by Clover Studio. Capcom, 2006.

One Chance. Flash. Developed by Dean Moynihan. Dean Moynihan, 2010.

One Single Life. iOS, Android. Developed by FreshTone Games. FreshTone Games, 2011.

Pac-Man. Arcade. Developed by Namco (Tōru Iwatani). Namco and Midway, 1980.

Passage. Windows, Macintosh OS X, GNU/Linux. Developed by Jason Rohrer. Jason Rohrer, 2007.

Phone Story. iOS (2011), Android (2012), Flash. Developed by Molleindustria. Molleindustria, 2011.

Pikmin. Nintendo GameCube. Developed by Nintendo. Nintendo, 2001.

Plantera. Microsoft Windows. Developed by VaragtP. VaragtP, 2016.

Play the LA River. Card game. Developed by Project 51. Project 51, 2014–15.

Pokémon Black & Blue. Flash. Developed by People for the Ethical Treatment of Animals (PETA). PETA, 2012.

Pokémon Go. iOS, Android. Developed by Niantic. Niantic, 2016.

Pong. Arcade. Developed by Atari, Inc. (Allan Alcorn). Atari, Inc., 1972.

Populous. Amiga, MS-DOS, Macintosh OS. Developed by Bullfrog Productions. Electronic Arts, 1989.

Power Grid. Board game. Developed by Friedemann Friese. Rio Grande Games, 2004.

Prince of Persia: The Sands of Time. PlayStation 2, GameCube, Microsoft Windows, Xbox. Developed by Ubisoft Montreal. Ubisoft, 2003.

Proteus. Microsoft Windows, Macintosh OS X. Developed by Ed Key and David Kanaga. Ed Key and David Kanaga, 2013.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Pussy Walk. Browser. Developed by Symbio. Symbio, 2015.

QWOP. Microsoft Windows, Android, iOS. Developed by Bennett Foddy. Bennett Foddy, 2008.

Realm of Nauga. TRS-80 Color Computer. Developed by Thomas Stephenson. Chromasette, 1982.

Red Dead Redemption. PlayStation 3, Xbox 360. Developed by Rockstar San Diego. Rockstar Games, 2010.

Risk Legacy. Board game. Developed by Rob Daviau and Chris Dupuis. Heidelberger Spieleverlag, Wizards of the Coast, Hasbro, 2011.

Rogue. Unix. Developed by Michael Toy and Glenn Wichman, 1980.

Seafall. Board game. Developed by Rob Daviau. IronWall Games, Plaid Hat Games, 2016.

Second Life. Microsoft Windows, Macintosh OS X. Developed by Linden Research, Inc. Linden Research, Inc., 2003.

September 12th. Microsoft Windows, Macintosh OS. Developed by Gonzala Frasca. Newsgaming.com, 2003.

Shadow of the Colossus. PlayStation 2. Developed by Team Ico. Sony Computer Entertainment, 2005.

Shelter. Microsoft Windows, Macintosh OS X. Developed by Might and Delight. Might and Delight, 2013.

Shelter 2. Microsoft Windows, Macintosh OS X, Linux. Developed by Might and Delight. Might and Delight, 2015.

Sid Meier's Civilization III. Microsoft Windows, Macintosh OS. Developed by Firaxis (Jeff Briggs and Soren Johnson). Infogrames and Macsoft, 2001.

Silent Hill. PlayStation. Developed by Team Silent (Konami Computer Entertainment Tokyo). Konami, 1999.

SimAnt: The Electronic Ant Colony. MS-DOS, Microsoft Windows, Macintosh OS. Developed by Maxis. Maxis, 1991.

SimCity. Amiga, Macintosh, IBM PC, Commodore 64. Developed by Maxis. Maxis, 1989.

SimCity 2000. Macintosh OS, Amiga, MS-DOS, Microsoft Windows. Developed by Maxis. Maxis, 1993.

SimEarth: The Living Planet. IBM PC, Macintosh OS, Commodore Amiga. Developed by Maxis. Maxis, 1990.

The Sims. Microsoft Windows. Developed by Maxis. Electronic Arts, 2000.

A Slow Year. Atari 2600. Developed by Ian Bogost. Ian Bogost, 2010.

Smite. Microsoft Windows (2014), Macintosh OS (2014), Xbox One (2015), PlayStation 4 (2016). Developed by Titan Forge Games. Hi-Rez Studios, 2014.

Sonic the Hedgehog. Sega Genesis. Developed by Sega. Sega, 1991.

Space Station Silicon Valley. Nintendo 64. Developed by DMA Design. Take-Two Interactive, 1998.

Spacewar! PDP-1. Developed by Steve Russell. Steve Russell, 1962.

Spelunky. Microsoft Windows. Developed by Mossmouth. Mossmouth, 2008.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Splatoon. Nintendo Wii U. Developed by Nintendo. Nintendo, 2015.

Spore. Microsoft Windows, Macintosh OS X. Developed by Maxis. Electronic Arts, 2008.

The Stanley Parable. Microsoft Windows, Macintosh OS X. Developed by Galactic Cafe. Galactic Cafe, 2013.

StarCraft. Microsoft Windows. Developed by Blizzard Entertainment. Blizzard Entertainment, 1998.

Stardew Valley. Microsoft Windows. Developed by ConcernedApe (Eric Barone). Chucklefish, 2016.

Strange Rain. iOS, Apple TV. Developed by Erik Loyer. Opertoon, 2011.

Submerged. Microsoft Windows, PlayStation 4, Xbox One. Developed by Uppercut Games. Uppercut Games, 2015.

Sunshine Ranch. Microsoft Windows, iOS, Android. Developed by Rekoo Japan. Mixi and Facebook, 2009.

Super Mario Bros. Nintendo Entertainment System. Developed by Nintendo R&D4. Nintendo, 1985.

Tennis for Two. Donner Model 30 analog computer. Developed by William Higinbotham. Brookhaven National Laboratory, 1958.

TerraQuest. Alternate-reality game. Developed by MindQuest. MindQuest, 2003.

That Dragon, Cancer. Microsoft Windows, Macintosh OS X, Ouya, iOS. Developed by Numinous Games. Numinous Games, 2016.

3rd World Farmer. Browser. Developed by Frederik Hermund, Ole Fabricius Toubro, Jakob Elias Nielsen, Roman Spycher, and Benjamin Salqvist. Last updated 2014 [original release 2005]. https://3rdworldfarmer.org/.

Thirty Flights of Loving. Microsoft Windows. Developed by Brendon Chung. Blendo Games, 2012.

This War of Mine. Microsoft Windows, Macintosh OS X, Linux. Developed by 11 bit studios. 11 bit studios, 2014.

Tokyo Jungle. PlayStation 3. Developed by Crispy's. Sony Computer Entertainment, 2012.

Trap It! Biotic game. Developed by Riedel-Kruse Lab (Stanford University). San Jose Tech Museum, 2015.

Urban Hunt. Alternate-reality game. Developed by Dave Szulborski. Dave Szulborski, 2004.

Viridi. Microsoft Windows (2015), Macintosh OS X (2015), iOS (2015), Android (2016). Developed by Ice Water Games. Ice Water Games, 2015.

Walden, a game. Microsoft Windows (2017), Macintosh OS (2017), PlayStation 4 (2018). Developed by the Game Innovation Lab (University of Southern California). Game Innovation Lab, 2017.

The Walking Dead. Microsoft Windows, Macintosh OS X, PlayStation 3, Xbox 360, iOS. Developed by Telltale Games. Telltale Games, 2012.

Warcraft: Orcs & Humans. MS-DOS (1994), Macintosh OS (1996). Developed by Blizzard Entertainment. Blizzard Entertainment and Interplay Entertainment, 1994.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Wetlands Restoration. Browser. Developed by the University of Washington Bothell and Harebrained Schemes. Facebook, 2012.

Wii Sports. Nintendo Wii. Developed by Nintendo. Nintendo, 2006.

World of Warcraft. Microsoft Windows, Macintosh OS X. Developed by Blizzard Entertainment. Blizzard Entertainment, 2004.

World without Oil. Alternate-reality game. Developed by Ken Eklund. Independent Television Service, 2007.

XCOM: Enemy Unknown. Microsoft Windows, PlayStation 3, Xbox 360. Developed by Firaxis Games. 2K Games, 2012.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:21 UTC
All use subject to https://about.jstor.org/terms

Index

Aarseth, Espen, 12, 48
Abzû, 111
Adventure, 23–24; and caving, 28–29; ecomimesis in, 24, 26, 28, 29, 31; environmental realism of, 38, 41; as environmental text, 36; interaction in, 26–27; Jerz's studies of, 28, 29, 41–42; literary qualities, 29; and Mammoth Cave system, 27–28, 38, 41; mazes in, 29, 31; realism of, 37, 38; topology of, 28–29, 30
agriculture, 164, 175, 177, 210, 266n84. *See also* farming in the United States
AirQuest, 48, 55–57
Allison, Fraser, 215–16
Altered State exhibit, 59–60
alternate reality games (ARGs), 49; *The Beast,* 49–50, 52; *Black Cloud,* 48, 54–55, 67; Cloudmakers group, 52; vs. digital games, 46–48; environmental engagement in, 52–53; failures, 50; as ground-truthing, 94; *I Love Bees,* 50; McGonigal on, 50–52; *Play the LA River,* 48, 57–58, 67; and reality, 50–52; scripting vs. improvisation, 51; and social games, 51; Szulborski on, 50–51; This Is Not A Game philosophy of, 51, 52–53; as transmedia, 66; *World without Oil,* 48, 53–54, 55
ambient gaming, 5–6, 17
animal perspectives in games: *Abzû,* 111; *The Endless Forest,* 112; *Euglena gracilis* exhibit, 17, 111; *Meadow,* 112; MMOGs, 112; *Never Alone,* 111; protagonists, 110; San Andreas Deer Cam, 42, 112–13, 256n13; *Shelter* series, 110–11; *Trap It!,* 112; virtual reality examples, 111
animals: labor, 170; life worlds of, 140–41; as nonplayer characters, 109–10; relations with humans, 107, 109
anthromes, 7–8
Anthropocene, the, 7, 74, 221, 231, 242n14
anthropocentric elitism, 44
arcade games, 213–14
assets, game, 115
asthma, 55–56, 57
augmented reality, 62–63
augmented reality games: vs. digital games, 46–48; *Pokémon Go,* 61–64, 67; as transmedia, 66

Banished, 92–93, 179
Bartle, Richard, 135, 213, 214, 216, 231
Battlefield 4, 200–201

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Beast, The, 49–50
Beck, Ulrich, 207, 232
Bennett, Jane, 134, 144
Berger, John, 109, 255n4
bestiaries, 257n6
big data in ecology, 91–92
Bigg, Grant R., 19
big history, 99–100, 101
bit-narratives, 124, 128; categories of, 128, 130; *The Diamond Age,* 128–29; environmental edges in, 125; and materialisms, 133–34; and materialist approaches to games, 124; "Mother Earth Mother Board," 129–30; *Mountain,* 124, 139–40, 141, 192; mountain-water-games, 135–45; *The Novelist,* 124, 131–33, 135; *Phone Story,* 124, 130–31, 135, 149, 258n56
bits, 128, 258n52
Black, Max, 39
Black Cloud, 48, 54–55, 67
Blackwell, Mark, 125
Blue Marble photograph, 79, 90
Bogost, Ian: *Cow Clicker,* 185; on Japanese rock gardens, 114; on ontology, 133–34; procedural rhetoric, 65; *A Slow Year,* 192
Bohunicky, Kyle, 181
Bolewski, Christin, 139, 260n72
Borges, Jorge Luis, 25
BranchOut, 60–61
Brice, Mattie, 232
broken-world thinking, 232–33
Brucker, Roger, 29
Brunton, Finn, 154, 157
Buell, Lawrence, 24, 25, 32, 39, 47
built environments, 144

California Academy of Sciences, 59
Campo Santo, 45. See also *Firewatch*
Carter, Marcus, 215–16
cartographic impulse, 135–36
Castronova, Edward, 10, 20, 37, 39
casual games, 159–60, 214–15. *See also* farm games; social games
catastrophe, 205–7
caving, 28–29
Chapela, Ignacio, 87
chapter overviews, 11–12, 21
Chen, Jenova, 34, 35, 38, 136, 137, 229
childhood nature experiences, 198
Chinese painting, 137–39, 142, 143
Christian, David, 99
Chronicles of Elyria, 230–31
ChronoZoom, 98–100, 101–3, 104
CityVille, 165
Clark, Andy, 39
climate change: Altered State exhibit, 59–60; armed conflicts caused by, 198–99; barriers to, 74; in fiction, 190; and scale, 70–71; U.S. military preparations for, 201
cloud, the, 155–59, 265n51
collapse, 187–88; catastrophe, 205–7; Diamond on, 209, 210–12, 232, 270n43; disaster capitalism, 190; Easter Island, 211–12; ecological, 188; failure, 94–95, 189–90; mass extinctions, 171, 208, 221; meanings of, 188, 208; overshoot causing, 208; Ponting's research on, 209–10, 211; and post-apocalyptic games, 187–88; in sandbox games, 188; societal, 209–11; temporal registers of, 207; and time, 232; tipping points, 208–9; *The World without Us,* 208, 212–13, 229–30. *See also* environmental violence in games; legacy board games; permadeath games
collective intelligence, 50
Conkin, Paul, 163, 166–67, 175
consumer electronics: disposed, 251n12; energy consumption rates, 150; environmental impacts of, 149–50; Guide to Greener Electronics, 150
Cooper, Scott, 75, 92, 93, 252n23

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Country and the City, The, 164–65
Cow Clicker, 185
cross-species interaction, 176–77, 181
Crowther, William, 23, 27–28, 38. See also *Adventure*
Crutzen, Paul, 7, 74

Daly, Herman, 169, 170–72
Damasio, Antonio, 35
Darfur, Sudan, 198–99
Darfur Is Dying, 229
dark ecology, 172–73
dark ludology, 179, 181
Daston, Lorraine, 78, 89, 91, 253n57
DayZ, 187, 215–16, 218
Dear Esther, 42, 43
death, 229–31. *See also* permadeath games
De Decker, Kris, 158, 265n51
Delappe, Joe, 42
Derrida, Jacques, 107, 109
Despret, Vinciane, 222
destructibility. *See* environmental violence in games
Deussen, Oliver, 119
Diamond, Jared, 209, 210–12, 232, 270n43
digital games. *See* games
digital humanities, 92
digital morphogenesis, 118–19
disanthropic games, 191–92; *Mountain,* 124, 139–40, 141, 192. *See also* bit-narratives; *Flower*; *Spore*
disanthropic literature, 191
disanthropy, 191
disaster capitalism, 190
Dixon, Dan, 231
Doane, Mary Ann, 205–7, 222
Don't Starve, 8, 9, 188, 215, 219–20
Dooren, Thom van, 222
Dozier, Jeff, 99–100

Ebert, Roger, 259n70
Eco, 223–25, 233
eco-cosmopolitanism, 90
ecocriticism, 10, 25, 244n16, 246n47
ecological economics, 169–72, 266n77
ecological localization, 178–79, 181
ecological research and gameplay, 94–95; environmental failure, 94–95; ground-truthing, 94, 254n63; perturbation experiments, 92–93; scaling models and dimension analysis, 93–94; and social realism model, 96–97
ecology, 6; big data in, 91–92; collapse in, 188; dark, 172–73; and digital technology, 91–92; and economy, 147; and entropy, 148; of games, 6–7; humans in, 7–8
ecomimesis, 24, 25; in *Adventure,* 24, 26, 28, 29, 31; applicability outside literature, 25; authentication role of, 38; as postmodern, 25; and text adventures, 25–26
edge effects, 12–15, 19
edges, 13–14, 19
Elder Scrolls IV: Oblivion, The, 116, 118
Eldredge, Niles, 82
ELIZA, 26, 244n19
Ellis, Erle, 7–8, 12
Emerson, Ralph Waldo, 72
Ender's Game, 222
Endless Forest, The, 112
energy consumption: the cloud's, 152, 155–56; consumer electronics, 150; corporate data centers, 137; efficiency vs. demand, 157; quantification difficulties, 158; video game hardware, 150–54; wired vs. wireless networks, 156
Englund, Göran, 75, 92, 93, 252n23
entropy, 146, 148; conceptual strengths of, 146, 147–48; disciplinary uses of, 148; and the game industry, 146; and game materiality, 146; heat, 151–55; in the life sciences, 148; and scale, 148; as

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

waste, 172. *See also* farm games; video game hardware
environmental education, 11, 15, 88–89, 234
environmental ethics, 24, 69, 136–37
environmental failure, 94–96. *See also* collapse
environmental gameplay and genre, 181–82
environmental games, 21; as environmental texts, 32–33; *The Novelist* as, 133; range of, 66–67
environmental humanities, 10
environmentalism, 11, 79
environmental labor, 170
environmental texts: Buell's criteria for, 32, 47; criteria for games, 36; games as, 32–33; and intersubjective experience, 47; and mediation, 47
environmental variability, 177–78, 181
environmental violence in games, 192, 194; vs. anthropocentric violence, 194–95; in *Battlefield* series, 200–201; destructibility, 188, 192, 200–201, 220, 268n19; effects of, 194, 201–2, 207; in *From Dust,* 192–93, 194, 202; player uses for, 194; player versus environment games, 199–201, 268n18; and premediation, 202–3, 207; in *SimCity,* 94, 95, 203–5; in *World of Warcraft,* 195–98
erythema ab igne, 154
escape rooms, 60–61
ethics of care, 113, 220
Euglena gracilis, 17, 111, 256n10
EverQuest, 69, 93–94
exploration, reasons for, 135
extinction: categories of, 222; mass, 171, 208, 221; and televisuality, 222; uncertainty in identifying, 272n75

Facebook, 159
failure, 94–95, 189–90
Farm Craft, 168–69, 177, 266n71
farm ecology, 175
farm games: animals in, 174, 177; *Banished,* 179; and classical economic models, 171–72; common narrative tropes, 167; *Cow Clicker,* 185; cross-species interaction in, 176–77; and dark ludology, 179, 181; diversity in, 165–68; downloadable, 167–68; ecological localization in, 178–79; effects on players, 176; entertainment value of, 176; environmental variability in, 177–78; erasures of labor, 164, 168, 169; examples of, 162; *Farm Craft,* 168–69, 177, 266n71; and farm ecology, 175; *FrontierVille,* 178; genre of, 181, 182, 184; and god games, 184–85; *Happy Farm,* 159–60, 161, 179; *Harvest Moon,* 22; ideologies of, 169, 173–74; lack of environmental degradation in, 172; male vs. female characters, 167; pastoralism of, 162–63; plants in, 174; and real-time strategy games, 183; single-player, 162; social, 162; *Stardew Valley,* 179–81; success of, 162, 163; *Sunshine Ranch,* 179; *3rd World Farmer,* 179; as unrealistic, 173–74; virtuality of, 173; water in, 172; *Wetlands Restoration,* 177; work and play in, 169. See also *FarmVille*
farming in the United States: base acreage calculations, 166–67; Conkin on, 163, 166–67, 175; distress narratives, 165; diversity in, 166; employment rates, 162, 165; ethnically diverse migrant labor, 165–66; history of, 163–64; and policy, 169; racial issues, 166
FarmVille: advertisements for, 161; advertisements in, 174–75; animals in, 266n79; avatars in, 167; and *CityVille,* 165; ecological localization in, 179; as

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

environmentally absurd, 146, 173–74; environmental variability in, 177–78; lack of failure in, 20; pastoral idealism in, 22; as politically disconnected, 173–74; popularity of, 159, 161; as single-player, 169; social mechanics, 182; use of time intervals, 185; user account statistics, 160–61
Faunasphere, 109, 112
Fiber-Optic Link Around the Globe (FLAG), 129–30
fiction: Liu on, 103–4
Fine, Gary Alan, 244n6
Firewatch, 44–46
Flanagan, Mary, 48
Flint, Christopher, 125
Flower, 31; audiovisual feedback, 33; as disanthropic, 192; environmental realism of, 38, 41; as environmental text, 31–33, 36; human presence in, 33, 34; immersive qualities, 34; inspirations for, 34, 38; and Morton's environmentalism, 34; player agency in, 33; player emotion, 35; realism in, 34
Foldit, 49
Forest Fragmentation Project, 13–15
Franceschini, Amy, 86–87
Fresno, California, 56
Friedman, Ted, 185
From Dust, 95, 192–93, 194, 195, 202, 207
FrontierVille (The Pioneer Trail), 178
Frosh, Paul, 122–23
Fullerton, Tracy, 1, 46
Funke, Alex, 77–78
Futurefarmers collective, 86–88, 253n44

Gabrys, Jennifer, 235
Gage, Zach, 228
Gaia hypothesis, 253n34
Galison, Peter, 78, 89, 91, 253n57
Galloway, Alexander: countergaming, 65, 250n91; on game hermeneutics, 65; on interactivity, 65; on media effects theories, 64; social realism concept, 37, 65, 96–97
game environments: as backdrops, 6, 22, 44, 114; benefits of use, 64–65; common shortcomings, 21–22; ecology of, 6; edges in, 14–15; educational potential of, 234; environmental realism, 22–23, 38, 47–48; and exploratory play, 41; graphical spectacle model, 6, 114, 135, 189, 201, 233–34; interaction with, 23, 191; Jenkins on, 40; locality in, 22–23; as mesocosms, 20–21, 38–39, 41; and natural environments, 38–39, 40–41; pastoral ideals in, 22; in permadeath games, 219–21; and player emotions, 35; range of, 234; reliance on cliché, 22; resource extraction model, 6, 32, 135, 196, 233–34; risks of, 40; in text games, 31; of walking simulators, 43. *See also* environmental violence in games; farm games
games: as abstractions, 176; as art, 259n70; characteristics of, 26, 65; critiques of, 38–39; disanthropic, 191–92; drudgery in, 176; ecological analysis of, 234; effect on mortality salience, 227; as emotional experiences, 35; and environmental education, 11, 15, 88–89, 234; genres of, 181–82; indebtedness to nature, 233; interaction in, 65; vs. islands, 212; and late capitalism, 191; materiality of, 146, 148–49; as models, 93–94; and nonhumans, 134; obsolescence of, 228; progression in, 73; public-to-private space shift, 5–6, 242n11; and scientific research, 71–72; and scientific visualization, 91; similarities to, 2–5; systems theory definitions, 145–46; and Thoreau's transcendentalism,

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

3–4; transmedial aspects of, 65–66; types of, 8–9; as unnatural, 2; violence in, 64
game studies: and environmental criticism, 10; history of, 9–10; and literary ecocriticism, 24; ludology vs. narratology debate, 24; materialist ludology, 134; middleware in, 122; middleware research, 122; play in, 24–25; political economy in, 147
gamification, 47
Garrard, Greg, 191, 192
Ghosh, Amitav, 190
Giddens, Anthony, 207, 232
god games, 202–3; educational uses of, 204; environmental violence in, 203; and farm games, 184–85; *From Dust,* 95, 192–93, 194, 195, 202, 207; *Populous,* 203. See also *SimCity*; *Spore*
Gone Home, 42
Google, 157
Google Earth, 79, 90
Grandin, Temple, 63, 109, 184, 255n4
Grand Theft Auto series, 22
green games, 142, 144
Greenpeace, 149–50, 155–56, 262n14
Gregory, Ryan, 82
growth, economic, 73, 170
Grusin, Richard, 202, 206, 234
Guins, Raiford, 147, 149

Halberstam, Judith, 189, 267n2
Happy Farm, 159–60, 161, 179
Haraway, Donna, 1, 64, 113, 144, 184, 187, 188, 222, 232
Harvest Moon, 22
Hass, Robert, 124
Hayles, N. Katherine, 40
heat, 151–55
HeavenVille, 229
Heise, Ursula, 70, 85, 89–90, 222
Hewlett-Packard, 149, 262n14
history and fiction, 103–4
Hohn, Donovan, 127
Hudson, Kent, 131
human bodies, 146
humans as assemblages, 144
hunting games, 184
Hush, 229
hyperobjects, 72, 251n7

immersion, 14, 37, 243n22
immersive games: vs. pervasive games, 248n68
infrastructure studies, 152
International Big History Association, 99
International Union for Conservation of Nature, 221–22
Isbister, Katherine, 109, 134
islandology, 211–12
islands, 211–12
it-narratives, 124; contemporary commodity exposés, 125–27, 258n47; examples of, 124, 125; Lupton on, 125, 126; *Moby-Duck,* 127; Price on, 124, 125, 128; readings of, 125; *Tales of a Neoliberal T-shirt,* 126–27

Jackson, Steven, 232–33
Jenkins, Henry, 31, 40, 64, 66, 69
Jerz, Dennis, 28, 29, 41–42
Jones, Steven, 84–85
Journey, 136; appeal of, 140–41; and the cartographic impulse, 135–36; Chinese culture in, 137; design goals, 136; distance and time in, 142; multiplayer aspects of, 136–37; and *Passage,* 137; as subverting walkthroughs, 42; and topophilia, 142; and von Uexküll's theories, 140–41
Juul, Jesper, 10, 20, 94–95, 134, 189, 231

Katamari Forever, 76–77
Katz, Jonathan, 59

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Keogh, Brendan, 216–17, 219–20, 227, 231, 232
Key, Ed, 44, 247n52
Klein, Naomi, 190
Kohler, Chris, 159–60
Krajewski, John, 223

Laure-Ryan, Marie, 243n22
Leach, Neil, 134
Lee, Sherman, 137–38
legacy board games, 213, 225–26; as anti-establishment, 228; and climate change, 231–32; and the magic circle, 226–27; Mosca on, 226–28; permadeath in, 226; player skill in, 226; *Seafall,* 225, 233
libraries, 115
Lindenmeyer, Aristid, 119, 121
Linterman, Bernd, 119
Liu, Cixin, 98, 103–4
living subjects, 140–41, 143, 234, 252n21
localization, 179
Lose/Lose, 228
Louv, Richard, 4, 40, 242n10
Lovejoy, Thomas, 13, 15
Lovelock, James, 80, 253n34
Lowood, Henry, 183
ludology: dark, 179, 181; definition of, 243n24; materialist, 134; vs. narratology, 24
Lupton, Christina, 125, 126
Lyotard, Jean-François, 102

machinima nature walks, 42
Maeda, Robert, 138
magic circle, the, 15, 226–27
Mainichi, 232
Manovich, Lev, 120, 246n45
Martien, Lindsay, 61
Marx, Leo, 162–63
massively multiplayer online games (MMOGs): animal perspectives in, 112; *Chronicles of Elyria,* 230–31; *EverQuest,* 69, 93–94; permadeath in, 214, 230; PvP vs. PvE, 199, 201, 268n18; *World of Warcraft,* 195–98
materialism, 134; and bit-narratives, 124, 133–34; ludology of, 134; new, 124, 134; object-oriented ontology, 133–34; vital, 134
materiality of games, 146, 148–49
McCarthy, Anna, 5, 242n11
McCarty, Willard, 72
McGonigal, Jane: on ARGs, 50–52, 66, 248n70; on epic environments, 66; on social games, 184, 251n10; on social interaction in games, 185–86
McLuhan, Marshall, 156
Meadow, 112
media and the environment, 234–35
media effects theories, 64
Meijer, G. Ingmar, 157
mesocosms, 17–19; aquatic, 18–19; and edge effects, 13, 19; and emotions, 35; game environments as, 20–21, 38–39, 41; as mini-ecosystems, 19–20; vs. virtual reality, 39; and Visitor Interactions in Microbiology exhibit, 17, 18; *Walden, a game,* 46. *See also* alternate reality games; walking simulators
Microsoft, 150, 157
middleware, 122. *See also* plants in games and digital media
Milburn, Colin, 91, 142, 253n57
Minecraft: anthromes in, 8, 9; vs. *Eco,* 223–24; hardcore mode, 219; premise of, 188; *Towards Dawn,* 216–17, 219, 227
mining, 210
min-maxing, 142, 260n85
mobile games, 6–7, 48, 55–57
Moby-Duck, 127
Monke, Lowell, 47, 247n58, 253n56
monoculture, 164, 175, 177, 266n84
Moore's Law, 36

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Mori, Masahiro, 36
Morrison, Philip, 79–80
Morrison, Phylis, 79–80
Morton, Timothy: on dark ecology, 173; on ecological thought, 104; on ecomimesis, 24, 25; environmental thought of, 34, 245n29; scalar considerations of, 89–90
Mosca, Ivan, 226–28
Mountain, 124, 139–40, 141, 192
mountains, 136–37

Nardi, Bonnie, 23, 40
NASA photographs of Earth, 79, 252n31
natural resource valuation, 170
nature: as finite, 171, 266n77; media representations of, 2, 64–65, 241n5; and new media, 120–21; romanticization of, 2; unmediated experiences of, 2, 47
nature–technology dichotomies, 2; as cultural, 11; humans in, 2; media in, 4; problems with, 64–65; Thomashow's, 88–89
nature writing: masculinist, 271n59
Neko Atsume, 107–9
Never Alone, 111
Newman, James, 147, 153
Niantic, 63
Niemeyer, Greg, 48, 54, 55
9.03m, 43, 143
Nintendo: environmental scrutiny of, 149, 150; *Pikmin,* 36; *Pokémon Go,* 61–64, 67
No Man's Sky, 98, 100–103
nonhuman–human relations: animals as nonplayer characters, 109–10; digital objects illuminating, 144; nonplayer characters, 109, 134; Turkle on, 109. *See also* animal perspectives in games; bit-narratives; it-narratives
nonhuman labor, 170
nonhumans in ecological economics, 171
Novelist, The, 124, 131–33, 135

object-oriented ontology, 133–34
One Single Life, 231
OReilly, David, 139, 140
overshoot, 208

Pac-Man, 213
Parikka, Jussi, 148, 149, 251n12
Parker, Rob, 219, 227
Parks, Lisa, 257n35
Parliament of Things, 47, 146
Passage, 137
pastoralism, 162–65
People for the Ethical Treatment of Animals (PETA), 63
performative mastery, 23
permadeath games, 207, 213; as anthropocentric, 218–19; appeals of, 213, 215, 231–32; Bartle on, 213, 214, 216; Carter and Allison's work on, 215–16; *Chronicles of Elyria,* 230–31; and climate change, 231–32; *DayZ,* 187, 215–16, 218; definitions of, 217–18; *Don't Starve,* 188, 219–20; *Eco,* 223–25, 233; ecological and environmental, 218–19, 232; ecological perspectives on, 217, 221–22, 230, 231–32; and *Ender's Game,* 222; and excitation transfer effect, 215; and game worlds, 219–21; and gender, 215; Keogh on, 216–17, 219–20, 227, 231, 232; legacy board games, 226; *Lose/Lose,* 228; modern vs. traditional roguelikes, 227; and mortality, 221; and obsolescence, 228; *One Single Life,* 231; *Pac-Man,* 213; Parker on, 227; vs. permalife games, 232–33; potential forms of, 218; procedural generation in, 219–20; "real life" challenge, 229; and risk, 232; *Rogue,* 213–14, 215; roguelikes, 213–14, 215, 219; Rousse

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

on, 217–18, 219; and terror management theory, 227; and threatened species lists, 221–22; tragedy and survival in, 212; trends away from, 214
permalife games, 232–33
pervasive games vs. immersive games, 248n68
Pew Internet and American Life Project, 64
Phillips, Dana, 25
Phone Story, 124, 130–31, 135, 149, 258n56
Pikmin, 36, 188
Planet Money, 126, 127
plants and fractals, 120
plants in games and digital media: aesthetics of, 121–22; artistry of, 123; as blending human labor with automation, 123; complexity of, 115; creation and modeling methods, 115–16; and Da Vinci, 120; digital morphogenesis, 118–19; *The Elder Scrolls IV: Oblivion,* 116, 118; and fractals, 118, 120; graph theory vs. network topology, 120; ideal form ideology, 120; and L-systems, 119–21; and meaning-making, 124; middleware, 115, 118, 122–23; plant-and-play models, 115; procedural vs. rule-based, 119; SpeedTree, 116, 117, 118, 120, 121, 123; vs. stock photos, 122–23; structural vs. space-based, 121; *Viridi,* 113–14; virtual reality, 124, 257n39; Xfrog, 115, 118–20, 121, 123
plant thinking, 114, 256n16
play: changing conditions of, 235, 274nn99–100; in Greek philosophy, 10, 242n17; Louv on, 4, 242n10
players: models of, 135, 244n6
player versus environment (PvE) games, 199–201, 268n18
Play the LA River, 48, 57–58, 67
Pokémon Go, 61–64, 67
Poletto, Nicole, 61
Ponting, Clive, 209–11
postapocalyptic games, 187–88; and broken-world thinking, 232–33; *DayZ,* 187, 215–16, 218; lacking humans, 191
postmodernity, 102
Power Grid, 48, 58–59
premediation, 202–3, 206, 207
Price, Leah, 124, 125, 128
procedural generation: in permadeath games, 219–20; of plants, 120, 121, 123; and scale, 101–2. See also *Spore*
progression, one-way, 73
Proteus, 42, 44
Prusinkiewicz, Przemyslaw, 119, 121
Pussy Walk, 44
"pwn" term, 248n74

quadrats, 75, 252n20
QWOP, 44

Ramankutty, Navin, 7–8, 12
realism: of *Adventure,* 37, 38; environmental, 22–23, 38, 47–48; in *Flower,* 34; graphical, 36–37, 38; in mesocosm-based research, 19; and role-playing games, 37; Rothstein on, 36–37; social, 37
real-time strategy (RTS) games, 183–84
Red Dead Redemption, 22–23
remediation, 234–35
Riedel-Kruse, Ingmar, 17, 111–12, 243n1
risk societies, 207, 232
Rivoli, Pietra, 126
Robinson, Kim Stanley, 95, 96
Rockstar Games, 22–23
Rogue, 213–14, 215
roguelikes, 213–14, 215, 219, 227
role-playing games, 37
Rothstein, Edward, 36–37
Rousse, Thomas, 217–18, 219
Roy, Ananya, 87, 88

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Sample, Mark, 204–5
San Andreas Deer Cam, 42, 112–13, 256n13
sandbox and open-world games: collapse in, 188; *From Dust,* 95, 192–93, 194, 195, 202, 207. *See also* god games
Sayre, Nathan, 74
scalar models, 74, 251n13
scale, 69–70; deep zoom technology, 101; definitions of, 72; in ecological experiments, 74–76; in ecological visualizations, 86; in economics, 70; in environmental thinking, 70, 72, 74, 90; and explanatory power, 76; in Heise's work, 89–90; hyperobjects, 72, 251n7; in media theory, 70; in Morton's work, 89–90; and population, 70, 251n6; scientific misgivings about, 74–76; spatial-temporal connections, 74; Wiens on, 74, 75–76. *See also* ecological research and gameplay
scale in games: and awe, 71; and global vs. local debates, 90–91; *Katamari Forever,* 76–77; and mastery, 71; *No Man's Sky,* 98, 100–103; and procedural generation, 101–2; range of, 69, 71, 73; and realism questions, 71; Wright's games, 80. See also *Spore*
scale in media: challenges for, 98; ChronoZoom, 98–100, 101–3, 104; *Powers of Ten* film, 77–80, 87, 98; "Science in the Capital" series, 95–96; *A Variation on the Powers of Ten,* 86–87
science fiction: *The Diamond Age,* 128–29; *Ender's Game,* 222; Liu on, 103–4; status of, 44
scientific vision, 78–79
scientific visualization, 91
S'COOL project, 94
selective fidelity, 37, 245n37
September 12th, 49
serious games, 47, 49, 64, 66, 229
Shannon, Claude, 148
shan-shui-hua, 137–39, 142, 143
Shapiro, Arthur, 87
Shelter series, 110–11
Sheynkin, Yefim, 154
Shiva, Vandana, 169
SimCity, 203; and Herman Cain, 269n28; censorship of, 204; environmental violence in, 94, 95, 203–5; *Micropolis* remake, 204; no disasters option, 205, 270n34; premediation in, 203; real-world applicability of, 204; real-world cities in, 203–4; scholarship on, 203
site-specific knowledge, 87–88
SLOSS debate, 13
slow violence, 194
Slow Year, A, 192
Smith, Randy, 218
Sobel, David, 47, 247n58, 253n56
social games, 182, 183; *Cow Clicker,* 185; and Facebook's growth, 159; farming mechanics in, 160; friends-as-workers in, 184; lack of sociality in, 182, 184; monetization methods, 182–83; popularity of, 159–60. *See also* casual games; farm games; *FarmVille*
speculative realism, 134
Spinoza, Benedict de, 35
Spore, 80–81; Creature Creator, 80, 82–83; and digital scholarship, 84–85; as disanthropic, 192; ecological principles in, 81–83; inaccuracies in, 82; Jones on, 84; as local-network hybrid, 83–85; and *Powers of Ten,* 97–98; scale in, 71, 85–86, 97–98; and scientific inquiry, 91; scientific reactions to, 82; title meaning, 98; as toy, 83; valorizing human agency, 83
spores, 98
Squire, Kurt, 204
Stanley Parable, The, 42

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

Stardew Valley, 179–81
Starosielski, Nicole, 155, 238
Stephenson, Neal, 128, 129–30
Stevens, Wallace, 43
Stoermer, Eugene, 7, 74
Stone, Christopher, 124
Strange Rain, 143
Submerged, 142–43
Sunshine Ranch, 179
Suominen, Jaakko, 48
Super Mario Clouds, 22
sustainable framing, 175
sustainable growth, 170–71
Swain, Eric, 43
Swaine, Michael, 86–87
Szulborski, Dave, 50–51

Tales of a Neoliberal T-shirt, 126–27
technology: nature-inspired, 121–22
Tekinbaş, Katie Salen, 6, 8, 10
television, 202, 206–7
terror management theory (TMT), 227
Thacker, Eugene, 122, 147, 212
That Dragon, Cancer, 229
thatgamecompany, 136. See also *Flower*; *Journey*
thermodynamic perspectives on games: advantages of, 158; and computation generally, 154; gendered, 154; potential for, 147; raw materials, 155; thermodynamics, 151–55, 171, 172; waste heat production, 151–52, 153–54
3rd World Farmer, 179
30 Flights of Loving, 42
This War of Mine, 229
Thomas, Rick, 61
Thomashow, Mitchell, 88–90, 169
Thompson, D'Arcy Wentworth, 118, 121
Thoreau, Henry David: at Walden Pond, 1–4, 162, 271n59; on walking, 46
threatened species lists, 221–22
time, 141–42, 232
topophilia, 140, 141, 144
Totilo, Stephen, 195, 202
transmedia, 65–66
Trap It!, 112
Tsing, Anna, 138, 144, 155, 169, 177
Tuan, Yi-Fu, 140, 141–42, 143, 144
Turkle, Sherry, 109, 113

Uexküll, Jakob von, 140–41, 143, 234, 252n21
uncanny valley, the, 36
Unity Asset Store contents, 122

video game hardware: energy consumption, 150–54; engine metaphors, 152–53; environmental impacts, 149–50; ownership rates, 263n28; trends in, 158–59
video game industry environmental impacts: downloads vs. physical copies, 150–51; *E.T. The Extra-Terrestrial,* 149; e-waste, 149, 151; Greenpeace report on, 150; raw materials, 149; scrutiny of, 149–50
video games. *See* games
violence in games, 64, 193–94
Viridi, 113–14
virtual reality, 39–40
vital materialism, 134
Voluntary Human Extinction Movement, 230

Walden, a game, 1–3, 46
walking, 46
walking simulators, 42–43; as challenging game definitions, 44; *Dear Esther,* 42, 43; and environmental game design, 43; game environments of, 43; Key on, 44; mechanics of, 43; mesocosmic ambitions of, 46; *9.03m,* 43, 143; *Proteus,* 42, 44; *Pussy Walk,* 44; term debates, 43, 44; *Walden, a game,* 1–3, 46. See also *Firewatch*

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

walkthroughs, 42–43, 246nn47–48
waste, 172
Watanabe, Brent, 42, 112–13, 256n13
water, 142–43
waterfalls, 138
Watson, Richard, 29
Watts, Matthew C., 19
Weisman, Alan, 208, 212
Wetlands Restoration, 177
Whatmore, Sarah, 138
White, Richard, 169
Wiens, John, 74, 75–76
Williams, Raymond, 36, 164–65
Wired magazine, 129
Woods, Don, 23–24
Woods Hole Osprey Cam, 113
work and play, 169
World without Oil, 48, 53–54, 55
World without Us, The, 208, 212–13, 229–30
Wright, Will: on games and real-world identities, 53–54, 248n71; on games and scale, 85–86; games designed by, 80; on *Spore,* 83. See also *Spore*

xkcd, 160, 161

Zimmerman, Eric, 229

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:23 UTC
All use subject to https://about.jstor.org/terms

(*continued from page ii*)

47 *How to Talk about Videogames*
IAN BOGOST

46 *A Geology of Media*
JUSSI PARIKKA

45 *World Projects: Global Information before World War I*
MARKUS KRAJEWSKI

44 *Reading Writing Interfaces: From the Digital to the Bookbound*
LORI EMERSON

43 *Nauman Reiterated*
JANET KRAYNAK

42 *Comparative Textual Media: Transforming the Humanities in the Postprint Era*
N. KATHERINE HAYLES AND JESSICA PRESSMAN, EDITORS

41 *Off the Network: Disrupting the Digital World*
ULISES ALI MEJIAS

40 *Summa Technologiae*
STANISŁAW LEM

39 *Digital Memory and the Archive*
WOLFGANG ERNST

38 *How to Do Things with Videogames*
IAN BOGOST

37 *Noise Channels: Glitch and Error in Digital Culture*
PETER KRAPP

36 *Gameplay Mode: War, Simulation, and Technoculture*
PATRICK CROGAN

35 *Digital Art and Meaning: Reading Kinetic Poetry, Text Machines, Mapping Art, and Interactive Installations*
ROBERTO SIMANOWSKI

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:25 UTC
All use subject to https://about.jstor.org/terms

34 *Vilém Flusser: An Introduction*
ANKE FINGER, RAINER GULDIN, AND GUSTAVO BERNARDO

33 *Does Writing Have a Future?*
VILÉM FLUSSER

32 *Into the Universe of Technical Images*
VILÉM FLUSSER

31 *Hypertext and the Female Imaginary*
JAISHREE K. ODIN

30 *Screens: Viewing Media Installation Art*
KATE MONDLOCH

29 *Games of Empire: Global Capitalism and Video Games*
NICK DYER-WITHEFORD AND GREIG DE PEUTER

28 *Tactical Media*
RITA RALEY

27 *Reticulations: Jean-Luc Nancy and the Networks of the Political*
PHILIP ARMSTRONG

26 *Digital Baroque: New Media Art and Cinematic Folds*
TIMOTHY MURRAY

25 *Ex-foliations: Reading Machines and the Upgrade Path*
TERRY HARPOLD

24 *Digitize This Book! The Politics of New Media, or Why We Need Open Access Now*
GARY HALL

23 *Digitizing Race: Visual Cultures of the Internet*
LISA NAKAMURA

22 *Small Tech: The Culture of Digital Tools*
BYRON HAWK, DAVID M. RIEDER, AND OLLIE OVIEDO, EDITORS

21 *The Exploit: A Theory of Networks*
ALEXANDER R. GALLOWAY AND EUGENE THACKER

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:25 UTC
All use subject to https://about.jstor.org/terms

20 *Database Aesthetics: Art in the Age of Information Overflow*
VICTORIA VESNA, EDITOR

19 *Cyberspaces of Everyday Life*
MARK NUNES

18 *Gaming: Essays on Algorithmic Culture*
ALEXANDER R. GALLOWAY

17 *Avatars of Story*
MARIE-LAURE RYAN

16 *Wireless Writing in the Age of Marconi*
TIMOTHY C. CAMPBELL

15 *Electronic Monuments*
GREGORY L. ULMER

14 *Lara Croft: Cyber Heroine*
ASTRID DEUBER-MANKOWSKY

13 *The Souls of Cyberfolk: Posthumanism as Vernacular Theory*
THOMAS FOSTER

12 *Déjà Vu: Aberrations of Cultural Memory*
PETER KRAPP

11 *Biomedia*
EUGENE THACKER

10 *Avatar Bodies: A Tantra for Posthumanism*
ANN WEINSTONE

9 *Connected, or What It Means to Live in the Network Society*
STEVEN SHAVIRO

8 *Cognitive Fictions*
JOSEPH TABBI

7 *Cybering Democracy: Public Space and the Internet*
DIANA SACO

6 *Writings*
VILÉM FLUSSER

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:25 UTC
All use subject to https://about.jstor.org/terms

5 *Bodies in Technology*
DON IHDE

4 *Cyberculture*
PIERRE LÉVY

3 *What's the Matter with the Internet?*
MARK POSTER

2 *High Technē: Art and Technology from the Machine Aesthetic to the Posthuman*
R. L. RUTSKY

1 *Digital Sensations: Space, Identity, and Embodiment in Virtual Reality*
KEN HILLIS

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:25 UTC
All use subject to https://about.jstor.org/terms

ALENDA Y. CHANG is associate professor of film and media studies at the University of California, Santa Barbara.

This content downloaded from
103.242.197.52 on Thu, 18 Jun 2020 18:01:25 UTC
All use subject to https://about.jstor.org/terms