RE-COLLECTION

Art, New Media, and Social Memory

Richard Rinehart

Jon Ippolito

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Re-collection

Art, New Media, and Social Memory

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Persons desiring to train this faculty [of memory] must select places and form mental images of the things they wish to remember and store those images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote the things themselves, and we shall employ the places and the images respectively as a wax writing-tablet and the letters written upon it.

Cicero, *De oratore*, II, lxxxvi, 354, English translation by E. W. Sutton and H. Rackham from Loeb Classics Edition

She's gone. And the present is trivia, which I scribble down as fucking notes.

Character of Leonard Shelby from the film *Memento*

To everyone who's dead.

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Series Foreword

Leonardo, the International Society for the Arts, Sciences, and Technology, and the affiliated French organization Association Leonardo have some very simple goals:

1. To document and make known the work of artists, researchers, and scholars interested in the ways that the contemporary arts interact with science and technology;
2. To create a forum and meeting places where artists, scientists, and engineers can meet, exchange ideas, and, where appropriate, collaborate;
3. To contribute, through the interaction of the arts and sciences, to the creation of the new culture that will be needed to transition to a sustainable planetary society.

When the journal *Leonardo* was started some forty years ago, these creative disciplines existed in segregated institutional and social networks, a situation dramatized at that time by the "Two Cultures" debates initiated by C. P. Snow. Today we live in a different time of cross-disciplinary ferment, collaboration, and intellectual confrontation enabled by new hybrid organizations, new funding sponsors, and the shared tools of computers and the Internet. Above all, new generations of artist-researchers and researcher-artists are now at work individually and in collaborative teams bridging the art, science, and technology disciplines. For some of the hard problems in our society, we have no choice but to find new ways to couple the arts and sciences. Perhaps in our lifetime we will see the emergence of "new Leonardos," creative individuals or teams that will not only develop a meaningful art for our times but also drive new agendas in science and stimulate technological innovation that addresses today's human needs.

For more information on the activities of the Leonardo organizations and networks, please visit our websites at www.leonardo.info and www .olats.org.

Roger F. Malina
Executive Editor, Leonardo Publications

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I Introduction

1 The Lost and the Saved

Jon Ippolito

Jean Cocteau was asked what he would save if his art collection caught fire and he could rescue only one thing. "The fire," Cocteau answered.[1]

A Mystery Unfolds

Eva Hesse and Sol LeWitt were close friends. Both former painters, they became avant-garde artists who rebelled against the closed structures of their minimalist forebears and found a way to conjure light without paint. Hesse made sculptures from latex poured on cheesecloth; LeWitt drew directly on the wall with a blue crayon. They went to the same openings, visited each other's studios, had the same friends, were written up in the same magazine articles.[2] In their emphasis on process, both were harbingers[3] of the new media art forms spawned by the digital age.[4] Their place in history books on late twentieth-century art is assured.

But one artist's legacy will be known *only* via history books. The other's will live on in dazzling works displayed on the walls of galleries, museums, and private homes for the indefinite future. The reason for these two contrasting legacies—and what it implies for the fate of digital culture—is the subject of this book.

Eva Hesse's installation *Expanded Expansion*, from 1969, was among the first works of "installation art" of the twentieth century, one of a series of luminescent sculptures so beautiful that people cried when they saw them at exhibitions.[5] To make it, Hesse used some of the most experimental artistic processes of her day, in this case latex over cheesecloth stretched between fiberglass poles. *Expanded Expansion*, as the name suggests, was portable and versatile; you could bunch it together like an accordion on a small wall or stretch it twenty-five feet wide for a longer one.

Figure 1.1
Eva Hesse, *Expanded Expansion*, 1969. Installation view in 1969. Fiberglass, polyester resin, latex, and cheesecloth, 10 feet 2 inches × 25 feet (309.9 × 762 cm) overall. Solomon R. Guggenheim Museum, New York. Gift, Family of Eva Hesse. 75.2138. Photograph by David Heald (1986, New York) © SRGF.

But gradually the resin darkened, the fabric stiffened, and eventually everything began to deteriorate. *Expanded Expansion* is now a wrinkled, rigid skin decomposing in a wooden sarcophagus in the Guggenheim Museum's warehouse. A similar fate awaits most of Hesse's signature sculptures, as these once-limpid vessels of light gradually yellow and darken into brittle shells. Like the molted carapaces of ancient beetles, despite heroic efforts by museum conservators, all that may be left of these remnants of sculptural splendor one day is dust in an archival box.[6]

To today's creators armed with blogs and iPhones, rubber on cheesecloth hardly seems like new media. Unfortunately, as we shall see, the track record for newer media is even worse than for Hesse's disintegrating polymers. Audiotapes demagnetize. CDs delaminate. Internet art links to websites that no longer exist. Film spontaneously combusts in its canister. The

Figure 1.2
Sol LeWitt, *Wall Drawing 146. All Two-Part Combinations of Blue Arcs from Corners and Sides and Blue Straight, Not Straight and Broken Lines*, September 1972. Installation view, Villa Menafoglio Litta Panza, Biumo Superiore, Varese, Italy, September 16, 1981. Blue crayon, dimensions variable. Solomon R. Guggenheim Museum, New York. Panza Collection, Gift. 92.4160. Photograph © Giorgio Colombo, Milano.

Figure 1.3
Eva Hesse, *Expanded Expansion*, 1969. Detail of installation view in 1987. Fiberglass, polyester resin, latex, and cheesecloth, 10 feet 2 inches × 25 feet (309.9 × 762 cm) overall. Solomon R. Guggenheim Museum, New York. Gift, Family of Eva Hesse. 75.2138. Photograph by David Heald (1986, New York) © SRGF.

secret to cultural longevity lies not in a medium's technological sophistication but in the work's relation to that medium. Which brings us to Sol LeWitt. At first blush, a signature LeWitt work like his 1972 *Wall Drawing 146* would seem to be higher on the endangered species list than Hesse's, since walls get repainted when houses are sold or museums mount new exhibitions.

But LeWitt's drawings are generated by assistants following a predetermined set of instructions in their titles, such as *All Two-Part Combinations of Blue Arcs from Corners and Sides and Blue Straight, Not Straight and Broken Lines*,[7] or *Ten Thousand Lines about 10 Inches Long, Covering the Wall Evenly*.[8] LeWitt was careful to make his instructions as universal as possible, so his drawings could adapt to new spaces as the need arose: big or small walls, alcoves, soffits, electrical sockets. (I once asked LeWitt what would happen if he ever had to install a wall drawing on a wall that wasn't rectangular.

He replied that he had never seen a rectangular wall.)[9] As a result, LeWitt wall drawings are routinely created, painted over, and recreated by various qualified assistants the world over, and have been for four decades. There's no sign that his works are going to disappear any time soon—or to be more accurate, they disappear all the time, but always stand at the ready for their next reincarnation.

The Urgency of the Digital Era

Eva Hesse's *Expanded Expansion* is now terminally ill, lying in a crate in the Guggenheim's warehouse like a patient on life support, while Sol LeWitt's wall drawings are guaranteed to last as long as there are crayon wax and white walls. Paradoxically, the artwork that seemed least permanent at the time it was made has proven to be the true survivor. LeWitt's wall drawings have endured not by being "built to last" but by being variable. For works of this kind, fixity equals death.

In some ways, these two works are beyond the need for a novel preservation paradigm. We are too late to save the Hesse,* since the artist died without leaving any solution to her work's failing health; and the LeWitt, which is based on repeating a fairly straightforward set of instructions, doesn't really need expert conservators to stay alive. Nevertheless, as the ensuing chapters will make plain, the vulnerabilities of digital media are propelling a vast swath of today's culture toward the same fate as that of *Expanded Expansion*—but at a rate accelerated ten- or a hundredfold. Movies and mp3s, installation art and interactive games—all will be lost unless we uncover the underlying causes of today's cultural destruction before it's too late.

* Rick: Are we? If we rely entirely on the artist's express declarations, we limit the range of works we can preserve. And, lacking specific direction from the artist post mortem, should we assume a default position of letting the work die rather than intervene?

The goal of this book is to gather sufficient evidence to finger those causes and put a halt to—or at least slow—the disappearance of culture due to obsolescence. You'll be guided in this process by my co-investigator, Richard Rinehart (Rick), and me, Jon Ippolito. We will recount our investigation chapter by chapter, interweaving our field notes and making comments in the margins of each other's texts.†

† Rick: Like this!

To start the investigation, Rick will survey the scene of the crime, looking for clues about where and when these disappearances have happened. In the middle of the book, Rick and I will interrogate a "triple threat" to twenty-first-century creativity in three separate sections—technology, institutions, and law—hoping to unearth the means and motives for contributing to the death of contemporary culture. These profiles will be complicated by the fact that all three suspects can be allies as well as enemies of ephemeral artifacts, making it hard to assess guilt or innocence. For this reason, our goal won't just be to blame technology, institutions, and law but also to show how these same suspects might be enlisted in the recovery of works that are not yet lost. Finally, in the conclusion, Rick and I will offer twelve ways that society—meaning you, the reader—can reclaim new media culture from oblivion.

Rescue Techniques

Apart from identifying the culprits responsible for disappearing culture, we'll also need to resuscitate the victims who haven't entirely succumbed yet, so there will be something left of this moment in history for the cultural record. Throughout this book, we'll refer to the following four strategies for rescuing cultural genres and gadgets from extinction.[10]

Storage

Storage is the default preservation strategy used by museums, libraries, and archives.[11] Storage captures matter and puts it in a box, on a shelf, under glass, in a climate-controlled vault deep in a mountain. There, stored culture waits in a form of suspended animation, protected from the normal processes of life and death. For as Bruce Sterling notes,[12] it is precisely the things life needs to prosper—sunlight, air, water—that are most damaging to the stuff we store, be it parchment or pigment.

Whereas storage is the longest-term strategy for old media, it is the shortest-term solution for new media.[13] Equipment left in a crate eventually becomes unusable as voltage standards change, cathode ray tubes blow, and floppy disk drives disappear. This is why digital preservationists "refresh" data onto multiple magnetic tapes or redundant hard drives, and digital media companies gloss over the ephemerality of hardware with promises of "infinite storage" in "the cloud." (Witness Gmail's boast that with fifteen gigabytes of storage, its users need never delete another email.)[14]

But bits depend on software protocols—drivers, codecs, HTML standards—that go stale even faster than hardware does. By itself, no flavor of storage—regular, redundant, or refreshed—can overcome software obsolescence.

Beyond these variations on storage, new media preservationists can avail themselves of three less well-known but highly flexible strategies: emulation, migration, and reinterpretation.

Emulation

"Emulation" means not storing digital files on disk or physical artifacts in the warehouse, but creating an audiovisual facsimile of them. Emulated culture looks the same, feels the same, behaves the same as the original, but in a different medium. For analog culture, emulation can be costly in time and money, for it may mean custom-fabricating materials that once were mass-produced, such as light bulbs or candies,[15] and such replicas are rarely useful outside of recreating a particular work.

In digital culture, however, the technique of software emulation—whereby one computer impersonates another—is a powerful preservation tool. An emulator that enables the 1985 game Super Mario Brothers to run on the 2010 operating system Windows 7 can in principle enable Donkey Kong, Hogan's Alley, and any other Nintendo cartridge game to run on Windows 7. (We'll look at emulation in depth in chapter 8.)

Migration

Migration often seems more prosaic than emulation, because a migrated work sticks close to the medium of the original, simply upgrading its technology to the current industry standard. An archivist might migrate a video from U-matic to Digibeta; a programmer might migrate a website from Netscape 4 to Netscape 6. Obsolete hardware can also be updated, as can candies and fluorescent tubes.

That said, migration can alter a work's look and feel, and the further a work is migrated away from its original medium, the greater the risk of its departing from the spirit of the original. Most consumers wouldn't think twice of swapping their bulky CRT-based television for a flat-screen TV, but for a video artist such as Gary Hill who plays off the sculptural form of TV monitors, that migration is more of a judgment call.

Though not as common, migration can also happen in space as well as time. An installation that specifies plants familiar to local gallerygoers might use ferns in São Paulo but cactus in Santa Fe.[16]

Reinterpretation

Reinterpretation is the most radical of the four preservation strategies, though also the most powerful. A reinterpretation sacrifices basic aspects of the work's appearance in order to retain the original spirit. Rare for the fine arts, reinterpretation is common in dance and theater, although even in the performance arts its use can be controversial. Director Peter Sellars was called an "artistic vandal" for his restaging of Mozart operas in modern settings like New York's Trump Tower;[17] the Samuel Beckett estate is notoriously stringent about performances of *Waiting for Godot* and the like, and will shut down a show that makes minor changes in even a couple of lines.[18]

Reinterpretation for artistic installations or sculptures, meanwhile, replaces obsolete mass-produced items or out-of-date products with their functional or metaphorical equivalent (a telegram handed to a character in a play might be replaced with a text message on a mobile phone), or obeys a set of instructions that varies according to the site, audience, or occasion (the backdrop might depict the skyline of whatever city the play is performed in). Or a work of software art written in one language may be completely rewritten for a different platform, as artist Mark Napier recommended for his online work *net.flag* once its original language, Java, becomes obsolete.[19]

A Foreshadowing

Before we investigate the disappearance of contemporary culture, it's traditional in detective stories to start with a little foreshadowing. So let's put some of our cards on the table at the outset.

Rick and I reject the notion that a bunch of preservation experts in a room will someday concoct a one-size-fits-all technical fix to rescue culture from oblivion. Instead, we see rescuing new media as a task that is best distributed across a wide swath of cultural producers and consumers, who will choose the most appropriate strategy for each endangered work, one by one.

To make this leap will require questioning some time-honored assumptions about creative culture. Archivists and librarians may have to regard storage as only one weapon in an arsenal of preservation techniques—and not a very long-range weapon at that. If so, then the necessity of periodically reinstalling or remaking a work could make the job of preservation inextricable from the job of presentation, muddling the separate job descriptions of conservators and curators.[20] To confuse matters more,

traditional institutions of cultural preservation are used to shouldering all the burden of safeguarding culture, and aren't sure whether or how to share that role with amateur preservationists. Can institutions learn to share that task with the general public? If so, what implications would this have for control over wall labels, copyright, even history itself?

Perhaps the most challenging shift might be an accelerated evolution in our cultural heritage. In botany, a "heritage rose" is one that hasn't been hybridized, that has remained the same. Yet for heritage to survive the digital era might require every generation to inherit a changed legacy—not just because the previous generation has added a new work to the canon, but because they have updated an original work's medium or even let a new author recreate it. Once dropped into the swift currents of new media, art changes from a singular object to a series of events. As more and more works make this transition, perhaps they will survive best not by being durable, like a stone—for stone worn by swift currents becomes brittle—but by remaining variable, like a stream of water.*

* Rick: Save Cocteau's fire by becoming like water. It's elemental!

Rick and I, along with others working in this field,[21] call this paradigm for fluidly creating and recreating works "variable media." The variable media approach encourages creators to define a work in medium-independent terms so that it can be translated into a new medium once its original format is obsolete. This philosophy is not rigid; while it augments storage with less traditional rescue techniques like emulation, migration, and reinterpretation, it nevertheless recognizes that some artworks cannot change without ruining what made them compelling in the first place. That said, while some proportion of today's cultural artifacts must die, there are plenty left that shouldn't have to—if we can identify the agents responsible for sending them to an early grave and find a way to outwit or reform them.

Before we examine the primary suspects for the disappearance of digital culture, Rick will step back in the next chapter to survey the larger scene of the challenges new media pose to social memory.

2 New Media and Social Memory

Richard Rinehart

In the previous chapter, Jon sketched a compelling picture of the current situation regarding art preservation and its challenges. Keeping that immediacy in the back of our minds, let us zoom out for a moment to consider how we got here. This book is intended to operate on three levels. First, we will describe the field of cultural practices and institutions known as "social memory" and the crisis currently confronting this field. Second, social memory provides the context for a case study in preserving new media art specifically. Third, throughout the book, we will present concrete examples and anecdotes from the authors' experiences that make this case study tangible and tractable.

Many efforts to preserve new art leap right to logistical problem solving. This is understandable given the urgency of the problem, but, in order to make the fundamental shifts necessary to solve the problem, we also need to understand the historical context and ideological assumptions that underlie the discourse and color our solutions. Attending to this context may appear to professional insiders as review, but we feel that it will further the discussion as well as broaden it to include newcomers, students, and professionals in outlying, but relevant, institutions and disciplines. Keeping this broad audience in mind, along with the fact that there are currently very few books on the topic of preserving new media art, this book can serve as an introduction to the field. For the cognoscenti and digerati who have been involved with this topic for years, this book can also serve as a review and a more detailed explication of the authors' proposed approach to the challenge than our past conference presentations and shorter journal articles have allowed. Recent threads in the professional discussion about preserving new media culture—such as the contemporary approach to digital forensics—are invaluable, and this book's final chapter concludes with a similar emphasis on the importance of triage and a call to action. However, this chapter and those immediately following offer additional

context and pose relevant questions that may not follow naturally from traditional museum preservation approaches, that are not immediately visible on the horizon of related fields like digital libraries, and that are less likely to arise in the conservator's hectic ER on a daily basis.

So how did we get here? It is useful to think of history as a function or a set of practices, and that's where the idea of social memory can help. Social memory makes history tractable and allows us to see artworks, curators, and preservationists as agents and practitioners of history rather than its passive subjects.

The Field of Social Memory

Social memory is how and what societies remember—the long-term memory of civilizations. It is how civilizations carry forward their social traditions, commercial arrangements, and political operations from moment to moment, year to year, and (if they are lucky) century to century.* It allows a civilization to persist beyond the lifetime of one individual or generation. Social memory emerged as a field of study in the 1920s and gained significant momentum in the 1970s, though after all that time there is still no consensus about the boundaries of the discipline. Rather than offer a narrow definition of social memory in their book *Social Memory and History*, Jacob Climo and Maria Cattell and their contributors simply list its various characteristics:

* Jon: As we'll see in chapter 10, if "civilization" took a clue from indigenous peoples, their social memory might last from millennium to millennium.

> Collective or social memories are shaped by social, economic, and political circumstances; by beliefs and values; by opposition and resistance. They involve cultural norms and issues of authenticity, identity, and power. They are implicated in ideologies. Social memories are associated with or belong to particular categories or groups so they can be, and often are, the focus of conflict and contestation. They can be discussed and negotiated, accepted or rejected. Collective memories are expressed in a variety of ways. They create interpretive frameworks that help make experience comprehensible. They are marked by a dialectic between stability or historical continuity and innovations or changes.[1]

This quotation indicates the controversial, dynamic, and ideological nature of social memory and serves as an apropos introduction for our discussion. Social memory scholar Maurice Halbwachs emphasizes its practical aspects, asserting that social memory is not a metaphor but a social reality, transmitted and sustained through the conscious efforts of

institutions and groups.[2] These efforts take many forms. In his book *How Societies Remember*, Paul Connerton goes beyond the familiar textual and literary aspects of social memory to focus on behavior, action, ritual, and ceremony as ways in which social memory is embodied in us all.[3] Historian Thomas Laqueur has written on the relationship between memory and place and the memorial site as a function of social memory.[4]

Social memory can be broken into two large categories: formal and informal. Formal social memory is "canonical" and is often stewarded by institutions such as museums, libraries, and archives (referred to collectively as the "cultural heritage sector"). These types of memory institutions and their distinctive functions will be detailed in our later section on institutions; suffice to say that they comprise society's organized "cabinets of wonder" or, to use a computer metaphor, they are our collective memory banks, the databases of civilization. Informal social memory, on the other hand, is characterized by folklore and distributed, popular forms of remembering. The comparable computer metaphor is that informal social memory acts like society's network system, preserving memory by making it a moving target. (Here I must credit Danny Hillis, who invented the world's fastest computer in which most of the data is not stored on any central hard disk but is kept constantly in transit from one place to another within the system. Author Kevin Kelly dubbed this approach "movage" for moving storage.)[5] The effort to preserve video games from the 1980s (which Jon will detail in chapter 8) is an example of informal social memory that also shows social memory is not always about really old things. Very few formal institutions are devoted to preserving vintage video games (the Stanford University Library's Stephen M. Cabrinety Collection is a notable exception);[6] however, there are legions of fans, connected across the Internet, who collaborate informally to preserve these games by writing software emulators that allow gamers to run old games on new machines. This communal endeavor reveals one common and telling difference between the ways formal and informal social memory function. Formal social memory often emphasizes preserving a cultural object in its original fixed form as a way of maintaining its historical accuracy and authorial integrity (storage). Informal social memory, on the other hand, often emphasizes updating or recreating the cultural object as a way of keeping it alive (migration, emulation, and reinterpretation). One might say that the formal strategy privileges the form of the object of preservation, while the informal strategy preserves the working function of the object (this is a bit of an oversimplification as we'll see, but it's useful to exaggerate the differences in order to see them more clearly). These two broad categories of social

memory are often implied to be irreconcilable, but they should not be seen as mutually exclusive. When archival studies professor Laura Millar wrote, "Records and archives are devices used in the process of transforming individual memories into collective remembering,"[7] she was hinting at the connective tissue that forms the continuum of formal and informal social memory. Indeed, our greatest preservation challenges, such as those outlined in this book, can be met only by a unified strategy that borrows tactics from both "high" and "low" culture and both formal and informal social memory.

Many assume that social memory focuses exclusively on the past, but it is equally if not more a future-oriented activity. Preservation—the social memory function this book focuses on—is all about considering what a particular object will encounter in the future, how it will need to be used, who will access it, who will care for it, and what extra information will help those future generations do all of this. A conservator needs to be a futurist as much as she needs to be a historian. But how can one accomplish both? What models exist? Collectively, archaeology and paleontology museums represent millions of years of Earth's history, while those museums emphasizing human history—anthropology, history, and art museums—cover about ten thousand years of culture. We have about ten thousand years of previous highly organized human activity upon which to base our thinking about how culture changes over time, may change in the future, and how social memory may serve that future. Ten thousand years is not an arbitrary amount of time; rather, it seems to be a magic number in this context. The Long Now Foundation in San Francisco is a nonprofit organization advocating that businesses and individuals take responsibility and plan for the long-term future of the environment, technology, and culture. In *The Clock of the Long Now*, founder Stewart Brand describes the origin of the organization: "Peter Schwartz suggested 10,000 years as the appropriate time envelope for the project; 10,000 years ago was the end of the Ice Age and beginning of agriculture and civilization; we should develop an equal perspective into the future."[8] Elsewhere, journalist Gary Kliewer wrote in an article for *The Futurist*, "How could you label Pandora's box so that no one would mess with it for 10,000 years? The U.S. Department of Energy recently asked a panel of experts to design a marking system that would warn people against digging into the Waste Isolation Pilot Plan in southeastern New Mexico, where radioactive materials from U.S. nuclear defense operations will be permanently entombed. The markers need to last as long as the danger and this waste will pose a threat to human health for 300 generations."[9] Social memory and

Figure 2.1
Danny Hillis, Clock of the Long Now, 1999, on view at the Science Museum, London.

preservation practices extend far into the past, but just as far into the future—and so our strategies must reflect this long-range bilateral vision.

The Challenge of New Media

As more and more of our culture is created, transacted, experienced, and stored in bits and bytes without ever existing outside a computer, this digital culture cannot help but have a significant impact on the practice of social memory. New media impact social memory in two broad ways; they change the *object* of social memory and the *means* of social memory. That is to say, the cultural objects that serve as vessels and triggers for social memory—artworks, literary texts, census records, movies, political campaigns—are themselves becoming digital. Certainly not every cultural object is digital, and never will be, but an increasing percentage of each category is now born digital. Similarly, the tools and means by which we practice social memory—documentation, records, storage, communications, object management systems—are also increasingly digital, and unlike cultural objects, they are digital to a much greater degree, to the point that very soon they will be primarily if not exclusively digital.[10]

It is sometimes comforting to imagine that a brilliant scientist in a hilltop lab somewhere or some authoritative government agency must have this all under control, but in truth, no one yet knows quite how to conduct all the necessary social memory functions in a society that is increasingly "born digital." The U.S. military doesn't have the big answer, nor does the Vatican, Interpol, the U.N., MI6, Freemasons, IBM, or the cultural heritage sector. But they all bump into each other at relevant professional conferences as they diligently work on their respective portions of the big puzzle. In recognition of the reality and scale of the problem, the U.S. Congress allocated $99 million to the Library of Congress in 2000, creating the National Digital Information Infrastructure and Preservation Program.[11] This project is not nearly complete, but it serves as an important research hub and clearinghouse for related projects. Yet the challenge of new media to social memory is not purely an issue of technology. It is not a "tech" question best left to computer geeks, academics, and preservation specialists to answer behind closed doors; it is relevant to us all. The answers to the challenge of new media are more likely to arise from a confluence of related research from across varied fields and disciplines rather than as an edict from one source on high. As Paul Connerton notes,

It is surely the case that control of a society's memory largely conditions the hierarchy of power; so that, for example, the storage of present-day information technologies, and hence the organization of collective memory through the use of data-processing machines, is not merely a technical matter but one directly bearing on legitimation, the question of the control and ownership of information being a crucial political issue.[12]

This passage was published in 1989; how much more relevant it is today.

When a system of representation breaks down, it provides a picture of the system itself rather than its purported subject. When your TV breaks down, you no longer see your favorite shows and characters; instead, you see the infrastructure of TV itself, represented by white snow or a blue screen. When a system fails, whether it is a technology or a system of ideas, it goes from transparent to opaque and offers us a rare opportunity to consider the system explicitly. Presenting a broken system of representation or presenting media stripped of all content and narrative are common tactics of contemporary artists wishing to draw attention to the underlying system. For example, Marcel Broodthaers developed such a project in the late 1960s called *Musée d'Art Moderne, Département des Aigles* (Museum of Modern Art, Department of Eagles). In one temporary manifestation of this project, Broodthaers drew the foundation of a museum in the sand on the beach of Le Coq, Belgium. He wore a hard hat labeled "Museum" and he placed signs around the "museum" saying "Touching the objects is absolutely forbidden." Broodthaers was offering the viewer a portrait of the museum as a system stripped down to its bare essentials——a sand castle of avant-gardism vainly attempting to protect its only real content, the cultural status quo. Analogously, social memory is a system of representation that is currently being broken down by the challenge of new media. This challenge is taking the form of a series of crises including that of preservation. While we are scrambling to address these urgent problems, we should not forget that this challenge also allows us an opportunity to reexamine and revisit social memory as a system and to ask, What is important for us all to remember? What is OK to forget? Whom do these collective memories serve? And who are the ones who remember?

The Case of New Media Art

Our investigation focuses on collecting and preserving new media art as a case study in new media's broader challenge to social memory. Using a case study as a lens for close investigation and choosing new media art as that

Figure 2.2
Marcel Broodthaers, museum in the sand, 1969, Le Coq, Belgium.

case study should prove productive for several reasons. Preserving new media art is not an abstract dilemma but a real-world problem that offers numerous examples of specific artworks, real institutions, and current debates between artists, collectors and museums. This grounding in reality allows us to apply theories and ideas of social memory to preserving artworks and allows the real practice of preservation to, in turn, inform and refine those theories. Collecting and preserving new media art is of interest to many of us in its own right, as it is ripe with implications for art theory and practice.* The preservation of new media art may inform the problem of preservation in other fields, from government records to the music industry to video games, and will, in turn, be informed by those related efforts. Additionally, this case study is fertile because it brings social memory into the tangible realms of cultural heritage institutions, the computer industry and technology,

* Jon: Also, unlike scientific or administrative data, art depends on its medium's look and feel, which become the acid test for translation strategies like migration, emulation, and reinterpretation.

law and intellectual property, and public social practices (as Jon and I will detail in the following chapters). Lastly, our case study may bring together strategies of formal and informal social memory in ways as yet unseen.

Now let us clarify our object of study. It is debatable whether "new media art" was ever truly separate as a set of artistic practices or communities, and in recent years it has been, for better and worse, further subsumed into the discourse of contemporary art.[13] Artists and curators now talk of "post-Internet" art (art that may or may not make use of new media, but is "media-aware" and addresses the conditions of being networked).[14] When Jon and I reference new media art here, we are not indicating a separate "genre" of art. Rather, in the context of preservation, it is useful to refer to the medium-specific aspects of artworks. Digital forms of new media art (i.e., software art, multimedia interactive art, Internet art, and robotic art) throw the preservation challenges into high relief and make them a useful focus for our discussion. In practice it turns out that many of the challenges in preserving digital art are the same as for preserving other nontraditional art forms such as earth art, performance art, installation art, conceptual art, and more. This means that the solutions for preserving one of these forms seem likely to inform the preservation of the others. In addition, the challenges that digital media bring to social memory may have precedents from the predigital era. Those precedents may help us answer the digital challenge and, in turn, this new challenge may highlight or inspire answers that help us to address the older problems. So we will not limit our discussion to narrowly defined terms. We'll use the inclusive term "new media art," which has digital art at its center and other nontraditional art forms at its blurry edges.

When discussing artworks that specifically use digital media, it is helpful to distinguish between digital art and digitized art. "Digital art" refers to artworks that are born digital; they are created and experienced using digital media (they might not rely exclusively on digital media, but they incorporate them in ways that are essential and inextricable). Examples of this form include software art, multimedia interactive art, Internet art, and robotic art, all of which are addressed in our investigation. "Digitized art" refers to artworks created in traditional media, such as oil paintings or bronze sculptures, that have been photographed or otherwise documented in digital form. A website of images of artworks, such as ArtStor, would constitute a collection of digitized art. While the development, use, and preservation of digitized art are certainly important, they are somewhat outside the primary focus of our investigation. Additionally, the preservation of images, records, and other documentation in general has been

widely addressed elsewhere, so there is less of a need or opportunity to make an original contribution to that work here. So our investigation focuses on digital rather than digitized art—actual works rather than records or images of works.

Works of digital and Internet art, performance, installation, conceptual, and other new media art represent some of the most compelling and significant artistic creations of our time. These works constitute a history of alternative artistic practice,* but they also present significant obstacles to accurate documentation, access, and preservation. These art forms have confounded traditional museological approaches to documentation and preservation because they are ephemeral, documentary, technical, and manifold in nature and because their media formats are variable and become obsolete rapidly. It is not feasible for the arts community to keep the original equipment and software in working order over the centuries, and the computer industry has no incentive to continue producing old parts or to keep all new equipment backward-compatible indefinitely. Besides, preserving media art as an "original" physical object may be counterproductive and inappropriate, as discussed in later chapters. Owing to a lack of preservation and documentation methods, and thus access, such artworks often are not used in research and instruction; they become invisible to history. If we don't design strategies for preservation, many of these vital works—and possibly whole categories, such as early Internet art—will be lost to future generations.[15] In many cases, these art forms were created to contradict and bypass the traditional art world's values and resulting practices. They have been successful to the point of becoming victims of their own volatile intent, but their radical critique makes them more important to history, not less.

* Jon: Are creative websites and apps really "alternative" art, given their popularity among mainstream audiences? Or do the obstacles you identify to their absorption by museums encourage the art world to brand them as alternative?

So what exactly are the challenges in preserving new media artworks? How many ways are there to die? Let's take a moment to preview some of the challenges that will be detailed in later chapters.

Version and Variability

In the late 1990s after Pixar had released the first completely computer-generated film, *Toy Story*, they called around to a few film archives seeking

advice on how to preserve the film. They were given expert advice about cold storage and how to avoid "vinegar syndrome," but it quickly became apparent that Pixar was not primarily interested in preserving the film print itself as an object; rather, they were interested in preserving the movie as a set of computer files. One can easily see the logic in this. After all, a print of the film would be fixed for all time; when released again, it could be shown only as the original was shown: the same sequence of shots, same camera points of view, etc. But isn't this how film preservation is supposed to work? The closer to its original state in which a film is preserved, the more valuable it is, right? In the traditional film preservation paradigm, an original camera negative or internegative print is considered the "original" film, the "master" version, the Holy Grail from which all copies derived, including reedited versions. Pixar had, however, reached a turning point in "film" preservation. For Pixar, the computer files were more valuable than the film print because, from the computer files, one could generate a delicious variety of versions of the movie that could then be printed on film—but that could not be generated from a print of the film. Computer-generated imagery (CGI) is usually rendered in the computer as a 3D object. That means that the original release of *Toy Story* was just one of many possible derivatives from the original source material. The variables included the camera's points of view; speed and direction of the characters' movements; colors, opacity, textures, and placement of objects; and the sequence of shots. And, unlike with traditional film, it was possible to go back and change *any* of these variables after the fact, creating a new version of the movie. Pixar could potentially release a new version of *Toy Story* in which every scene is rendered from the eye level of an ant or seen through the eyes of the lead character, Woody. It's certainly possible to edit traditional film, but not nearly to this extent. The value of the "asset" *Toy Story* goes up in direct relation to the number of possible variations, derivatives, or products Pixar can get out of it, from video games to the director's (or ant's) cut. Variability increases value.

The *Toy Story* example is interesting because it inverts a key component of media preservation, the relationship between the "master" or original version and derivative copies. With *Toy Story*, the film was not the master version of the movie; instead, the film was one of many possible derivatives of the computer files. The master version of any analog media artifact, from film to video to photograph, is usually defined as the version that is closest to the point of creation or capture, and it is the version that contains the most accurate detail and highest information fidelity.[16] Analog media are different from digital media in that copying the master version creates a

derivative that contains less accurate information with each generation of copy. If one copies a 30mm film print and then copies that copy (etc.) enough times, one is left with a visual gray goo, no matter how visually articulate the original film was. With digital media, such as the computer files used to generate *Toy Story*, copying does not result in a loss of quality. So digital media suggest that perhaps the most valuable version of a cultural artifact is not necessarily the most "accurate" but the most fecund, the version capable of reproducing the greatest variety of offspring. With new media, instead of "master" copies we should think of "mother" copies. Mother copies not only result in greater commercial value but also offer the greatest chance of preservation, like a species that is able to mutate within a generation and thus survive sudden environmental changes. In practice, this means that when museums acquire works of software art, they should acquire not only the application program or "viewing copy" of the work but also the source code from which new versions of the program can be generated for new environments. When they acquire interactive games developed using the computer program Flash, they should collect both the fixed-run-time version of the game file (the filename ending in .swf) and the editable source file (ending in .fla). And when they collect video artworks, they should collect not just the locked-down DVD format that will play only as long as the DVD standard and players persist, but the raw video files from which they can generate backup DVDs and, indeed, new formats when DVD becomes obsolete. Security in media preservation comes not from fixity but from variability and mutation, and with digital media works we no longer have to make a choice between indexical (historical) accuracy and use-friendly fecundity. These notions of variability in new media art will be further developed in chapters 4 and 11.

Is the Music inside the Guitar? The Album? The Radio?

It might seem obvious that new media themselves are the problem and thus the challenge is a technical one. When museums first began to collect new media artworks, they often resorted to what they knew best: collecting physical objects. In the context of "computer art" that often meant obtaining the computer hardware related to a work of art and storing it in the vault as a way of preserving the artwork. But it quickly became apparent that this was a problematic approach to new media art. For instance, which computer was one supposed to collect? The desktop computer from the artist's home that they used to begin the artwork in question? The laptop they used on the plane to complete the project? The server at the museum

used to present the digital art in the galleries for the first time? There really was no natural "original" physical artifact. This approach was also impractical. Computers are hardly infallible machines and they quickly obsolesce. Computers in a vault will break down, and even after a relatively short time period—say thirty years—the museum will be unable to obtain a replacement computer of the same make and model. They will also be unable to obtain replacements parts, and they will certainly not be able to fabricate new parts (in the way they can sometimes do for artworks in traditional media that use essentially medieval technologies). Is it even appropriate to make the one-to-one equation that the computer is the artwork? Is the artwork defined by the brushed aluminum box? Probably not. Rather, the "original" computer is but one way to render said artwork, and certainly not the only way. Technology's role in the preservation of new media art will be further investigated in the following three chapters devoted to the topic.

Performing the Art

New media art is as performative and variable as it is visual or artifactual. That is, new media art can be seen to be as much a performing art like music or theater as it is a visual art like painting or sculpture—though it is often visual arts institutions like museums that are struggling to preserve it. By way of example, we can turn to a series of artworks by Felix Gonzalez-Torres colloquially referred to as "candy spills." These works are not digital, but they fit within our broad definition of new media art, and as mentioned earlier, they share qualities with digital art that may inform the preservation of both. A candy spill generally takes the form of the weight of a human body in pounds of individually wrapped candy, such as Bazooka bubble gum or licorice rods, carpeting the floor or piled against a wall or in a corner. Visitors to the gallery or museum where such a work is shown are invited to take a candy and eat it. This simple situation reveals and subverts many cultural constraints of the art world status quo. First, it has visitors eating, sometimes noisily, in the museum's galleries, bringing with that act a renewed sense of one's body, one's animal needs, and the mundane acts of reality normally external to the lab- or church-like environment of the museum. Secondly, it has visitors touching, in fact destroying, one of the artworks instead of standing respectfully behind the velvet rope. It also toys with the standard timeframe of art exhibitions that last a few months, since this work could be eaten and disappear in the first few days of an exhibition. And, of course, it pokes fun at the artwork as commodity,

since this work was itself composed of a cheap, commercially available commodity, and yet it was difficult to sell as an artwork because it could disappear overnight.

The first impulse of traditional museological preservation might be to gather together the "original" candies into airtight containers. When exhibited in the future, the candies would be placed behind a velvet rope with a wall label explaining that, historically, these candies could be taken and eaten; this would no longer be allowed, though, as taking the candies would destroy the historical integrity of the original artifact because the original candies might no longer be manufactured. However, artist Gonzalez-Torres foresaw that possibility and requested that exhibitors display only candy that could be consumed. The candy spill series serves as an illustrative example because the preservation solution seems so obvious. *Of course*, the artwork exists in the interaction between artist, institution, and audience/consumer more than in the original "object" or specific brand of candy used. Trapping these works in airtight jars behind velvet rope would not preserve them; it would transform them into mere collections of junk food.[17] Jars of original candy or "authentic" computers in the museum basement may be inappropriate preservation solutions for new media art. These artworks need to be "performed" as much as "viewed," and preserving them means preserving the behaviors of the artwork as much as, if not more than, the original artifacts. Consequently, museums must become expert at something new; they must bring the same rigor to documenting and preserving actions and performances that they now bring to preserving materials and artifacts. The idea of new media art as a set of performed possibilities will be explored in chapters 8 and 10.

New Media Art Has No Master

A somewhat smaller problem confronting preservation is that new media art has no universally recognized "masters," "masterworks," or "movements." There are artists who have been exhibited more than others, but there is no Rembrandt of media art, no *Mona Lisa*, and no impressionism—at least not that most would agree upon. While many rebel against reductive taxonomies, such canons often provide the easy handholds with which the uninitiated may obtain entry to a new and mysterious art form. More practically, such canons also provide a rallying point for preservation. When a museum or the cultural heritage field in general can point to the deteriorating Sistine Chapel ceiling, threadbare Old Glory, or the loss of the film masters of *Gone with the Wind*, they may galvanize support for

much-needed preservation efforts. The relative newness and lack of fixed points of reference for new media art are two more nails in the coffin of artworks that require preservation intervention on a much shorter timeframe than fresco, flax, or even film. Chapters 5, 9, and 13 will identify rallying points and suggest communal actions on behalf of new media art.

Social Remembering

Social memory requires people to care—it requires investment, commitment, even passion. It is not a set of neutral and mechanistic functions on autopilot, but a set of ensconced values and attendant practices carried out by people. It has become commonplace for artists and theorists to critique art exhibition practices because exhibition and scholarship are seen as the two institutional arenas in which art is constantly redefined.[18] Preservation, receiving a fraction of critical attention by contrast, is implicitly outside the realm of intellectual intervention and of the art discourse of curators, art historians, and theorists. It seems to exist in a land where chemists and other technicians carry out their objective science, unaffected by the agendas of the art world. But ideologies are every bit as much at play in preservation, and their impact here is, arguably, much more direct and permanent. We cannot effectively improve or expand the preservation paradigm without engaging the broader conceptual and logistical infrastructure. The good news is that we currently have a chance—an imperative—to improve both.

I mentioned earlier that the challenge of new media to social memory is not purely a question of technology, but that doesn't mean that technology is off the hook. The middle part of this book examines three likely causes for the pervasive obsolescence of today's media culture—technology, institutions, and law—starting with technology next.

II Technology

The middle parts of this book examine three likely factors for the pervasive obsolescence of today's media culture: technology, institutions, and law. Each of the parts profiles a different potential cause, weighing the evidence and motivations that might make that agent responsible for the erasure of contemporary creativity. That said, in all three parts we will be interested in more than who dunit; we also want to know what they might do to fix it.

The first chapter in each part—entitled "Death by Technology," "Death by Institution," and "Death by Law"—surveys a half-dozen case studies that show how celluloid and CDs, collection management systems, and copyright are killing off contemporary culture. If you are already well aware of the range of works endangered by technology, institutions, and the law, you can safely skip the first chapter in each part, and go on to the analysis that follows. Meanwhile, readers who have no interest in the disease but just want to know the cure will find our recipe for cultural permanence in the concluding part of this book.

3 Death by Technology

Jon Ippolito

The Allegations

When it comes to the causes of obsolescence, technology itself tops the list of the usual suspects. Anyone with even a passing familiarity with preservation recognizes that rapidly changing software or hardware is the culprit behind disintegrated celluloid, demagnetized videotape, and deprecated HTML tags. This chapter reviews the evidence that technology is to blame by examining a handful of case studies from the "endangered species" list of the last century, ranging from physical installations to biotech art. To be fair, we'll also examine a few unusual works that are meant by their creators to degrade or disappear. Our goal will be to decide whether technology is the culprit, or just an accomplice.

Technology as Cause of Obsolescence

There's plenty of evidence that the abbreviated lifespan of almost every example of media art of the twentieth century and beyond is due at least partly to its dependence on recent technologies. A few examples will suggest the variety of medium-engendered vulnerabilities, from the contingency of industrial processes to the fragility of life itself.

Industrial Media

Art doesn't have to be electronic to be endangered; electric will do. Dan Flavin's light installations from the 1960s to 1990s consist materially of nothing more than store-bought fluorescent fixtures arrayed on the wall, yet they are renowned for illuminating rooms with washes of color, bending walls with optical effects, and otherwise transforming the space around them.

Figure 3.1
Dan Flavin, *Alternating Pink and Gold*, 1967. Fluorescent light. © 2012 Stephen Flavin / Artists Rights Society (ARS), New York.

When the work of Flavin and his circle appeared on the scene in the early 1960s, critics gave it monikers such as ABC art, conceptual art, and minimalism. The vicissitudes of art history, always eager to pigeonhole, consigned Flavin to the ranks of minimalism—a rather arbitrary identification, as his fellow "minimalists" were mostly sculptors, while the immateriality of Flavin's light installations might be more easily associated with the instruction-based work of conceptual artists such as Sol LeWitt, whom we met in the introduction.

Regardless of how they are categorized, many of the other artists in Flavin's circle accepted, and often celebrated, the fact that their work could be recreated from readymade components. Sculptors Donald Judd and Richard Serra outsourced the production of artworks of Plexiglas or hot-rolled steel, following in the footsteps of Bauhaus painter László Moholy-Nagy's famous artworks ordered from a sign factory over the telephone.[1] When Italian collector Giuseppe Panza di Biumo acquired works by Flavin for what would become the first significant collection of minimalism, he didn't walk out of the artist's studio with an armful of light bulbs. Panza bought certificates of authenticity signed by the artist, accompanied by simple diagrams describing how to reconstruct the works from standard electrical parts.

Not only did this "do-it-yourself" approach to fabricating his work make it easier to store Flavin's art; it also meant that museums could save money lending a Flavin installation from one continent to another. Rather than spend hundreds of thousands of dollars on crating, shipping, and insurance, a museum in New York could simply fax the diagram to a museum in Germany, and entrust its staff with the responsibility of spending a thousand times less to buy equivalent European bulbs with the appropriate voltage.

Beyond mere convenience, Flavin believed that the fixtures were fungible; the medium of his work was light.[2] That said, an undeniable part of the kick viewers received from a good Flavin installation lay in the irony of conjuring luminous ethereal expanses from ten-dollar hardware. Flavin was known for using only the standard off-the-shelf bulbs, either two, four, six, or eight feet long, in a handful of colors including warm and cool white, yellow, and a dark cherry-red—which at the time were all easy to find at any sizeable hardware store.

As ubiquitous as fluorescent tubes used to be, all industrially produced artifacts have lifespans of manufacture—which is to say, they die. By the late 1990s, factories began discontinuing production of the once-standard cherry-red bulbs because the pigments used in their creation were found to be too toxic for workers to handle under contemporary safety guidelines. Within a decade, ubiquitous became unique.

Should museums stockpile old bulbs (storage)? Update Flavin bulbs to newer designs despite the difference in appearance (migration)? Wrap red gels around the outside of white fluorescent tubes (emulation)? None of these options seems consistent with the works' original aesthetic. But because these problems surfaced largely after the artist's death, it's impossible to know what Flavin would have made of the tradeoff between the importance of using generic components versus the specificity of the look and the light produced by those components.

Moving Image

The medium of film has morphed many times over its century-long history. While lay viewers may be aware only of the transition from film to video, filmmakers and technicians have watched the moving image march from celluloid to acetate to polyester, and video from U-matic to Betamax to MPEG 4. As Rick noted in the introduction, even the definition of what is important to preserve about "film" has changed with the introduction of computer-modeled cinema. This steady progression of new formats notwithstanding, film purists will always argue that video cannot capture the gleaming allure of celluloid—at least while people are still alive who remember seeing the "silver screen." Yet by and large the industry has accepted the gradual electronification, and now digitization, of the moving image.[3]

Despite the general deference to technical progress for mainstream film formats, some of the most important moving images of the twentieth century would be lost as artistic experiences if reduced to bits on a DVD or pixels on a plasma screen.[4] Ken Jacobs's remarkable *Bitemporal Vision*

Figure 3.2
Ken Jacobs preparing his film performance *Bitemporal Vision* (1994). Photograph courtesy of the artist.

film performances are one example. While they date from the late twentieth century, and definitely draw on the ethos of avant-garde film in New York in the 1960s and 1970s,[5] Jacobs's events hark back to the early days of cinema, and to proto-cinematic inventions such as the magic lantern and zoetrope.

To screen a film from his *Bitemporal Vision* series, Jacobs points two 16mm film projectors, each armed with thirty seconds or so of footage, at the same screen. The lights go out, Jacobs starts a propeller in front of the projectors that acts like a stroboscope, and the magic begins. While the audience watches, Jacobs prods the snippets of film stock backward and forward one frame at a time, so that the two juxtaposed images are slightly out of sequence. This temporal displacement creates subtly shifting visual effects that often create an inexplicable sensation of three-dimensional movement. In *Bitemporal Vision: The Sea*, for example, Jacobs manipulates two copies of black-and-white footage of waves just off a coastline, and in so doing manages to coax the waves up and out of the picture plane, as though the projectionist were the proverbial sorcerer's apprentice, making the sea rise and fall at his command.

Many critics consider Jacobs a salient figure in American avant-garde film, and preserving his entrancing *Bitemporal Vision* films would thus seem to be an eminent priority for today's film archives. Yet the well-worn grooves of film preservation are almost useless in this task: putting two snippets of 16mm celluloid into cold storage—or worse yet, committing them to a digital format on a hard drive—would preserve only a prop of Jacobs's film performance without capturing any of its script.[6]

Network

One of the first curated websites for online art, *ada•web*, was a common destination among early Internet users during its lifetime from 1995 to 1998. While *ada•web* was one of the first organizations to commission online projects by artists with substantial offline reputations, such as Jenny Holzer and Lawrence Weiner, many of its commissions went to artists whose reputations had been established primarily online, including Group Z (Michaël Samyn), jodi.org (Joan Heemskerk and Dirk Paesmans), and John F. Simon, Jr.

When funding from *ada•web*'s parent company America Online dried up in 1998, curator Steve Dietz worked with the website's cofounder Benjamin Weil to rescue *ada•web* by archiving it, frozen in its final form, in a "digital arts study collection" at the Walker Art Center. Yet even before its embalming at the Walker, some of *ada•web*'s many appendages had already

shown signs of premature aging.[7] The Group Z page, for example, includes three sections: projects that work with Netscape 1.1, those that work with Netscape 2, and those that work with Netscape 3 and 4.

These early browsers, released in the mid-1990s, did not yet support later animation techniques like JavaScript and Flash, but net artists were clever enough to manipulate them in innovative ways—often by taking advantage of their flaws. For example, webpages are supposed to have a single <body> tag, where the visible part of the page goes; this is distinguished from the <head> tag, where the metadata such as the page title goes. Netscape 1.1, however, released in April 1995, had a bug that inadvertently enabled HTML hackers to add multiple body tags sequentially, with the result that each "body" would be painted to the screen one after another, producing (via background color and other body attributes) a primitive form of animation.

In March 1996, the release of Netscape 2 fixed that bug, ruining works by Group Z, jodi.org, and other innovators who created some of the first animated websites. HTML-based animation had lasted eleven months, perhaps a record for the shortest lifespan of any widespread medium up to that point.[8]

Biotechnology

Manipulating life arguably has a history older than any recorded medium, as the practice of breeding plants and animals can be traced back to Neolithic times. As the discipline grew in the twentieth century to include insights from microbiology, the number of biotech techniques, and artworks made with them, expanded to include genetic manipulation (Eduardo Kac's transgenic animals),[9] tissue culture (SymbioticA's artificial skins),[10] and cloning (Natalie Jeremijenko's cloned saplings).[11] How soon bio-art techniques such as polymerase chain reaction will become obsolete depends partly on the specific technologies involved and partly on their commercial and legal viability. (How long will it be before there is a legal ban on some kinds of cloning?)

Yet even life art created by "tried-and-true" techniques can have an expiration date. Damien Hirst is best known for provocative works like *The Physical Impossibility of Death in the Mind of Someone Living* (1991), a dead tiger shark floating in a giant aquarium filled with formaldehyde. The work can be read on many levels; it's probably most frequently been associated with Hirst's "bad boy" attitude and eagerness to demonstrate that the art world will swallow anything if it's hyped correctly. However,

once installed in a museum next to paintings and sculptures, Hirst's pickled creatures can't help but remind us of the role such collections play in preserving culture that was once alive. Sharks have to keep moving to stay alive, and Hirst's shark can be read allegorically as underscoring the irony of killing to preserve, like the proverbial butterfly pinned to the wall.

Perhaps even more ironically, Hirst's formaldehyde proved insufficient for preserving his own work, and the original shark had to be replaced in 2006.[12] Biological life is, as Schrödinger put it, an anti-entropy machine, but once that life is over, entropy wins out sooner or later.

Site-Specific Media

Site-specific artworks have a pedigree that runs from cave paintings through Renaissance altarpieces to Richard Serra's *Tilted Arc* (1981–1989), a Cor-Ten steel sculpture originally installed in New York's Federal Plaza. The removal of *Tilted Arc* created such an uproar among art cognoscenti that the following year saw the passage of the Visual Artists Rights Act to protect such works.[13] Yet, as Rick will note in chapter 7, modern art history and curatorial practice have conditioned us to expect to see carvings originally lodged in New Guinea villages or ancient Greek temples now plunked on pedestals far from their country of origin. As if to sever works further from their context, the rise of "locative" media, particularly personal digital assistants, smartphones, and augmented reality, has made watchwords of mobility and ubiquity, conjuring up clouds of information that can be accessed at will from anywhere on the planet.

A closer look, however, shows that training such mobile devices on the world outside can make them even more dependent than dugout canoes or Elgin marbles on their physical environment. Janet Cardiff's *The Telephone Call* (2001), a quirky guided tour of the San Francisco Museum of Modern Art, invites visitors to pick up a camcorder, press the Play button, and follow the mysterious itinerary enacted on the camcorder's video screen, from the museum's public lobby to a back stairway and back again. Unfortunately, when the museum was renovated in later years, the viewer's pathway no longer matched the architecture pictured on screen.[14] Even web-based works can depend on local protocols; jodi's *GeoGoo* (2008), which draws a series of skittering markers that wend their loopy way across a virtual coastline, will be reduced to a blank screen if and when Google changes their API—the "Application Programming Interface" that helps third-party software communicate with Google Maps.[15]

Technology as Means of Obsolescence

The endangered status of the works described above is clearly derived from their dependence on ephemeral technologies, yet the fragility of these media often takes their creators by surprise. Certain artists even feel "betrayed" by the technology they chose to support their creative vision, or cling to a state of denial about the certain doom their works face.[16] More savvy artists may accept the inevitable decline and disappearance of new media, at least regarding certain of their creations. Some of these, including Eva Hesse herself,[17] reluctantly accept the tradeoff for using experimental materials. Others choose to euthanize their works before they become decrepit remnants of their former selves. Still others craft works that deliberately accommodate or play off this slippage.

Either way, it's hard to fault the technology just because it was used for the artwork, if the artists knew (or should have known) from the beginning that it was ephemeral. In these cases, technology is not guilty by nature so much as guilty by association. To paraphrase the National Rifle Association, technology doesn't kill art; artists kill art.

So let's look at the same genres, this time focusing on artworks where obsolescence is intentional rather than accidental, and technology is more accomplice than culprit.

Industrial Media

In the 1960s, when land artists such as Alan Sonfist, Dove Bradshaw, and Robert Smithson turned to the earth and natural processes for inspiration, they accepted the consequences of letting nature have a go at their materials. In some cases, the results were unintentional, as when changing water levels in the Great Salt Lake encrusted Smithson's famous *Spiral Jetty* (1970) with salt and diminished the algae bloom that enhanced the visual contrast between basalt rocks and red-tinged water. There has been some debate over whether to "restore" Smithson's *Jetty* by adding or cleaning rocks, but critics and conservators of process art accept that most of the works they study were meant to evolve as naturally as possible, and Smithson in particular was fascinated by entropy.[18]

William Anastasi's *Sink* (1963) embraces entropy even more directly, as the work would not exist without deterioration. *Sink* is nothing more than a rectangular slab of iron on which the owner pours a small puddle of water each day. The water slowly rusts away the surface, leaving a subtle oval depression that catches the next pool of water. The title is hence a double pun: the more the surface sinks, the more it resembles in form

Figure 3.3
William Anastasi, *Sink*, 1963. Metal and water. Photograph courtesy of the artist.

and function a kitchen sink. The work was a favorite of avant-garde composer John Cage, who watered it daily along with the plants in his apartment.

Moving Image

While works of process art like Anastasi's *Sink* are encouraged to decay, other works are allowed to decay only because to attempt to preserve them would deny their artistic essence. Nam June Paik's *Crown TV*, for example, is a cathode ray tube television from about 1960, rewired to display a beautiful oscillating geometric pattern rather than a soap opera or car commercial. To do this, Paik transferred the electrodes that normally convey sound from the speakers to the visual output. Each time the work is installed, it requires an analog TV (not so easy to find these days) and someone to adjust the parameters of the audio-video connection to create an appropriately rich pattern on the screen (such as the abstract "crown" suggested by the title).

One of the earliest landmarks from an artist who has been called the father (and grandfather) of video art, *Crown TV* would seem a preservation priority if only for history's sake, and the work was in fact chosen as a case

Figure 3.4
Nam June Paik, *Crown TV*, 1988 version of a 1965 original. Prepared television. Photograph by David Heald, courtesy of the Nam June Paik Studio.

study in the exhibition "Seeing Double: Emulation in Theory and Practice" held at the Guggenheim museum in New York in 2004.[19] Nevertheless, when exhibition co-curator Caitlin Jones and longtime Paik champion John Hanhardt discussed strategies like migration and emulation with Paik and his assistant Jon Huffman,[20] they concluded that storage was the only strategy that could preserve *Crown TV*'s essential dynamic—namely, hacking everyday hardware to produce a surprising result. Paik had created *Crown TV* literally by crossing the wires of a typical TV set of his day; but with a contemporary digital TV set, there are no wires to cross. Attempts to emulate the setup by, for example, displaying a video recording of the original image would be a travesty, not just because of any loss of quality, but because there is no "original image"—just a set of dials that allow the installer (and in *Crown TV*'s earliest exhibitions, the viewer)[21] to choose

* Rick: Now, half a dozen years after "Seeing Double," even the safe approach of "storage" would fail for a similar work by Paik such as *Magnet TV*. Viewers of this work could manipulate TV images using a large magnet. In addition to the problem of finding the hardware as mentioned here, there are no longer any analog TV signals in the air to capture and mash up.

from among the infinite variety of oscillating patterns.*

Network

Author Bruce Sterling maintains a keen interest in the arc of technologies from shiny to lackluster to extinct. The Dead Media list that Sterling inspired in the 1990s is a remarkable compendium of ancient gizmos and recent gadgets that no longer work, from pneumatic tubes in nineteenth-century department stores to the use of pigeons for communication in World War I.[22] So it shouldn't be surprising that when asked to create a work of net art, Sterling envisioned a piece that tackled the speedy obsolescence of Internet formats head-on—albeit in the signature "past-is-future" aesthetic of his fellow cyberpunk authors.

Embrace the Decay (2003), created by Sterling with the help of Jared Tarbell, is a Flash animation showing the image of a typewriter; as the viewer types on her own keyboard, the virtual typewriter's keys bang out the letters and words in virtual ink on the screen. Beyond this simple demonstration of historically parallel interfaces, however, lies a lesson in entropy. Random keys on the typewriter gradually fall off as the viewer types, and the corresponding letters disappear from the text; finally, the virtual paper on which the letters appear degrades according to one of several algorithms depicting natural events like ink fading, fax paper heating, or staining.

Originally, Sterling and Tarbell's work only embraced virtual decay. Given its dependence on a now obsolete, proprietary Flash plugin,[23] however, *Embrace the Decay* has since been reduced to a pile of meaningless bits, held together by a title that seems less irreverent than inescapable.

Biotechnology

To create the project *One Trees*, Natalie Jeremijenko and her collaborators distributed a thousand cloned walnut tree saplings across the San Francisco Bay area in an elegant refutation of common misconceptions about cloning. Produced in 2000, four years after scientists announced the first cloned mammal, Dolly the sheep, *One Trees* at first sight appeared to participate

in the accompanying media frenzy and its flights of speculation about replacing people with their doppelgangers.

To anyone who bothered to examine the work, however, *One Trees* pointedly demonstrated that varying environmental factors ensure that cloned organisms develop quite differently. (As Jeremijenko points out, identical twins have different fingerprints.) Jeremijenko installed her tree(s) indoors and outdoors, in nutrient-rich and poor soil, on level and inclined ground, and even upside-down.[24] The variety of shapes the trees grew into—the upside-down tree did a U-turn so its leaves could find the sun—spoke louder than any philosophical argument about the importance of environment in the nature-versus-nurture debate.

One Trees is another work that by its nature fights the traditional preservation paradigm, because the work is not about keeping something the same but is about illustrating its differences. To try to preserve this work via storage would be nonsensical.*

* Rick: This reminds me of a discussion with artist Ken Goldberg about preserving his work *Telegarden*, 1995, then in the collection of the Ars Electronica museum. *Telegarden* allowed viewers to control a robot over the Internet to seed and tend small plants in a small container of soil. His half-joking, but radical, preservation idea was to move the plants from the container out to the grounds of the museum, tend the plants indefinitely, and do away with the robot. Does that mean we'd have to change the title from "new media art" to "renewable media art"?

Site-Specific Media

Jennifer Crowe and Scott Paterson's *Follow Through* (2005) was a place-based artwork created specifically for the Whitney Museum's permanent collection galleries that visitors could access on Palm Pilot handhelds. Mocking the solemn demeanor of the typical museum visitor, the instructions on *Follow Through*'s handheld screens showed pictograms of recommended body movements along with textual cues such as "Rotate your body 90 degrees to wall. Cross arms, turn head and slowly shuffle around counterclockwise." Because it piggybacked on an existing audio tour, this playful work could not survive a rehanging of the paintings and sculptures in the permanent collection.

Like *The Telephone Call* and *GeoGoo*, *Follow Through*'s implicit fragility underscores the dependence of much of so-called "mobile" technology on its setting, as the artists admit:

If this piece were to be recreated, that would mean we'd need the 5th floor to be exactly the same as it was when we originally installed it. However, if we were asked to do another version of *Follow Through*, we could easily do it in a different space in the museum provided we were able to use the same methods we used to develop the original—for example, we spent two weekends observing viewers in the gallery. These observations are the basis for the "exercises" we prescribed for the viewers. [Also, *Follow Through*] would have to be retooled to accommodate for changes in external references (i.e., position of certain works compared to other works, position of things like benches, position of security guards, and overall architecture). The piece could be recreated, but spatial references are very important as the piece exists now.[25]

We touched on the strategy Crowe and Paterson suggest for coping with the inconstancy of physical space in our introduction, where we called the complete re-creation or reperformance of a creative work "reinterpretation." This powerful strategy can be applied to much more than site-specific media, and we will return to it in depth in chapter 10.

Reinterpretation is a preservation strategy orchestrated by humans—but of course, whenever one technology breaks, another often comes along promising to save it. The advent of augmented reality platforms such as Layar would seem to solve the problem of shifting physical environments corrupting a site-specific work.[26] In the networked model of augmented reality, images visible on a mobile device whose camera is trained on Times Square are not stored locally on that device's hard drive. Rather, the device downloads the images in real time from a website, where they can in principle be updated to reflect an up-to-date map of the square's shops and billboards.

Unfortunately, "can" and "will" are often two different things. It takes dedication and research for a network-based model of a museum or city street to stay current with changes in that environment. Some augmented reality projects leverage community participation to adapt to an evolving cityscape; for example, showing only the latest restaurant reviews for Broadway can bury outdated references to restaurants that have closed. Nevertheless, most artistic works in place-based media do not have this same potential for automatic updates. And while relying on a free API like Layar makes mobile works accessible to viewers on many different devices, it adds a layer of software that becomes another potential failure point, should the protocols for interacting with Layar's network change over time.

In the exhibition "Not Here," the artists of Manifest.AR solved this potential mismatch between virtual and real not by suggesting their works be reinterpreted in the future,[27] but by emphasizing how the uncoupling of content and site can subvert gatekeepers who normally control that

Figure 3.5
Manifest.AR, "Not Here," augmented reality application. View at the Samek Art Gallery, Lewisburg, 2011. Photograph courtesy of the Samek Art Gallery.

relationship.[28] First, they chose imagery that did not need to be coupled to outside objects; while pictograms showing star ratings for restaurants would need to overlay the appropriate street positions as seen in a phone camera viewfinder, a horde of reproducing frogs can be overlaid pretty much anywhere.

Second, Manifest.AR chose to "exhibit" their works in some of the art world's most exclusive venues. Unlike creators of conventional public sculpture, augmented reality artists don't need permission to overlay data or imagery on a neighborhood, building, or even museum wall. When smartphone-wielding visitors to Manifest.AR's virtual "occupation" of the Venice Biennale debated the merits of works visible only through their viewfinders, guards and other museum-goers who weren't clued in could be forgiven for scratching their heads at the attention paid to seemingly empty walls or courtyards. Realizing the paradoxical relationship between real and virtual at the heart of augmented reality, Manifest.AR decided to replicate their Venice show at the Samek Art Gallery in Pennsylvania and the Kasa Gallery in Istanbul.[29] The same works are "present" in all three locations, just identified with a different set of latitude and longitude coordinates.

Manifest.AR artist Will Pappenheimer's virtual toads offer an apt metaphor for this strategy of decoupling augmented reality works from unique locales. Real cane toads wreaked havoc on the local fauna when introduced in Pappenheimer's native Australia; by scattering his virtual toads from Sydney to New York, Pappenheimer suggests we think of augmented reality as an invasive rather than indigenous species. Thus, it would seem one way to accommodate changes in physical surroundings is not to make mobile applications site-specific, but to make them site-adaptable.

Assessment

The first set of examples makes a convincing case for technology as the cause of obsolescence. But the second set goads us to cross-examine that contention. As we have seen, for some artists, and for certain artworks, the choice of a new medium has doomed the artwork in the long term, whereas for others the temporal limitations of a medium become an accepted fact or even a crucial part of the work's aesthetic.[30] The variety of ways creators have coped with media decay mitigates the case against technology as the culprit of obsolescence and oblivion. If technology is a smoking gun, it is also something the victim chose to brandish in the first place.

This apparent paradox may be resolved by clarifying what we mean by the word "technology." As Leo Marx observes, "technology" is a catchall term we apply to semiconductors and subroutines, but that in fact extends outward from these hard and soft artifacts to include the clean rooms in Bangkok, the call centers in Bangalore, the salespeople in the New York Apple store, a computer science teacher in Chicago, and the copywriters for the "I'm a Mac/I'm a PC" commercial in Los Angeles.[31] In other words, "laptop" technology includes the entire social and economic apparatus required to get those semiconductors and subroutines into a laptop, plus the marketing and motivation to get users to buy a laptop and hammer on its keys.

Departing from this definition, we might say that a laptop is not just a box of electronics and software applications, but a global nexus of associations—including the expectations users bring to it. Hence, from Leo Marx's perspective, Group Z and Bruce Sterling might have used the same web browser but used different technologies—not because one was Netscape and the other Firefox, but because they brought different expectations of permanence to the works they made for their browser.

That said, we shouldn't lay all the blame on the creators for choosing—or failing to recognize the nature of—media with expiration dates. For a

technology's user is not the only part of Leo Marx's social equation; it also includes the manufacturer, who has a clear incentive to produce commodities that must be upgraded to a new version every two years. Consider, for example, the telescoping timescales of contemporary obsolescence. Industrial products like fluorescent lights and analog film have been around since the late 1800s and early 1900s; video formats since the 1960s; web plugins since the late 1990s. And now, regardless of seniority, they all seem to be dying at the same time.

Despite this accelerating cycle of contemporary obsolescence, the majority of consumers today take for granted the inevitable necessity of upgrading to a new mobile phone every couple of years or downloading a new Firefox version every few weeks. Often they do so in order to add features and fix bugs, as is the case with an open-source product like Firefox. For commercial media products, however, a competitive marketplace and the promise of perennial revenues encourage companies like Apple and Microsoft[32] to design products to have, as Bruce Sterling says, "the lifespan of a hamster."[33]

Whether the obsolescence of new media is planned or inadvertent, an unfortunate consequence is that all of the artworks born of twentieth-century media are due to expire right at the beginning of the twenty-first. If there is a bright side to this telescoping half-life of new media products, it is that the combined pressure of film historians, museum conservators, and Internet archivists all throwing up their hands at once has created a consciousness of the scope of the threat that transcends the usual disciplinary-bound enclaves of preservation.

Understanding the scale of the crisis also means recognizing that the paradigm of preservation may have to change dramatically to accommodate new media. As suggested by the examples above, the presumption that medium-specific strategies like storing art in a vault are automatically the best practice for preserving creative work is fundamentally flawed. In order to salvage the rich array of creative practices born during the last century, society has to move from preserving media to preserving art. In the process, we will have to view change not as an obstacle but as the means of survival.

4 Variability Machines

Richard Rinehart

If we return to the roots of new media, to the first modern theories of computation developed by Alan Turing and his contemporaries, we may discover that what we need for the preservation of new media art turns out to have been built into technology from the very beginning: variability.

The Tech Case for Variability

Abstraction—the separation of the logical from the physical, of bits and symbols from printed circuits, of content from form—is foundational to the idea of the modern computer and is what makes it a "universal machine." A computer is a symbol engine. It turns electrical impulses into symbols—0s and 1s—and can then assign those symbols to many different functions. In one case, they can be pixels in an image; in another case, they can be numbers; in another, they can be samples in a sound wave, and so on. In this way, the computer can be a calculator, a TV, a video game console, or a typewriter: a universal machine. How a computer is built and how it works are less important than how it functions. The "father of the computer," British mathematician Alan Turing, put it this way: "Importance is often attached to the fact that modern digital computers are electrical, and that the nervous system is also electrical. Since Babbage's machine was not electrical, and since all digital computers are in a sense equivalent, we see that this use of electricity cannot be of theoretical importance. . . . If we wish to find similarities we should look rather for mathematical analogies of function."[1]

Abstraction means that variability rather than fixed function is a defining characteristic of digital media. This variability results in the highly contingent and ephemeral nature of digital media and yet may provide the seeds for their longevity. The solution for preserving new media culture lies not in attempting to circumvent its variability with outdated notions of

fixity, but rather in embracing the essential nature of the medium and transforming its greatest challenge into a defense against obsolescence.

In the introduction, I mentioned that new media art is as performative or behavior-centric as it is artifactual or object-centric and that it exhibits variable form, much like music. A single musical work can be performed using different instruments or hardware each time. As long as the same essential score is performed within appropriate parameters, the musical work itself will be recognizable and will retain its integrity. The performing arts are not exclusive in their variability; music merely provides a useful and widely understood analogy, as invoked by new media artist Mark Napier:

> In music, a song can be played on different instruments. The song is not diminished by this experimentation, and its author may very well benefit from hearing a new approach to a composition. We hear Beethoven symphonies played on a variety of instruments, perhaps slightly altered by the interpretations of the musicians, but they are still recognizable as works by Beethoven. Software-based artwork is similar: the computer language, operating system, and hardware form an infrastructure that supports the artwork, but they are not the artwork. The artwork is an algorithm, a design built on this infrastructure, which is constantly changing and rapidly aging. To hold onto that technology is to tie us to a sinking ship. We have to be nimble enough to jump to the next boat, and our artwork has to be adaptable enough to do that gracefully.[2]

Digital artworks at the core of our investigation are by definition computational artworks—that is, artworks that may be the end result of computational processes or composed of ongoing computational processes. Computation may manifest physically in the flow of electricity and organization of magnetic bits, but it is not tied to any one specific physical instance. It is, definitively, a repeatable event. In practice, digital artworks may be authored on one brand of computer hardware and software platform, but presented under a different configuration. In works of Internet art, aspects such as color, scale, and speed can vary significantly when viewed on different monitors over different network speeds. This variability is not considered corruptive but rather as an inherent property of the medium and the work. Digital and related new media art will almost certainly use different hardware for presentation a hundred years from now, but can still be considered authentic.

The Art Case for Variability

Above, I provide a technological argument for why new media art is variable, but surely artworks operate at levels not dictated by their

Figure 4.1
Wendy Carlos, *Switched-On Bach*, 1969, album cover.

technological substrata. In new media art, the new media may be variable, but is the art? In this book, Jon and I argue that some art is better served if it is considered medium-independent. By that we mean that the artwork should not be tied to any one specific technology, but not that the artwork should be considered apart from media altogether. As I mentioned earlier, in the context of preservation, it is necessary to consider the exact relationship between an artwork and its medium. Now that I have come at this problem from the technological angle, let's consider the art case for variability. How an artwork is situated in space and time is one way to understand its variability. In "The Work of Art in the Age of Mechanical Reproduction," Walter Benjamin proposes that traditional works of art acquire their importance and authenticity—their aura—in part via their

location in space (that is, a singular location). The viewer experiences that aura through his or her own spatial proximity to the artwork in question. Experiencing an image of the artwork, the artwork at a distance, is not the same; the aura is absent. Benjamin writes, "Even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be."[3]

Despite the missing aura, Benjamin celebrates the reproduction as being able to transport something of the artwork to new locales across space and time: "The cathedral leaves its locale to be received in the studio of a lover of art; the choral production, performed in an auditorium or in the open air, resounds in the drawing room."[4]

But what happens when an artwork is born in a form that is itself a reproduction, such as photography or film? Benjamin maintains that the aura is absent in these works, but that is not necessarily a bad thing: "For the first time in world history, mechanical reproduction emancipates the work of art from its parasitical dependence on ritual. To an ever greater degree the work of art reproduced becomes the work of art *designed for reproducibility* [emphasis mine]. From a photographic negative, for example, one can make any number of prints; to ask for the 'authentic' print makes no sense."[5]

When Benjamin talks about photography and film in his essay, he could have been talking about new media art. Many writers before me have drawn the comparison.[6] Computational media are born as reproductions even more than film is. Artists using a computer to create a work of art arrange a series of 0s and 1s in the computer's dynamic memory, and when they hit Save those bits are written to a magnetic disk. Only seconds into the process and already they are making copies. To ask for the "authentic" bits or even the "authentic" computer makes no sense. The aura is dead, at least for much new media art. Benjamin heralded this situation in 1936; can museums finally accept it? Even today, as museums try to figure out how to collect new media art, they routinely draw up contracts with artists whereby the artist artificially limits the number of copies she will ever make (in order to preserve the aura for a work that never had it?). And sometimes artists are even asked to sign the disks they hand over. Benjamin had something to say about this, too: though media art forms lack an aura, people would try to invent one anyway. He asserted that this was done in films by making the actor famous, a maneuver he quickly dismissed as the "spell of the personality." And when museums artificially make reproducible artworks into unique objects, aren't they attempting to cast this same "phony spell of the commodity"?[7]

"Art degenerates as it approaches the condition of theater," pronounced art critic Michael Fried in his famous 1967 essay "Art and Objecthood," which defended late modernist painting and took aim at the minimalists.[8] I don't intend to cover here the well-trod divide between Fried and the minimalists,[9] only to see how some of the factors in that debate may function in our discussion of new media art. Like Benjamin, Fried carefully considered how the ideal artwork is situated with regard to space and time. Fried thought great art should exhibit a quality he called "presentness" and be "at all times wholly manifest." He believed that a state of grace came from this type of suspension of time where the past is hidden, the future is unknown, and there is only an eternal present. He contrasted "presentness" with an opposite condition that he called "presence"—a condition that minimalist sculpture shares with theater. Presence signals not only a kind of theatricality, but a sense of time in which the artwork is not manifest in an eternal moment but rather unfolds, bit by bit, in real, mundane time. Presence also introduces multiple contingencies that serve to destroy the fleeting sense of grace.[10] These contingencies include requiring the viewer to move about in order to view all parts of the work, operating equipment, and external referents. If minimalist sculpture and theater exhibit "presence," media art has it in spades. Media art relies on clunky, earthbound equipment, and it is not "at all times wholly manifest." Media art is often the result of live, ongoing computational processes unfolding in real time, bit by bit, or it requires the viewer to interact or contribute and thus complete the work. Though intended to be critical, Fried's essay ironically provided some of the theoretical basis for minimalist art. In a similarly backhanded fashion, his ideas shed light on the variable nature, and thus the preservation, of new media art.

The painting *Lavender Mist* by Jackson Pollock would fulfill Fried's ideal criteria of presentness. A more recent artwork that would certainly foil these criteria is Shawn Brixey's *Epicycle*.[11] In this proposed new media work, Brixey would place cameras in each of the Earth's twenty-four time zones, pointed at the horizon. In a central room, he would then display the live video feed on twenty-four monitors circling the viewer. The viewer would then be presented with a view of nature that is not possible in nature—a view in which the sun is always rising (on at least one of the screens around him in a perpetual sunrise/sunset). As with minimalist sculpture, the viewer would not be able to view this work from a single fixed point (not to mention the temporal aspect of the work that keeps it from being "wholly manifest"). The viewer would be required to visually and cognitively assemble the work in a performance of body, space, and motion that suggests

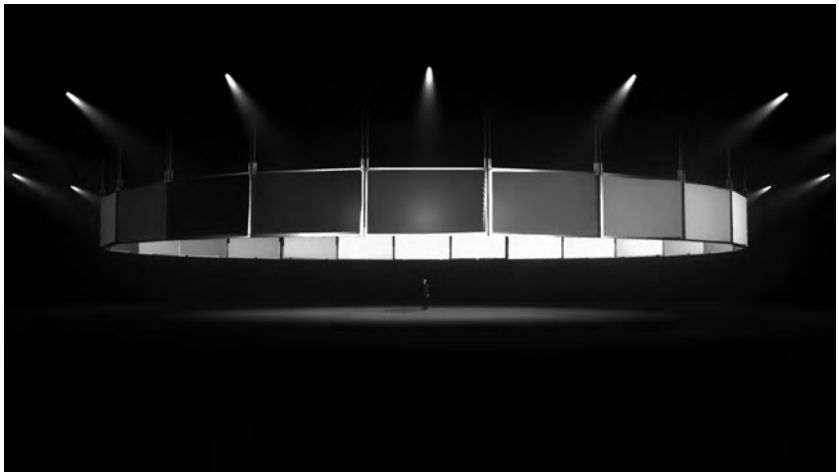


Figure 4.2
Shawn Brixey, proposal for *Epicycle*, 2000.

relativity. *Epicycle* uses technology in an attempt to marry two types of time: the ancient circadian rhythms of biology and geology and the newer global time where the sun never sets on the Net. It also strives for celestial grace, but grace derived from time's perpetual unfolding rather than its suspension. *Epicycle* is nothing if not a set of external spatial and temporal references. Looking at new media art through Fried, even through his imagined critique, shows how new media art operates like an algorithm that relies on dynamic external variables, taking it even further away from a definition as an eternal fixed object and toward performativity, relativity, and variability.

Following Turing, computation and thus artworks requiring computation can be performed on any computer that can provide the right functionality. Following Benjamin, media art has no aura, and the idea of one true original is ludicrous. Following Fried, media art exudes presence in that it is not self-contained and is highly contingent on equipment, user interaction, real time revelation, or any number of extrinsic variables. Yet some in the world of museums and preservation continue to argue that, in order to properly preserve media art, we should collect the "authentic" computer, software, and bits, store them as self-contained artifacts, and exhibit them in their "original" form. This approach denies the inherent variability of media art, or at least sees it as a corrupting force against the power of authenticity to which museums have been handmaidens for

centuries. The ancient assumption that all artworks should retain an aura and the modernist ideal that they exhibit presentness are based on notions of purity and fixity that no longer apply.

Reconciling with Variability

Despite institutional inertia, there are encouraging signs that some museums are beginning to reconcile with the fact that variability inhabits all art and that new technologies merely bring that fact to the forefront.

In a June 2008 online article for *Newsweek* magazine, Jen Graves recounts that Marcel Duchamp authorized artist Richard Hamilton to recreate Duchamp's *Large Glass* sculpture for an exhibition at the Tate Gallery in the 1960s. She connects this to a spring 2008 exhibition at the Tate in which Duchamp's erotic peep-show-through-a-keyhole *Étant Donnés* had been recreated entirely in projected stereoscopic illusions. Graves goes on to describe another instance of variability that seems even more apropos of our discussion:

> There is yet another major work on display this spring in reconstituted form, this one on the West Coast. In "California Video," up through June 8, the J. Paul Getty Museum in Los Angeles recreated a 1976 installation by the artist collective Ant Farm. Consulting with the artists in what curator Glenn Phillips calls "a radical conservation project," the museum reconstructed the tacky '60s living room in which Ant Farm's video reenactment of the assassination of JFK originally played, on a vintage TV. The new work has two dates, 1976 and 2008. When it comes down, all of the objects and instructions about how to install them will be archived and can be sold. Essentially, the original work of art has been reborn as a new piece.[12]

Wonderful! It merely remains for institutions to transport their newfound insight into variable media artwork from their exhibitions to their collections and to translate it from ad hoc exhibition planning to formal preservation methodology.

Artists too are increasingly experimenting with new ways for their variable media works to enter institutional collections. Jon Thomson of the artist duo Thomson & Craighead offers an interesting example of how they sold an artwork as a set of instructions in such a way that the instructions attain archival "permanence" while the realized work remains appropriately ephemeral:

> When we sold a work to the British Council a few years ago—it was an instruction-based work using live data as its material— . . . what we also did, given that the work itself could be reduced to a series of instructions is make a unique edition (plus artists

Figure 4.3
T. R. Uthco, Ant Farm, *The Eternal Frame*, 1975, 2008. Getty Museum, Los Angeles.

Figure 4.4
T. R. Uthco, Ant Farm, *The Eternal Frame*, 1975, 2008, 2010. MOMUK, Vienna.

copy) of archive prints that contain all the information required to remake the work in perpetuity.[13]

Thomson goes on to explain how the artists also use a parallel variable media strategy of producing multiple versions of the work, some for the art market and collectors, others for open dissemination and study:

> One way we are trying to work now is to make works available on our website in streaming, embedded forms etc. that may also have a gallery/installation iteration so that a version of the work is freely available online but another version of the work as installation can be taken up by the art market at large. . . .
>
> This also allows our website to be a simple visible archive, something that we value a lot ourselves when we come across it elsewhere (ubuweb, etc. . . .) and speaking for a second as a visiting lecturer at art school I can report that the availability and visibility of work in repositories like ubuweb is really changing the way art students are able to access stuff that until then could only be little more than hearsay or historical trace.[14]

Of course, artists working in nontraditional media have collaborated with collectors for decades to develop innovative strategies for transferring artworks, but these have always been heroic ad hoc efforts. We seem to be at a moment now when, driven by the volume of new media works and their extreme degree of variability, such collecting practices may reach critical mass. As Thomson alludes to, new media propel the nature of the works and the practice of scholarship toward a tipping point at which new collecting practices may become a formal conservation methodology alongside chemical analysis of paintings and cold storage for films.

Preserving media artworks as variable manifestations rather than fixed objects requires a kind of ecological balance: introduce too much variation and you have a new species, an entirely new artwork, but allow too little variation and the artwork cannot adapt to changes in its environment and it is doomed.* Clearly the question is not whether artworks are variable at all; sculptures, installations, new media works, and paintings all change over time. Rather, the question is how much they can vary while retaining their integrity. The solution is to ask—ask the artist, ask everyone—and then make the answer to those questions explicit, inscribed onto the historic record that accompanies the artwork. The current practice is not to ask (or to ask occasionally and record the answers as curious marginalia) but usually to assume that no variation is allowed—that new media artworks are like marble statues and that to

* Jon: We'll return to this ecological metaphor in chapter 11.

allow any alterations would be to destroy their precious aura—and this fixation with fixity spells death for these artworks as surely as for a pinned butterfly or Damien Hirst's pickled shark.

As we've seen here, variability is not an expedient notion about how to preserve new media art, and new media culture generally, but it is inherent in them. They are born with this seed of salvation already inside them. Fixating on the "original" form of a new media artifact is both impractical (it's quite certain that your MacBook Pro will not be functional two hundred years from now) and inappropriate (there is no one true original form and no aura anyway; fixity is actually the corruptive force here). Variability, the propensity for new media to reconfigure at a rapid pace, is perhaps the greatest obstacle to preserving new media art and culture. But we need not struggle against it. Instead, we can embrace change and turn it from preservation's deadliest enemy into our greatest ally.

5 Metadata and the Historic Record

Richard Rinehart

Metadata seems to be exactly the type of dry technical arcana that keeps geeks up at night but needn't concern the rest of us (or perhaps the rest of you). However, as we'll see in this chapter, metadata has the power to shape what we remember and what we choose to forget, and to change the way we write history.

What Is Metadata?

Metadata belongs to the softer side of technology—the "information" side of information technologies.[1] It is data about data.[2] Another way to put it is that metadata provides context. In information design, metadata reveals a level of meaning that is implicit in the data itself and easily understood by humans but not by computers. Computers nonetheless require this context in order to effectively process the data in question. A classic example of how metadata is deployed can be illustrated by the following example. The datum "Star" is semantically ambiguous; it could be the noun denoting celestial bodies, it could describe a lead actor, or it could be a personal name. However, the metadatum "personalname" is added to make the meaning explicit and thus actionable by computers in the form of improved search engines and the like:

<personalname>Star</personalname>

<celestialbody>Star</celestialbody>

<celebrity>Star</celebrity>

A person would implicitly understand these metadata through context and have little use for them, so when metadata appears, it usually does its work invisibly, in the source code for a webpage, for example. Here a computer can make effective use of them. For example, if websites and search

engines made use of the above metadata, an Internet search for all *people named* Star would return only documents containing the first sample above and not the others (a great refinement considering that, as of 2013, a Google search for "star" turns up 2.87 billion results that do not differentiate between these three uses of the word). Improved searches are the least of metadata's implications. For a brief moment, metadata seemed poised to form the foundation for a whole new kind of Internet. In 1999, Tim Berners-Lee, director of the World Wide Web consortium (and "father" of the web), wrote,

> I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web—the content, links, and transactions between people and computers. A "Semantic Web," which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The "intelligent agents" people have touted for ages will finally materialize.[3]

Although metadata as envisioned in the semantic web has not been broadly adopted by the masses that do the blogging, tweeting, and YouTubing, it has been adopted, in simpler form, by institutions to provide a range of services.[4] Metadata, hidden from human eyes, underlies and enables every single e-commerce transaction. Even more relevant here, metadata has been used by cultural heritage institutions like libraries for decades, long before the idea of the semantic web, in fact. Whenever you search a library catalog, you are taking advantage of the fact that the library system knows that "Moby Dick" is the title of a book and not the author.

Metadata Standards

Before we move to how metadata applies to art and preservation, there is one more ingredient that is necessary to make metadata truly useful: standards. The original "standards" were the flags of royalty and warlords that were brought out onto the battlefields of medieval Europe around which the troops could rally. Similarly, metadata standards offer common ground around which a community can interrelate. Using the example from above, one party could use the metadata "personalname" to indicate a name thus:

<personalname>Star</personalname>

while another might opt to use "name" to indicate the same thing:

<name>Star</name>

A computer would not know these two are really the same and would not treat them the same, thus defeating the purpose of using metadata in the first place. The answer to this dilemma is for everyone (at least everyone within a community that needs to communicate with each other) to decide to use the same metadata; that is, to establish a standard. As with any technology that gets adopted on a broad social scale, metadata has immediate social implications. The best standards become public property, open to everyone. But, who defines the community and who gets to decide what standards to use? Who is behind the metadata and what viewpoint does the metadata represent? For most professional communities, a well-meaning cabal of the largest members—the largest computer companies, the largest museums and research libraries—appoint themselves to be the standards-bearers. There are numerous examples of these benevolent, yet top-down standards-developing bodies, such as the International Standards Organization (ISO), the W3C computer industry consortium, and the Getty's *Art and Architecture Thesaurus* (AAT).

The Rhizome VocabWiki project demonstrates a different, bottom-up, model for developing metadata standards. The media arts organization Rhizome was looking for a dictionary of art terms (i.e., metadata) to describe the new media art it had been collecting in its online database, the ArtBase.[5] Existing art standards such as the AAT lacked terms of sufficient granularity to describe the nuanced differences in types of new media art. For instance, as of 2008, the AAT included no entry for Internet Art or net art—the medium of much of the art in Rhizome's ArtBase. So Rhizome, along with a few institutional collaborators, set about developing a compendium of new terms; by agreement with the Getty, these terms would eventually feed back into and extend the AAT. Rhizome gathered groups of experts to develop and vet these terms, but they innovated in that they also invited artists and the public to help. Anyone submitting a new media artwork to Rhizome's ArtBase could also contribute terms for describing these works. The community emerged organically, as anyone could elect to join, and the most commonly used terms rose to the top in a bottom-up community consensus.* This compendium of

* Jon: Technically, Rhizome's staff weeds out some quirky or spamlike terms that rise to the top, such as the names of particular artists who get a bit tag-happy. I don't see this as compromising the bottom-up process, but as adjusting it to account for its users' behavior—much as Google tweaked its PageRank algorithm to prevent Googlebombing, the practice of artificially directing certain searches toward less relevant results.

popular terms (folksonomy) was then combined with the set of terms developed by professionals (taxonomy). Folksonomies have been used by such online services as Flickr and are often criticized by cultural heritage professionals as being incoherent because of their lack of standardization. But Rhizome's hybrid solution may offer the best of both worlds in that the multiplicity of popular terms are mapped, via their application to individual artworks, to more standardized taxonomic terms.

Every metadata standard, at its core, expresses a point of view and frames the object of its description according to that view. It opts to include and recognize some elements of information while omitting others.[6] When the object of description is a work of art, for instance, metadata can become hotly contested territory. Nonetheless, the benefits of using standards are worth the effort. The benefits include platform independence, portability, accessibility, extensibility, and longevity. Let me run through these benefits in a bit more detail. If your digital content is in a neutral, standardized format that is not controlled by any one piece of software (and its related software company), then your data is protected from the whims or misfortunes of that company and can be ported to another software platform. In other words, it is platform-independent. If your digital content is platform-independent, then it is also portable; you can share it with colleagues no matter what computer or software they use. If it's portable, then it is also accessible. The web, for instance, is accessible to so many people only because it is built using a set of technical standards that many computers can recognize (meanwhile, the reason the web is also so difficult to use is that there are virtually no shared semantic standards). If your digital content is formatted in an open, documented standard, then it is also extensible; it's possible for others to extend your efforts and build new services using your content. Lastly, if your content is standardized, it lives in a format that may not last forever, but it will certainly last longer than the proprietary formats controlled by computer companies who respond to market forces by updating (read: obsolescing) their software every eighteen months. The benefit of longevity for preservation is obvious, though one should not necessarily conflate the two. The longevity offered by standards helps preservation; it does not, by itself, ensure it. As mentioned earlier, metadata standards are useful mainly in that they frame an appropriate viewpoint and facilitate helpful actions and practices.

Considering the benefits of metadata standards, some might conclude that all new media artists should be required, or at least encouraged, to adopt them. Surely this would greatly help our effort to preserve these

artworks for the long term. However, this is similar to asking painters and sculptors to use only archival materials in producing their art, and the tradeoffs make that an unwise solution. In order to retain the full spectrum of expressive and critical forms, artists from Leonardo da Vinci to Eva Hesse often need to use experimental, unstable, or proprietary media. In conversation with me, artist Kevin McCoy related that although he was concerned about the preservation of his works as they enter museum collections, he didn't want the ghost of preservation to haunt his every creative choice.[7] It falls to those who collect and preserve such works to take the responsibility for deploying relevant standards whenever possible.

The Historical Record

In order to understand how metadata and metadata standards apply to the arts, culture, and preservation, we must now explore what the historical record comprises and specifically what the historical record in the digital age comprises. The historical record is made up of varying degrees of evidence, varying by how close they are to the source of the object of study. A common way of describing this in museums is that there are two main levels of evidence.[8] The original artifact (artwork, fossil, manuscript) is the "primary evidence." The ultimate source of knowledge about an artifact is the artifact itself; no research can beat donning the lab gloves and spending an afternoon in the vault poring over an artwork. Everything said about that artifact is considered "secondary evidence"—books about it, quotes about it, photographs of it, etc. Sometimes an optional third level is brought in. "Tertiary evidence" (you see this could go on forever) is information that is garnered from secondary evidence exclusively. For instance, when an art historian visits a museum for an extended study of an artifact upon which they write a book, they have created secondary evidence. However, when a high school student writes a paper on that same artifact, but does not visit the artifact and instead bases the paper on the art historian's book, he has created tertiary evidence. The chain of evidence is important because it shows how authority (the "aura" of scholarship) is invested and conveyed by proximity and access to the original artifact in addition to other factors such as the reputation of the scholar in question, etc. "Evidence" is a bit of a moving target. For instance, if the object of study is an artwork, then that work is generally the best source of information. If, however, the object of study is a historical set of ideas such as the art movement fauvism, then the artwork and contemporary

writings could be equally primary sources. New media artworks are often intangible, complicating their function as primary evidence. When you find a clay pot in an archaeological dig or a painting in an attic, even without any contextual metadata you know that you have an object in hand that needs explanation. Its physical presence draws attention to its existence first and offers clues as to its nature second. Digital artifacts, however, even those that constitute primary evidence, are born and live their entire existence in an invisible medium, and their existence as intangible 1s and 0s multiplies their chances of being quietly lost.[9]

Together, primary and secondary (etc.) evidence are the information-bearing entities that compose the historical record, and here is where metadata comes in. Students use library catalogs (metadata) to find books (secondary evidence); scholars use museum websites (metadata) to locate paintings (primary evidence) they want to study; and conservationists use museum collection databases (metadata) to determine which objects (primary evidence) require conservation treatment. The American Library Association described metadata as "structured, encoded data that describe characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities."[10] When taken in the context of the historical record, those are some pretty important functions; metadata facilitates (or inhibits) the identification, discovery, assessment, and management of the evidence of history.

Works of art for which there is incomplete, inappropriate, or inaccessible metadata—as is often the case with nontraditional art forms such as performance, installation, conceptual, and new media art—are off the radar of scholars and teachers. These works may exist in a collection somewhere, but if they are not locatable and identifiable, they are simply left out of literature and teaching; they do not get to function as primary evidence nor generate secondary evidence. They form what Jeanette Ingberman, director of Exit Art, has called "the unwritten history of American art."[11]

Preserving New Media Art with Metadata and Musical Scores

How are we to apply all this thinking around metadata to preserving new media art? How will we write the small piece of unwritten history that is media art? Our metadata standards determine what we include and what we leave out of our records and descriptions—what we choose to remember and what we choose to forget. How can we make sure to remember what is necessary to preserve new media art? In chapter 4, I proposed that new

media art is performative and variable like the performing arts. If you follow this line of thinking, it is appropriate to think about how the performing arts such as music are preserved and to consider whether we might adapt mechanisms from those disciplines, like the musical score, for preserving media artworks. What would a score for new media art look like? What metadata standard would we use to write it? How would it work?

A notation system for new media art would have numerous practical applications. It could be used, of course, to aid in preservation of artworks. It could also be used to provide access to and present works in the future; as a documentation format; as an architecture for databases to manage collections of works; as a framework for online public access catalogs; for educational and community forums dedicated to media art; or to provide structure for collaborative artist networks used to create new art, such as The Pool at the University of Maine.[12]

A score for media art and musical scores might be analogous, but they are not identical. Musical scores embody admittedly complex relationships to the works they describe (or transcribe), and they are often open to a wide range of interpretation. Yet musical scores provide a useful model for the preservation of new media art, because they provide a well-known example of *a standardized way of describing highly variable works of art that aids in the reperformance or re-creation of those works*. Though there are many ways to document works of art, there are few types of documentation whose specific function is to act as a recipe and aid in the re-creation of those works. In the visual arts, we are much more familiar with documentation after the fact in the form of a photograph of a painting, video of a performance, or review of an exhibition. These kinds of documentation are akin to recordings rather than scores. They are useful for showing us snapshots of how the work appeared at a fixed moment in history, but they are less useful for providing specific instructions on how to preserve that work for the future.

Musical scores also demonstrate a time-tested working model for how to navigate the border between prescription (maintaining the integrity of the work) and the variability that is inherent in both musical and media arts. Formal notation systems, such as musical notation used in scores, necessarily embody tradeoffs between prescription and abstraction. If a system of notation is too abstract, it describes the work in such a way that it can be confused with other works; it lacks integrity. However, if a system of notation is too prescriptive in describing incidental minutiae as required (fixed) entities, then it disallows any of the variables that occur in the real world and makes it impossible to realize the work.

Requirements for a Formal Notation System for New Media Art

The first requirement of a system of formal notation for scoring works of new media art is that it be appropriate to the content and purposes it is intended to serve. The standard metadata or "tombstone data" that makes up the descriptive metadata in most traditional art contexts may not provide the most useful description of new media artworks. For instance, complex multicomponent works, highly collaborative works with numerous authors over time, works that reconfigure over time, or works with complex technical descriptions are not well accommodated in traditional art description systems. Gallery wall labels (and related metadata in the collection management system) tend to prefer pithy accounts of one or two artists, one year, and one fixed version of the work.[13] Our score must be able to describe the artwork not just as an object or collection of objects but also as an event or activity (or any combination of these). It must account for not only the origin and location of files and objects but also the explicit declaration of behaviors, variables, and contingencies. This formal notation system need not describe the artistic process per se, but it should be able to describe the work as a set of parameters manifested as a product or occurrence.

Our system of notation for new media art should describe levels of agency and choice within the work, allowing for a continuum of assignable human or automated roles from creator to user and all levels of participation in between. Many metadata standards for modeling media artifacts come from the entertainment industry. These standards assume there is an invisible barrier separating creator from user that structurally limits users to trivial navigation or selection actions while authors, creators, and programmers get to make the "real choices." This model splits the people interacting with media objects into binary camps of those who make and those who use. It fails to recognize the more complex social situation that often surrounds media artifacts, projects, or systems—from open-ended digital art to social networking sites to open-source software communities. Instead of mere "interactivity," our ideal formal notation system should describe decision points related to an artwork without limiting who or what makes those choices. It should not structurally differentiate the choices made by creators from those made by presenters or audiences. This allows agency to assume the form of a smooth continuum that stretches between creator and user and suits the description of highly interactive works, distributed authorship, and even open-ended collaborative projects and systems.

A notation system should be practical, cost-effective, scalable, and tractable. It should allow varying levels of implementation, from minimal records created by a small gallery with a staff of three to complex scores that are expanded upon at various points in the life cycle of the work. Addressing these concerns positions new media artworks not as abstract and isolated entities but rather as entities in the complicated context of the real world.

A notation system should provide broad interoperability with the metadata standards of the communities that new media artworks encounter, including cultural informatics, library and museum standards, and technology and media industry standards. There are many standards being tested in the museum and library communities for managing and providing online access to cultural materials such as books and images of artworks. A notation system for media art is distinct from these in that it needs to include the level of detail necessary not just to describe the works but also to recreate them. However, interoperability with these other standards is needed so that documentation for media artworks does not remain marginalized in specialized databases or rarefied websites but instead can easily coexist alongside traditional art documentation. Using metadata standards, as mentioned earlier, enables these metadata scores for media artworks to be portable, accessible, and easily shared, and that benefits everyone, from the public to the artist to the museum or collector trying to preserve the works.

Promising Beginnings

The arts and broader cultural heritage communities have initiated several promising projects that could inform a notation system for new media art. Matters in Media Art is a project of the Tate, San Francisco Museum of Modern Art, New York's Museum of Modern Art, and the New Art Trust, founded by media art collectors Richard and Pam Kramlich.[14] Dedicated less to long-term preservation per se, and more to the logistics of acquiring and loaning media artworks, Matters in Media Art provides collectors and museums with useful guidelines and sample questionnaires that have obvious implications for how to address media artworks in the short and long term. Jane Hunter and Sharmin Choudhury of the Distributed Systems Technology Centre in Australia have developed the Preservation webservices Architecture for Newmedia, Interactive Collections, and Scientific Data (PANIC) project. This aptly named project arose from the information and computer science communities, but it frequently used

digital artworks as case studies and focused on developing archival software systems that would alert archivists when an object under their care was reaching technical obsolescence—the intelligent agent as canary in the coal mine. On Dr. Hunter's website, PANIC is listed as a "past project."[15] While it's clear that Dr. Hunter's ongoing work is important to media preservation, it's worth noting that some preservation projects, being necessarily experimental, don't live as long as the works they are intended to preserve.* This suggests we not put all our eggs in one basket, but consider distributed and multivalent preservation strategies as outlined in later sections of this book.

* Jon: Like the 1980s Domesday Book on analog laser disc!

A related project that worked more directly on metadata strategies was the Capturing Unstable Media Conceptual Model (CMCM) that came out of V2_, the interdisciplinary center for art and media technology in the Netherlands.[16] CMCM developed an intensely complex model of the interrelations of the various aspects of media and performative art projects, along with exhaustive taxonomies for types of behaviors, types of collaborators, and their respective roles. Though CMCM recognized the importance of collaboration and distributed authorship in media art as well as the compound nature of the works, its complex and prescriptive conceptual model may prove difficult to apply in real situations. The Digital Music Library Data Model Specification from Indiana University is of interest in that it provides a metadata model for documenting musical works and would seem to offer insights that media art could borrow.[17] This model describes a score as a component of a musical work, but the model itself does not function as a score for recreating the work. Thus, this metadata model holds a slightly different position in relation to the work itself than is desired for a new media art score.

The Variable Media Questionnaire (VMQ) was begun at the Guggenheim Museum and is now maintained at the University of Maine's Still Water lab.[18] The VMQ is a set of questions aimed at capturing the instructions and parameters necessary for recreating a work of art. It was developed for the nontraditional art forms that this book focuses on—digital art, performance, conceptual, and installation art—but it applies as well to traditional art forms like painting, photography, and sculpture. The Media Art Notation System (MANS) is an attempt to express the conceptual model that is implicit in the VMQ as explicit standardized metadata. In short, MANS proposes a formal notation language with which to write scores for media artworks that aids in their preservation and re-creation regardless of what

software tools you choose to use. The technical workings of MANS are detailed in articles online and in the April 2007 issue of *Leonardo: Journal of Art, Science and Technology*.[19] What follows here is a nontechnical discussion of MANS with examples to help illustrate what a score might look like for media art.

Media Art Notation System v.1.0

The following example presents an outline structure of MANS and includes its core concepts. These concepts form a "broad-strokes" description and provide structure for describing the work of art. This broad description could be formed by the artist at the time the work is created or by a museum at the time the work is collected. Further details, alternative accounts, and audience annotations could be filled in later in the life of the work. Think of this as an outline for a score of a work of art.

Score: Metadata about document itself
Who created the score document, on what date, who maintains it, etc.
<DIDL>
Work: Media artwork or project
Title, artist, collaborators, description of the work.
<CONTAINER>
Version: An occurrence/state/account of work
If the work has been shown and reinstalled several times, which specific version does this element describe?
<ITEM>
Part (optional): Logical subcomponent
If the work has multiple components, video, computer program to run, hardware, visible structures, etc., then list them here.
<ITEM>
Choice (optional): Variables affecting configuration
For each part listed above, also list how that part should be recreated in the future. Should the video always be shown at the same size, on the same type of monitor? etc.
<CHOICE>
Resource: Physical or digital components
Describe, include, or add a link in the score itself specific "tangible" resources used to manifest each part above in this version of the work, such as MPEG video files, plywood base, make and model of computer, etc.
<RESOURCE>

The elements above can be used in a repeating or recursive manner. For instance, one score could describe one work that has multiple

versions, each version being made up of multiple parts, and so on. The "Resources" at the bottom of the above description would be the work's variables and would most likely change from version to version. See below for an incomplete but illustrative example of how MANS might look when applied to a real-world work of art. The sample segment below identifies the work, while further (omitted) sections would outline how to reconvene the work.

<!–This element represents the logical work or project as a whole. Note that descriptive metadata elements are repeatable, as there may be several creators, versions, subjects, applicable types, etc. –>

```
<DESCRIPTOR>
    <STATEMENT TYPE="rn:mpeg:mpeg21:did/statement-types/text/xml">
        <dc:title>Ouija 2000</dc:title>
        <dc:date>2000</dc:date>
        <dc:creator>Ken Goldberg</dc:creator>
        <dc:contributor>Billy Chen</dc:contributor>
        <dc:contributor>Rory Solomon</dc:contributor>
        <dc:contributor>Jacob Heitler </dc:contributor>
        <dc:contributor>Steve Bui </dc:contributor>
        <dc:contributor>Bob Farzin </dc:contributor>
        <dc:contributor>Derek Poon </dc:contributor>
        <dc:contributor>Gil Gershoni </dc:contributor>
        <dc:contributor>David Garvey </dc:contributor>
        <dc:contributor>Paulina Wallenberg Olsson </dc:contributor>
        <dc:contributor>Barney Bailey </dc:contributor>
        <dc:subject>Millennium</dc:subject>
        <dc:type>Installed</dc:type>
        <dc:type>Encoded</dc:type>
        <dc:type>Performed</dc:type>
        <dc:type>Networked</dc:type>
        <dc:format.extent>8 by 8 by 8 feet, largest component</dc:format.
        extent>
        <dc:publisher>The artists</dc:publisher>
        <dc:language>English</dc:language>
        <dc:identification.location>Berkeley Art Museum
        </dc:identification.location>
        <dc:relation.version>2000, Berkeley</dc:relation.version>
        <dc:relation.version>2000, New York</dc:relation.version>
        <dc:rights>All rights the artists</dc:rights>
    </STATEMENT>
</DESCRIPTOR>
```

```
<ITEM>
    <DESCRIPTOR>
    <!–This section includes a picture and caption that represent the work. –>
        <COMPONENT>
            <RESOURCE
            REF=http://bampfa.berkeley.edu/images/art/matrix/186/matrix_186.
            jpg TYPE=”mage/jpeg”/>
            <DESCRIPTOR>
            Installed Berkeley Art Museum, 2000; Screen Shot
            </DESCRIPTOR>
        </COMPONENT>
    </DESCRIPTOR>
```

It doesn't look like much, certainly not as visually stimulating as a musical score, but it provides the same basic functionality—a recipe for remanifesting, reperforming, or recreating the work in the future. MANS, like the VMQ it is based on, presumes that some works may be strictly manifested in a limited number of ways, but does not assume that all works of media art are equally restrictive in this way. Of course, as with most metadata, a

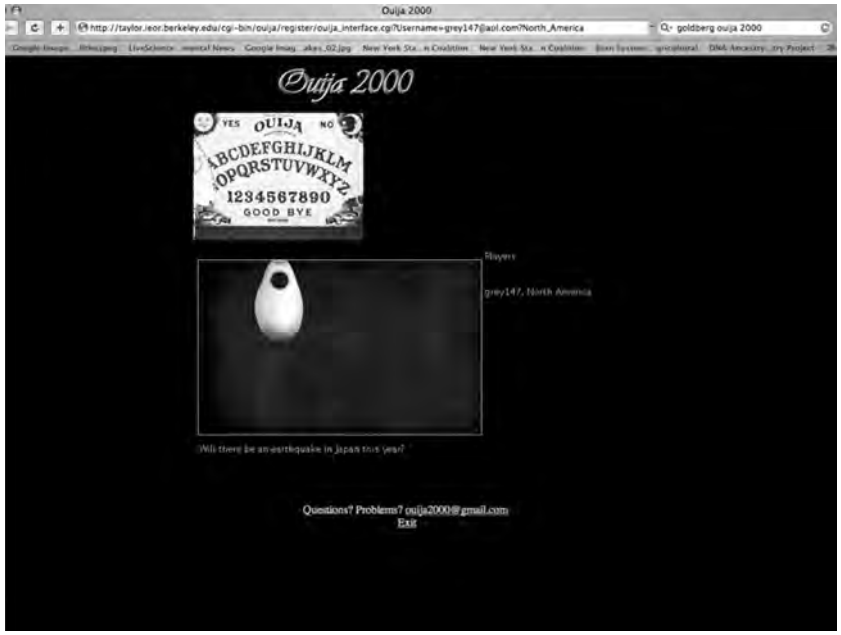


Figure 5.1
Kenneth Goldberg, *Ouija 2000*, 2000.

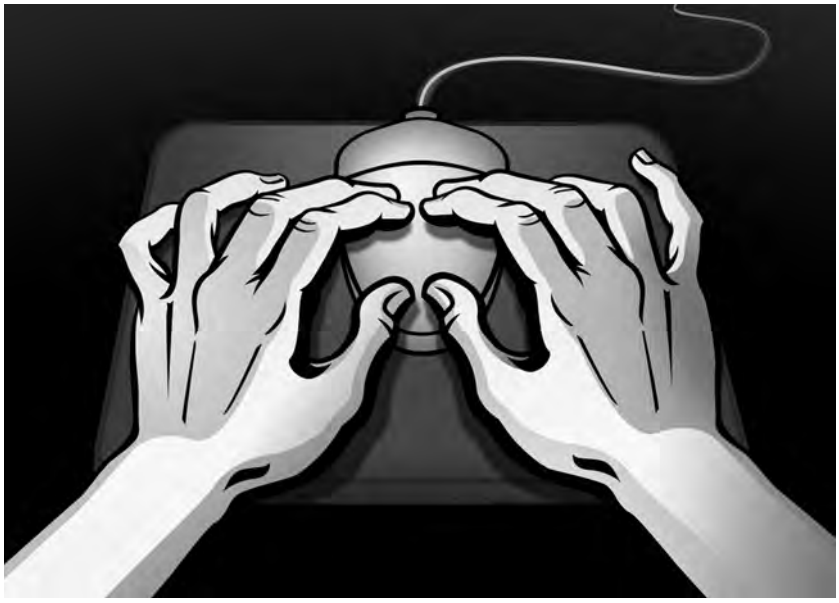


Figure 5.2
Kenneth Goldberg, *Ouija 2000* splash page, 2000.

person would never need to see the score as it is above, in its "raw" form. Rather, they would use software tools with pretty interfaces to create and manage the score, tools such as those developed in the collaborative project Forging the Future.[20] MANS scores for new media art could be used either to deliver records about art works or to deliver all the components of an artwork along with instructions on how to reassemble it. The former is the basis for most cultural heritage projects to date, while the latter offers possibilities as yet unexplored.

MANS is but one of a handful of proposed models that could be used to describe, use, recreate, and preserve media art. A younger generation of scholars, including Megan Winget, of the University of Texas School of Information, and Ben Fino-Radin, who has been working on Rhizome's online art database and more recently at MoMA, is broadening our thinking about how metadata can help save new media art.[21] And MANS should not be adopted as is; it's an open-ended proposed standard intended to inform the development of software tools and alternate implementations. For instance, Stephen Gray at the University of Bristol has adapted MANS to describe performance art for the archive.[22] The primary purpose of MANS

is to demonstrate the type of metadata we need in order to preserve new media art. It proposes one way of making the parameters of a variable artwork explicit and thus creating a recipe with which to recreate the work while maintaining its integrity, authority, and artistic impact.

Technology and memory are not neutral with regard to each other; meaning is always in play between them, and we've seen that metadata can hide or reveal the evidence of history and shape the historical record. It remains for artists, museums, collectors, and others who make up the cultural informatics community to critique, refine, integrate, and test conceptual models and metadata standards on actual artworks in real-world environments. It is already clear that in these efforts there is no one "silver-bullet" solution. Metadata may be the focus of this chapter, but of course metadata is no solution by itself; it is merely a piece of the preservation puzzle. There are also institutional, cultural, legal, and community practices that need to come into play, as outlined in the rest of this book. Reflecting the fragmentary, dynamic, and often social nature of new media artworks themselves, preservation solutions will come in the form of interpenetrating clouds of conceptual models, multilayered implementations, argument, and collaboration.

III Institutions

6 Death by Institution

Jon Ippolito

Who's Minding the Store?

In a Sherlock Holmes novel, solving a crime is a matter of Holmes's gathering enough clues to finger the villain, usually an outsider, with the help of his friends in high places.[1] Solving the disappearance of twentieth-century culture, however, may be more like an episode of the TV series *Scooby Doo*, where the villain turns out to be the establishment figure who should be watching the store. An institution, according to one of the less uncharitable definitions, is an organization resistant to change. Even when that institution's mission is to preserve culture, its adherence to time-honored policies can doom the works in its care as surely as printing them on nonarchival paper or leaving them out in the rain.

As intimated in previous chapters, a historical focus on storage to the neglect of other strategies has limited the ability of museums, archives, and libraries to cope with rapidly mutating media technologies. The defects of storage as a preservation strategy—which afflict far more than just new media culture—can include an undue focus on a work's original material and equipment, no matter how ephemeral, as well as a disregard for the work's original context, whether it is the placement of a Renaissance predella or links to related webpages. As the preferred preservation method of institutions, storage has the unfortunate side effect of creating collections of discrete, isolated objects that, when cut off from their generative context—or "diffusivity"[2]—become passive, silent, and dead.

The novel preservation strategies introduced in chapter 1, including migration, emulation, and reinterpretation, can certainly help institutions move beyond storage and its limitations. Yet institutions may find that considering alternatives to conventional storage is less a panacea

than a Pandora's box, opening up a reconsideration of the entire apparatus of social memory. For example, the fact that most museums habitually collect rare, unique physical objects and tie these works' value to their rarity makes museums less likely to take advantage of redundant and distributed data storage, an essential technique for guarding against accidental loss, even for duplicable artifacts. Furthermore, the very process by which new media works are registered in institutions—categorized by, for example, the single creator, date, and other metadata that appear in a typical wall label—can limit the potential variability of those works, and thus their ability to outlast the present moment.[3] Even worthwhile efforts by museums to create metadata standards and projects too often fail due to their overly centralized and top-down approach.[4]

Rick will flesh out these problems in the following chapters; in the meantime, let's just survey some of the damage.

First, though, a confession. Several of the following anecdotes of institutional failures draw on my experience as a museum curator and hence an institutional insider. This personal disclosure is not designed to malign past employers or co-workers or their noble vocation; most museum and library staff show incredible dedication with very little reward. And while I may be playing Deep Throat in this chapter, I've been guilty of aiding and abetting institutional misbehavior myself. Sure, my job seemed to demand it at the time, but this familiar refrain from the mouths of wrongdoers is a signal that institutional expectations can actually hamper their employees from carrying out the institution's mission. Rather than serve only to point fingers, I believe this disclosure is necessary because institutions of all kinds tend to shield their inner workings from outsiders, and yet it is their most unremarkable of habits, often executed with the best intentions, that are the most at odds with cultural preservation.* Museums, archives, and libraries should be allies, not enemies, in the war to preserve culture; this chapter is intended to enlist them.

* Rick: This kind of back story is necessary. We'll never solve deeply rooted problems, such as preserving digital culture, if we rely exclusively on the discourse that happens at the surface of the implicated parties as happens through public programs, PR, and even professional conferences in the cultural heritage world. For instance, we could use a professional conference on failure, so we can stop congratulating ourselves and learn from our mistakes.

Case Studies

If You Can't Find It, It's Not Preserved: The Granite Mountain Records Vault

Stone is one of the most enduring substances, and also one of the most enduring metaphors of stolid fixity in the face of nature's changeable character.[5] Surely one of the grandest investments in this metaphor is the Granite Mountain Records Vault, a climate-controlled repository near Salt Lake City built by the Church of Jesus Christ of Latter-Day Saints, commonly known as the Mormons. To ensure optimum environmental conditions for the vault, few visitors are allowed inside, but Stewart Brand and Alexander Rose of the Long Now Foundation were granted a visit of the facility as part of their research into very long-term storage systems.[6]

Famous for their obsession with genealogy—and perhaps not coincidentally, with the long-term view—the Mormons built this vault to house several million rolls of microfilm tracing the family trees of over a billion people. Its tunnels snake 700 feet into the Wasatch mountain range, and its granite walls are said to be capable of surviving a nuclear war. Suitably impressed by their tour, Brand and Rose asked how family records were filed, and were told new records are simply added at the end of the currently empty shelves—a protocol that computer scientists call Last In, First Out, or LIFO.

LIFO is not the ideal system for discovery; imagine if you had to find books in a library based on when the books were acquired.[7] So, naturally, the Mormons have a database that associates family names and other metadata with the shelf. To Brand's and Rose's astonishment, however, they were told that this database is located on a computer running an Oracle database, a proprietary (and therefore vulnerable) platform, in a room *outside* the vault's bank-style doors.[8] This is like burying the Library of Congress in a steel box in the Gobi desert, only to write down the latitude and longitude on a Post-it note on someone's refrigerator.

This overreliance on storage at the expense of access is perpetrated by warehouses of all scales, whether they are embedded in solid granite or in a SoHo sidewalk. While researching a story for the *New York Times* on early attempts by museums to collect digital art, critic Matthew Mirapaul contacted a staff member at the New Museum of Contemporary Art to inquire about a recently accessioned suite of contemporary art, including some digital works.[9] Mirapaul pressed his contact to describe exactly what the museum had acquired: CDs? Hard drives? Certificates of authenticity?

Flustered, the registrar replied after some hesitation: "I'm not exactly sure what we have, but I am sure that we have it."[10]

You Can't Get There from Here: Data Silos

Perhaps the Mormons' access problems will soon be solved, as in 2002 the church began an ambitious plan to scan and post online all the records in the Granite Mountain Vault, with volunteers creating indices to the records. But I'm not so sure.

For their part, artists were early adopters of the Internet as a distribution platform, and art historians eventually followed in their footsteps. As of this writing, scholars have created several excellent resources for finding information on artists, artworks, and art movements. These online databases include the archives of the Langlois Foundation for Art, Technology, and Science, coordinated by Alain Depocas; Media Art Net (MedienKunstNet), coordinated by Dieter Daniels and Rudolf Frieling with the ZKM/Center for Art and Media Karlsruhe; and the Database of Virtual Art (since renamed the Archive of Digital Art), coordinated by Oliver Grau and the Danube University Krems.[11]

Sadly, avant-garde archives can be as endangered as the media they steward: recent decades of economic turmoil have seen the demise or endangerment of well-established archives including New Langton Arts, ABC No Rio, the Langlois Foundation's physical archive, and the Netherlands Media Art Institute (NMIk). Fortunately, in rare but happy cases, these databases occasionally outlive the institutions that birthed them.[12] Once a collection is online, the costs of maintaining a domain name and web host are a fraction of the costs of renting and maintaining a physical space. This is good news for historians, because the Langlois archive, Media Art Net, and Database of Virtual Art are well researched, multilingual, relational databases packed with texts, images, and sometimes video documenting the fast-paced evolution of art and technology over the past fifty years. The accumulated knowledge accessible via their innovative interfaces represents thousands of hours of research by archivists, interns, and software designers.

And yet a researcher who wants to learn more about, say, Shigeko Kubota, has to consult each of these important resources separately; there is currently no technical means to search all three at the same time. Search engines like Google are good at spidering pages that contain explicit links to each other but are currently unable to dig up any webpages accessed by a form, such as by typing "Shigeko Kubota" into a search field.

The technical challenge is formidable, which is one reason a solution has so far evaded the designers of online archives, not to mention Google's

* Rick: To be fair, the common solution to this is to create giant, centralized, "union" databases. And there are library network standards like Z39.50 or OAI harvesting for searching across databases. But these have a high set of entry requirements that limit participation and thus data. I cover our more streamlined, inclusive "interarchive" idea in the next chapter.

engineers.* Yet there is another reason that speaks more to the ingrained habits of institutions than the structure of PHP or MySQL: today's collecting institutions, no matter how digitized, remain hamstrung by their own history as centralized repositories.

Why do hundreds of thousands of visitors flock to the Guggenheim every year?[13] Many to see Frank Lloyd Wright's masterful spiral; some to see particular artworks, such as Mondrian's *Composition 1*; others to learn more about art from the definitive wall texts. But when museums extrapolate this exclusivity-based business model, consciously or unconsciously, to the web, they miss out on the fundamental purpose of Internet technologies, which is not to hoard information but to share it. And so museum lawyers and web designers don't brainstorm about the best way to disperse information on their collections across the web, but instead about the best way to draw visitors to their site and make them stick.[14]

But that's not how other Internet enterprises succeed. Very few links found on Google actually link to Google itself; that is in fact why we use it. Facebook, Digg, and just about every other social network offers free widgets to incorporate into third-party webpages. Twitter boasts the most banal collection conceivable—billions of 140-character news bursts about the weather or what the sender just ate—yet the unimpeded circulation of its fleet messages have become popular enough to cause outages among its Internet service providers (and to merit collection en masse by the Library of Congress).

Museums of the nineteenth and twentieth centuries may have prospered by reinforcing boundaries in support of rare experiences discovered by instruction. But museums of the twenty-first century will prosper the same way that successful Internet enterprises have: by piercing boundaries in search of ubiquitous experiences discovered by extraction.

Too Much Authenticity Can Be Inauthentic: Robert Morris, *Labyrinth*

As suggested in chapter 3, new media of the 2000s share with process art of the 1960s the ability to *execute*—to perform a set of instructions or

code—rather than the ability to *represent*—to portray a theme or subject.[15] For both genres, what the work does can be more important than how it looks—or at least, the two may be inextricably related. Artist Robert Morris was an early innovator in process art, as might be guessed from the titles of works such as *Box with the Sound of Its Own Making* and *Combinations* (a modular sculpture meant to be rearranged every time it is exhibited).

Although Morris is often classed as a minimalist, his process-oriented aesthetic wasn't shared by all his minimalist colleagues. Donald Judd, for example, chose immaculate copper or Plexiglas for his boxlike constructions, and thereby burdened conservators with difficult choices of how to remediate scratches or oxidation on his finicky surfaces. By contrast, Morris actively opposed such fetishism of the artist's material. Not only did he recommend that his own minimalist sculptures be broken down and rebuilt as necessary for different exhibitions, but he mandated that they be built out of ordinary plywood, at no higher quality than the standards of run-of-the-mill carpentry. Morris even asked that the refabricators of his minimalist slabs, plinths, and other geometric shapes paint them a gray of their own choosing.[16] Deferring such choices to museum staff was a means for Morris to distance the work from his own taste—perhaps an homage to the indeterminacy advocated by American composer John Cage, and perhaps also a means to avoid pinning the work down like an immobilized butterfly.[17] So you would think Morris's practice, like LeWitt's, would automatically lend itself to new modes of preservation.

Unfortunately, Morris underestimated the capacity of museums to pin down butterflies, at least to judge from my own experience. Sometime around 1998 I was working as a curator at the Guggenheim when I overheard someone in a nearby cubicle discussing the re-creation of Morris's work *Labyrinth*, a cylindrical maze large enough for visitors to walk through, for an upcoming collection show. My ears pricked up when I heard my colleague reading over the phone the identification number of the Pantone color chip he had found in the *Labyrinth* object file, explaining how important it was to paint the sculpture that specific gray.

As the saying goes, I was shocked, but not altogether surprised. Having a few years earlier coordinated a tour of the Morris retrospective curated by Rosalind Krauss and Nancy Spector at the Guggenheim in 1994, I was familiar with Morris's process-oriented aesthetic, but it is a real departure from the well-worn grooves whereby museums are accustomed to doing business. Whether or not they understood the inherent variability of the

Figure 6.1
Robert Morris, *Untitled (Labyrinth)*, 1974. Painted plywood and Masonite, 96 inches (243.8 cm) high, 360 inches (914.4 cm) in diameter. Solomon R. Guggenheim Museum, New York. Panza Collection, 1991. 91.3814. Photograph by Erika Barahona Ede©SRGF.

piece, the preparators who had built the *Labyrinth* for the previous retrospective threw the paint chip into the file for future reference, and my curatorial colleague naturally assumed this exact color was required to recreate the piece. A phone call to the artist cleared up the issue, but without any additional guidelines to encourage variability, collecting institutions default to fidelity to material rather than fidelity to artistic process or intent.

Left Behind in the Paper Chase: Fluxus Archives

New media works are often performative, which can be double trouble because performance is one of the few art forms as endangered by cultural amnesia as new media. A discarded concert program can be the Holy Grail for historians of performance, for in their field the "ephemera" meant to advertise an event typically last far longer than the event itself. Art

historian Owen F. Smith found one such paper trail in 1987 in the private Sohm Archive in Stuttgart, where he spent a year rummaging through hundreds of boxes of posters, handwritten letters, and playbills to piece together a chronology of the Fluxus period. What Smith uncovered, however, led to a cautionary tale about overrelying on inert documents at the expense of human memory: "If you prioritize that written material, it's often close, but it's often not what really went on."[18]

Some ephemera contain deliberate inaccuracies, as when Fluxus impresario George Maciunas advertised a 1975 exhibition with the title "Fluxfest presents TWELVE BIG NAMES," together with a list of blue-chip artists including Bruce Nauman, Philip Glass, and Andy Warhol. Disappointed visitors to the exhibition saw only the artists's names projected large on the wall for five minutes apiece—a sendup of the art world's preoccupation with celebrity.

More often, paper inaccuracies just reflect the variable nature of human schedules, as when a performer is delayed, absent, or changes a work at the last minute. In one particularly droll example from Smith's research, a program from the 1962 Copenhagen festival "Fluxus—Music and Anti-Music" incorrectly lists several artists who never had a chance to participate because one performance unexpectedly went on for three hours. In that work, artists Dick Higgins and Emmett Williams presented a score by Eric Andersen that required them to choose an undisclosed trigger to action. Each of the performers independently chose to wait until the other moved first, leading to a stalemate in which they both sat still until everyone in the audience eventually got up and left.

Fortunately, many archives of recent history offer something more than stainless-steel shelves and solander boxes: a human archivist. When Smith ran into documentation conundrums, he could turn to Hanns Sohm, the dentist who had attended many Fluxus events and could reconstruct the context for the ephemera in his eponymous archive. In my research on Fluxus artist and video art "grandfather" Nam June Paik, I've been lucky to work alongside Barbara Moore, who manages the archive of her late husband Peter's invaluable photographs of late-twentieth-century avant-garde performance. Barbara Moore's razor-sharp memory schooled me in the hazards of assuming I had pinned down the historic record simply because I found a program listing performer, date, and venue.

In the years since Smith rifled the Sohm archive, Hanns Sohm has died and his archive has entered the collection of the Staatsgalerie Stuttgart; the renowned Silverman archive managed by Fluxus expert Jon Hendricks has

entered the Museum of Modern Art in New York; and many expect the Peter Moore archive to be acquired by a museum in the future. These museums are adept at preserving newsprint. But who will recount the life stories of the scraps of paper? Who will preserve the memory of the archivists themselves?

Even when human anecdotes are documented, few catalogues indicate which "facts" came from pieces of paper and which from people's lips—or indeed acknowledge that whatever ends up on the former originally came from the latter. The most advanced collection management software of our day, such as The Museum System or Multimimsy, are the product of decades of refinement; yet none of the software I have ever tested includes any systematic fields for documenting the source of particular items of information.[19] There is no patron saint of data entry who whispers the truth into the ears of registrars as they fill out collection records. They work from what they are told by artists, art handlers, and curators, or what these folks have left in object files. Paper trails are nice, but they are emergent—and sometimes misleading or downright incorrect—indicators of the real source of culture. The rich tapestry of cultural heritage is woven from the perspectives and memories of Hanns Sohm, Barbara Moore, and other ordinary and extraordinary human beings.[20]

Captions Courageous: Meg Webster, *Stick Spiral*

If it is, ironically, the conservative impulse of institutions that threatens the conservation of variable media, that impulse is most frequently wielded by the lowliest agents on the institutional totem pole.[21] They police what to print as documentation, how to store works, where visitors can step, and a host of other policies. Visitors may assume there are logical reasons for the appearance of wall labels, the arrangement of crates in a warehouse, and the sharp words spoken to a child who gets too close to a painting—but they are often consequences of policies decided by ad hoc rules rather than professional standards. Anxious not to make any missteps in their climb up the ladder of their institution's organizational chart, the minions of an institution tend to reinforce the most conservative interpretation of their jobs.

Two such minions bumped heads while preparing the program for the 2001 symposium "Preserving the Immaterial" at the Guggenheim. One was me; the other was an assistant editor in the publications department. The cover of the program featured Meg Webster's 1986 *Stick Spiral*, an installation of tree branches and similar foliage laid out in a colossal spiral on the gallery floor. The performative nature of Webster's ephemeral work made

Figure 6.2
Meg Webster, *Stick Spiral*, 1986. Branches, dimensions variable. Solomon R. Guggenheim Museum, New York. Panza Collection, Gift. 92.4083. Installation view from "The Material Imagination," Guggenheim Museum SoHo, November 18, 1995–January 28, 1996. Photo: Ellen Labenski © SRGF.

her an ideal poster child for a conference on variable media. An ecologically minded artist, Webster didn't want people to be cutting down trees to make her art, so she stipulated three rules for the work's creation: the trimmings had to come from local vegetation; they had to be recent enough to retain the fragrance and flora of the original plants; and they had to be cut down for some reason other than the work's exhibition. Clearly this meant that each re-creation of the work would be substantially different in both substance and appearance.

Knowing this, I wrote the caption for *Stick Spiral* to read "dimensions vary with installation," a convention that was beginning to catch on in my curatorial work at the Guggenheim. The brochure's editor returned the edited copy, which now read something like "121.9 × 396.2 × 457.2 cm." The absurdity of this formulation is clear to anyone with

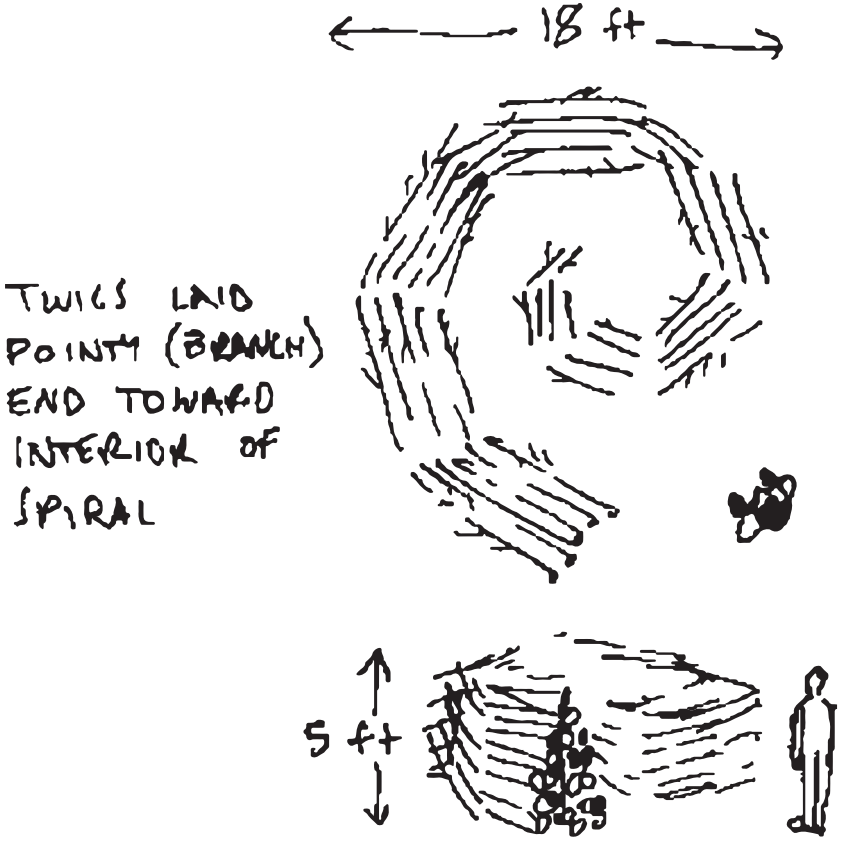


Figure 6.3
Jon Ippolito and Meg Webster, diagram for installing *Stick Spiral*, 1995.

any firsthand knowledge of the work. The measurements were impossibly accurate, the tenth of a centimeter being an artifact of a publications policy that stipulated English inches be converted to metric measurements at a high—and to any scientist, a completely unreasonable—level of accuracy. To make matters worse, anything made of leaves, branches, and flowers piled upon each other is not going to remain at a fixed height over the course of a single day, much less from one installation to another. When I brought this objection to the editor, she replied that the "real" dimensions were from the object file, and that the publications department had a strict policy that all captions must include dimensions in this format—even for the first symposium ever dedicated to variable media.

After much protest I managed to get the head of the publications department to reinstate my original caption,[22] but the experience taught me that an institution's plasticity is measured not by the sweeping innovations promised in its mission statement, but by the habits of its everyday operations staffed by ordinary people.

Storage versus Memory

Two threads run through the cases described above: the vulnerability of storage as the end-all preservation strategy, and the abstraction of institutions from the individual people who generate and ultimately benefit from the culture they are charged to preserve. What connects these two threads is the difference between storage and memory, a distinction echoed independently by theorists Wendy Hui Kyong Chun and Aleida Assmann.[23] Storage by definition attempts to keep an artifact as unchanged as possible, whereas human memory is constantly rewritten, and hence transformative. Chun describes how these conflicting dynamics play out in the quest to build an "artificial memory" using digital media (in, say, a database or emulator). We might go further and identify storage as an archetypically institutional strategy, inasmuch as the mission of an entity resistant to change is indeed to store itself. Memory, by contrast, is a consummately human construct: more volatile than instinct, but also more adaptable.

Artworks, of course, are made by humans rather than institutions. In the long run, art may depend on institutions to survive, but in the short run we too often see the reverse: institutions, usually unwittingly, consuming art to further their own survival.[24] Museums suck in drafts of culture produced by a sea of desultory individual actions, and regurgitate them back to the public, and to themselves, as a frozen set of truths. Each artwork named in a wall label, for example, typically has one artist, one title, one date, one medium, one set of dimensions, and one credit line (collection). This one-to-one construct paints a monolithic picture of artifacts that are in reality constantly multiplying and evolving. The reductivism is hardest on new media, which rely on constant regeneration for survival; the single work *Apartment*, for example, first released by Martin Wattenberg, Marek Walczak, and Jonathan Feinberg in 2002, went through twenty-two variations in less than eighteen months.[25]

Only by devoting more of their energy to nourishing the memories of artists, scholars, and ordinary folks can collecting institutions hope to keep up with a culture in constant change. There are preservation alternatives to storage, but there is no preservation without memory.

Can museums, libraries, and archives find a way to leverage human memory to ensure better "institutional memory"? Absolutely: some have already begun to do so.[26] In the following chapter, Rick will focus on how museums can overcome their particular obstacles to incorporating live memory; in chapter 10, I'll look at institutionless communities as a model for long-term social memory; and in our conclusion, we'll make general recommendations for a broad swath of new media institutions.

7 The Open Museum

Richard Rinehart

The world has increased its rate of change with alarming rapidity. Museums have not followed suit.

Theodore Low, 1942[1]

Cultural heritage institutions like libraries, archives, and museums are critical to the practice of social memory, as Jon detailed in the previous chapter. But how exactly do they practice social memory, and, in the midst of the information revolution, how are they serving that function lately? Do these institutions need to upgrade to remain relevant to a society changed by new media? To explore these questions, we need to understand these institutions a little better. I will not attempt here to recount the entire genesis of modern cultural heritage institutions; that topic has been expertly covered in numerous other sources.[2] Here I will focus on the early development and current character of cultural heritage institutions, spotlighting aspects of their institutional culture relevant to our case study. Additionally, I want to answer the question of whether museums are being forced to choose between preserving their own past way of doing business and preserving their new media collections, and, if so, whether there is a way around that dilemma.

The Formative Years

Museums, libraries, and archives—the institutional tripod that supports the formal or canonical aspect of social memory—each derive from a confluence of numerous social practices and organizations. Ancient *athanaea* inspired libraries and archives, while the *mouseion* (home of the Greek muses) gave museums their name. In the eighth century, the Shosoin in Nara, Japan, was founded and remains the world's oldest extant institution

that we would recognize as a museum.[3] In the sixteenth century, Europeans formed their variously named cabinets of wonder, cabinets of curiosity, *Wunderkammern*, or *Kunstkammern*. European nobility and the newly minted bourgeoisie funded explorers who would return to their benefactors with objects and animals never before seen by Europeans. The *Wunderkammern* were rooms filled with shells, bones, horns, minerals, and cultural artifacts—what we would now call specimens of natural history, archaeology, anthropology, and art—from all corners of the globe. These private collections served as trophy rooms of Europe's "age of exploration" and, through a darker lens, as evidence of Europe's global conquest and colonization. Europeans' fascination with these fantastic alien artifacts was the start of a long tradition of the global "Other," yet the *Wunderkammern* and the objects they contained also served as earnest tools for wondering and material precursors to the "age of enlightenment."[4] These artifacts were often arranged throughout the room by their noblemen-philosopher-astronomer owners not according to any simple linear principle that we might recognize, such as geography and national narratives, phylogenic taxonomies, or historical timelines. To their creator-owners, these arrangements represented the entire sum of knowledge, the world in a bottle, a material cosmology. The fakery for which the *Wunderkammern* were later famous (some presented narwhal tusks as unicorn horns)[5] was the result of more than scientific naiveté. Authenticity was moot because accuracy in modern terms was not the goal. If the skeleton of a Nile crocodile needed antlers in order to better represent a philosophical idea or a position within an evolving cosmological theory, then it was granted antlers (and this original impulse of the *Wunderkammern* is kept lovingly alive in Los Angeles's Museum of Jurassic Technology).[6] The dual nature of the *Wunderkammern*, as a symbol of cultural oppression and a toolkit for inspiration and wonder, remains in today's museums that are seen, alternately, as elitist institutions of social control and as educational playgrounds—as simultaneously closed and open.

Over the centuries, cultural heritage institutions transformed from eccentric collections to public institutions. They were imported to the newly colonized Americas, where they were remade again. Libraries had been born millennia before, but in 1731 Benjamin Franklin founded the first public lending library and saw it, together with the public school, as the bedrock of an informed, vigilant citizenry and a successful democracy.[7] This development and attitude are noteworthy precedents to today's debates about information access as an egalitarian ideal, and suggest that the vaulted institution and open access are not mutually exclusive

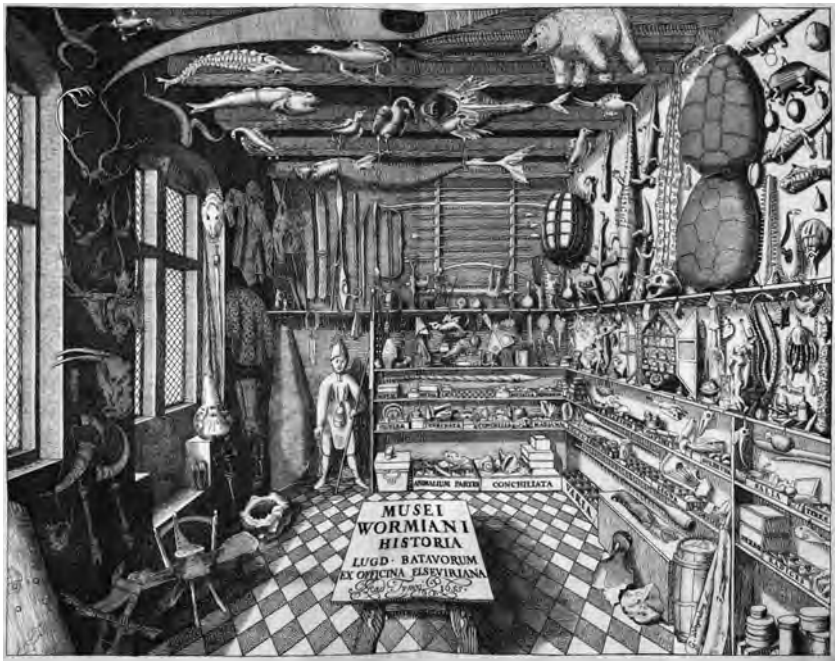


Figure 7.1
Musei Wormiani Historia, 1655, title page (a *Wunderkammer*).

prospects. Today the American Library Association often takes up the cause of open, public access to information, from books to bits. The ALA often finds itself across the table from private corporations that are promoting the latest protectionism, from stricter copyright laws to digital rights management technologies.[8] A century after the first public lending libraries, museums developed another social attitude that is just as persistent and relevant to today's debates around institutions, new media, and information access. In the nineteenth century, museums contributed to a larger social impetus toward public education, "self-betterment," and a general raising up of the masses.[9] Although most museums would not create formal education departments until the twentieth century (museums do move slowly), it was clear from the nineteenth century onward that museums strove toward a goal of public service and attempted to function as temples of spiritual and intellectual self-improvement for the common person. Museums and libraries developed along similar but different paths, and in the United States museums never quite took the center stage in public education that libraries did, either preferring or being relegated to the

peripheral and more individual-oriented roles of leisure-time activity or informal education.

This spirit of self-improvement also served as code for an ideology of capitalistic individualism that stood in opposition to the rising tides of socialism and communism in the late nineteenth and early twentieth centuries.[10] The nineteenth-century push for art education in museums and public schools was sometimes a thinly veiled tactic for training children in the manual dexterity they would need to work in the new industrial factories.[11] And, as every art educator knows, art classes and shop are still where some schools park their "bad kids"—often economically challenged students who are tracked toward the mechanic's garage instead of mechanical engineering colleges. Both the noble spirit of self-improvement and the entrepreneurial orientation remain with museums today and serve to distinguish their institutional culture from libraries in telling ways.

These slight developmental differences are compounded by real operational differences. Museums in the United States receive proportionately less public funding than libraries and rely more on private patronage, ticketed attendance, and commercial services like bookstores and cafés. And museums traditionally earn small but much-needed income from clearing copyrights related to works in their collections. Perhaps because of these differences, museums sometimes find themselves out of alignment with libraries. For instance, they often take a neutral rather than an activist stance in current debates about new media, access, and copyright.[12]

Coming into the contemporary era, cultural heritage institutions have evolved into their latest, but certainly not final, forms. There are now numerous varieties and flavors of such institutions—from centers for science and technology to historical societies—but most of them fall into one of the three primary molds: museums, libraries, or archives. These forms are not only the templates for modern cultural heritage institutions; they are primary to the modern practice of formal social memory in general. Other institutions may survive for centuries—governments, universities, religions—but when they get involved in practicing social memory, they often create subdivisions based on the three templates: Oxford's Ashmolean Museum, the Library of Congress, and the Vatican Archive, respectively. In the last decade, each of these institutions adopted digital media primarily to represent and provide access to their traditional collections, and those collections are themselves increasingly digital. These three primary memory institutions differ with respect to the content of their collections, the access they provide to them, and the ways in which they describe and document them, as outlined below. These differences are important to

remember as we borrow strategies and solutions from each to preserve new media art and culture.

The content of library collections tends to be mass-produced, textual, and published (books and journals), whereas the collections of museums are typically rare or unique physical objects (artworks, fossils). And the collections of archives are also textual, but usually unpublished unique instances (original author manuscripts, corporate records).

The interface that libraries provide between their users and their collections is usually direct and minimal—self-service with little interpretation—and is meant to facilitate identification and retrieval. The result is an online public access catalog (OPAC): a comprehensive inventory with locator features. However, since the Internet has become a de facto global OPAC, libraries have responded by placing less emphasis on "access" and more on interpretation and expert filtering. Museums, on the other hand, have always provided access that is indirect, selective, and mediated in the form of exhibitions. Typically, only ten percent of a museum's collections is on view in the museum at any given time; yet twenty years ago, unlike with libraries, no one expected to find a card catalog in the museum lobby detailing the other ninety percent. Museums have gone the inverse direction of libraries in response to the Internet, from interpretation to access. Now one may often find a comprehensive catalog of a museum's collection online.

The respective professional jargon of the three institutions reflects their respective attitudes about access. Libraries call their customers "users," implying that they actively make use of the library's collections, while museums call their customers "visitors," implying that they are just passing through and it would be inappropriate for them to touch anything. Archives employ a hybrid of the two aforementioned models; they usually provide access to their collections not one by one like libraries, nor presented in thematic groupings like museum exhibitions, but in chunks called, a bit confusingly, "collections." Archival collections are actually subcollections of the overall institutional collection that are grouped according to the history of ownership of the (sub)collection. If Bank of America donated its records to an archive, the archive would present the user with a description of that entire collection in aggregate (a "finding aid") and may then provide mediated physical access where the user may view and touch the collection, often under supervision. Visitors get to wear those snappy little white gloves, but they can't take the collection home.*

* Jon: We'll talk more about what happens when users *can* take works home below and in chapter 10.

Lastly, museums, libraries, and archives differ in their descriptive practices—the kinds of records or documents they produce to describe their collections of cultural materials. For instance, libraries typically employ cataloging standards to describe published books or journals for public access. Since a key public access question would be what the book is about, libraries have become expert at describing subject—what a thing is about. Museums typically describe unique physical objects in order to physically manage them as much as for public access. Museums have thus become expert at describing the *Ding an sich* (thing unto itself) including the properties that define unique objects such as their size, material, purpose, maker, unique marks, etc. Archives collect in aggregate, often a collection of papers produced by a person or organization over a lifetime. So archives have become expert at describing relationships between items as well as the history of their ownership, or provenance.

As we develop strategies for preserving digital culture, we need to keep an eye on these evolving institutions to determine which, if any, is best suited to collecting and preserving different types of digital cultural artifacts, from Internet artworks to online presidential campaigns. Many current projects and professional discussions use the term "digital archiving" to describe the preservation of and access to digital culture.[13] But when these ideas are translated into institutional practice, do they really mean to inherit the practices of archives specifically? Perhaps it's only an expedient term, since archives are the only one of the three types of institutions whose name can also be used as a verb, but we would do well to remember that digital culture and digital collections may present us with the opportunity to mix and match practices from across the three types of institutions. For instance, do we want to describe new media artworks one by one, or in groups either as "collections" or in themed exhibitions? Do we want to provide comprehensive catalogs that facilitate access, or do we instead want to describe these works with interpretive texts that tell a story? And, perhaps most importantly, do we want the public to don figurative white gloves when handling these bits, or do we want them to take them home?

In the larger picture, museums, libraries, and archives are more alike than different in their function as social memory institutions and in their more historically recent values regarding education, access, and public service. We cannot forget these core values and functions when developing institutional solutions for preserving digital culture because collecting and preserving are not ends to themselves but are inextricably coupled with access and public service. The following sections will introduce how con-

temporary digital culture is challenging some of the core historic assumptions of the aforementioned cultural heritage institutions.

Contemporary Challenges

Fixation with Fixity

None of the institutions described above is adept at describing or guiding change. Rather, they are expert at describing fixity. This often results in a protective professional culture that is itself resistant to change. Given the history of museums, that's understandable. The *Wunderkammer*, the model for the modern museum, is the world in a bottle, separated from mundane worldly time, in which philosophical objects hang like stars in suspended eternity. The contemporary "white cube" of the gallery only furthers the idea of the museum as separate from mundane social spaces, a kind of frozen white heterotopia.[14]

The legacy of Martha Maxwell (1831–1881) illustrates how this historic attitude is transformed into institutional practice. Maxwell was singular in the nineteenth century as a woman curator, conservationist, and taxidermist of natural history collections. But she is better remembered for her approach to conservation—"kill it to preserve it." A 2009 exhibition at the National Cowboy and Western Heritage Museum dedicated to Maxwell was titled, "Did She Kill 'Em All?"[15] Maxwell hunted endangered species in the nineteenth-century American West in order to obtain specimens that were then protected for all time against the vicissitudes of change by being stuffed with cotton and formaldehyde. She froze these creatures in active poses and staged them in naturalistic dioramas—an innovative practice that became the standard for natural history museum display for a century (and counting).

But things may be changing. Since 2006, Mary Jane Bradbury, a historical reenactor at the Denver Museum of Nature and Science, has had the job of preserving the legacy of Martha Maxwell. She accomplishes this not through displaying the body of Maxwell (a strategy of fixation that would be ironic in this case, but is not unheard of in general: think of Lenin's glass coffin or various popes entombed in catacombs) but by impersonating Martha for museum visitors. Strangely similarly, in 2005 at the Guggenheim Museum, performance artist Marina Abramović reperformed or recreated several iconic performances originally developed and performed decades earlier by other artists such as Vito Acconci and Bruce Nauman.[16] The Guggenheim has, in the past, presented these historic performance works on videotape as fixed objects frozen in time, but in this case they

Figure 7.2
Ferndale Museum taxidermy display, Ferndale, California. The case was made and donated by Camille Regli and Shirley Hopkins, owner of A Memory Saved Taxidermy, Fortuna, California, in 2011.

opened up the possibility that these signature works might be kept alive in a different manner.

Bradbury's and Abramović's works do not so much undermine authenticity as they point to a different kind of authenticity. What is important to preserve of certain artworks or living beings may go beyond their original materiality—the "original" atoms from the bodies of Maxwell or Acconci or the endangered bison—to, instead, their social, ecological, or artistic function. Bringing artworks or historical personae into the present is another way of bringing the world into the museum, and contemporary museums increasingly embrace the idea of allowing the world—with all its noise and electric glitter—inside their walls. These examples suggest that institutions are sometimes open to change. But museums draw the line at the inner keep of the vault; this novel attitude may apply to public programs but not to collections. Again, on the surface this distinction makes sense. It seems so intuitive as to be obvious that the best way to provide

Figure 7.3
Historical reenactor Mary Jane Bradbury as nineteenth-century naturalist Martha Maxwell, as performed on September 24, 2011.

us with glimpses into other eras is to extract objects from those eras and fix them in invisible time capsules that protect them from the pollution of time—to preserve the original in its one true authentic form forever. But while this may seem practical, even logical, its implications can be deadly in the full consideration of social memory, and it is the opposite of what is needed to best preserve new media art in particular.

Quantization of Memory

Quantization is the computer process of creating a representation of an analog source by taking regular samples from the source and assembling those samples so that the whole resembles the source. In digital imaging, that means representing the continual gradation of an evening sky by taking tiny snapshots of the sky, pixel by pixel, and ordering them so that to the human eye they appear as a continual gradient. This sampling is how digital technologies represent the world outside: sounds, images, weather patterns, etc. In quantization, each sample can have only one homogeneous value (each pixel of the sky is one solid blue), so one must take very small samples—ideally, below the threshold of perception—and then trick the senses into thinking that the rows of increasingly darker blue pixels are the same as the continual gradient of the sky itself. But there is always a tiny bit of gradation lost within each pixel and between pixels. It doesn't matter whether the pixels are an inch apart or a micron apart; something is always lost in the translation from the source to the representation. The Nyquist-Shannon sampling theorem articulates this loss and tells us how to mitigate it, at least in some instances.[17] The Nyquist-Shannon rate tells us that we should sample at roughly twice the rate of our intended output. For instance, if we want to produce audio that sounds "CD-quality" (44 khz or 44,000 sound samples per second), then we need to record and sample at a rate of 88 khz to mitigate the fact that shades of gradation will be lost through the sampling process.

As we apply the tools of digital media and their inherent representational inadequacies beyond visual or physical phenomenon to cultural phenomenon, we may observe a similar kind of inaccurate representation. Narratives are no longer stored in free-form texts and oral histories but in databases where each record compels the same fields, homogeneous samplings, from each source. Museums turn stories into history and history into records. This is a form of quantization or sampling that doesn't represent the continuous whole of the source; it suffers from a kind of sociohistorical "lossy compression." But what is the cultural equivalent of the Nyquist-Shannon sampling theorem that tells us how

to mitigate the effects of such loss? Can we go from stories to records and back again?

The idea of quantization as an artifact of technology that sets limits on the representational capabilities of new media drives us to consider the continuity and scale of social memory (or memories). For instance, this chapter on institutions is focused on the formal, canonical social memory that is practiced by institutions, but in chapters 8 and 10 Jon suggests ways in which institutional memory and folkloric or personal memory may be combined to great effect. The Internet allows a seamless platform for everything from institutional records to personal blog entries; why keep them separate? Allowing the personal into the institutional can be a powerful tool. As an example, the AIDS Memorial Quilt project, begun in 1987, invites individuals whose lives have been touched by the epidemic to contribute a sewn panel about their lost loved one. Sometimes portions of the quilt are exhibited publicly, but it is nearly impossible for any institution to exhibit the entire quilt because of its size (1,293,300 square feet).[18] The quilt channels personal memories and stories into what is essentially a public monument, without abstracting them into a homogeneous chapter of "history." The quilt converts personal stories into the public sphere (the domain of the institution), but by taking on a form too large to exhibit in any one institution, it critiques those institutions for being unwilling and/or unable to represent these personal stories—the issue is simply too big to be contained. The quilt is an analog precursor for how personal and institutional memories could be effectively integrated via new media such as the Internet.

For instance, the Media Art Notation System, detailed in the previous chapter, includes a feature called Accounts whereby one can record multiple parallel memories about the same artwork. This feature is especially useful in cases where the artist is dead or otherwise unavailable. The artist's gallerist may have one memory of how the work was installed and how it should be reconstituted, but the artist's lover may have a different memory, his or her technical collaborator may have another perspective, and historical documentation may provide yet another "account."* As

* Jon: In her record in the Variable Media Questionnaire, Guggenheim conservator Carol Stringari reported a disagreement of this sort between the Eva Hesse Estate and Hesse's longtime friend Sol LeWitt over whether her sculptures could be emulated. What we really need from museums of the twenty-first century is not their expertise in building climate-controlled vaults, but their practice in reconciling multiple interpretations.

long as these different memories are kept discrete and attributed clearly, they provide a value-added asset to documenting the work. History can make its own determinations about which account is more valuable in a given context. If such a feature were further opened up to public commentary (and why not? such a thing is trivial with networked media), one could tap into a broader, folkloric, social memory to develop cultural marginalia around a given work of art. One can imagine a future in which museum X is hosting an exhibition of artworks by the late artist Y, all recreated from the museum's authoritative scores of the works. Meanwhile, across town, funky artist space Z is hosting a parallel exhibition of the same works, recreated from alternative accounts of the work (and *un*authorized biographies are always more fun). Since the scores are online and open to all, both exhibitions become part of the updated score for said artworks, and history is richer for it.

Recording and storing multiple, sometimes redundant, sometimes conflicting memories about a work of art gives the historian much more to triangulate with and protects against the vicissitudes of time. In his article about a government-appointed panel's creation of a message that would last ten thousand years to warn future generations of the toxicity of nuclear waste dumps, Gary Kliewer wrote that the panel "devised an elaborate multitiered recipe for a timeproof warning system that tells the story many different ways, because there is no guarantee that any one message will work."[19] Breaking up continuous reality, be it optical or social, into discrete samples can mean that shades and nuances are lost in the gaps, if not properly addressed or at least mitigated. This is true of museum records as well as image pixels. Gathering multiple stories or "accounts" about an artwork is another form of sampling, but it is mitigated by the fact that the samples overlap and vary in their authority, creating shades of narrative. The map of history will never be 1:1 with the experiences it represents, but that was never the point, nor is it necessary for preserving new media art. For that, the more stories we collect, the higher our sampling rate, and the greater are our chances of finding the threshold of a cultural Nyquist-Shannon theorem that may allow us to go from story to record and back, from an artwork that dissolves into bits to an artwork that survives.

Flattening of Memory

A by-product of quantization is a kind of flattening of representation. Creating such regular samples, all designed to have the same function, results in each having the same meaning or value with real difference becoming, instead, minor variables. In a digital image file this might be fine, but when these methods are applied culturally, to institutions and

their collections via rigid processes or technological tools, it can be dangerous for history. Geoffrey Bowker has discussed this dynamic of the "replacement of memory by procedures":

> Consider the total institution. Mary Douglas (1986) argues that "when everything is institutionalized, no history or other storage devices are necessary" (48). If I get processed into a prison, I can survive there as just a number (as the Count of Monte Cristo discovered). There is no need for the institution to hold any information about me other than that I exist and that I am subject to its regulations for such and such a time period; there is no need for me to remember anything about my own past, or any sets of skills beyond a fairly simple motor set. Why I am there and who I am just don't matter to the institution itself; it "remembers" all it needs to know through the complex set of procedures that it puts into place.[20]

Institutions are very good at setting up rigid record-keeping templates, standards, and processes—fixed structures meant to contain fixed artifacts. Some amount of this may be necessary, but how much? At what point, and in which contexts, does rigorous methodology turn into nuance-nullifying bureaucracy?

One difference between museums and libraries is that museums, especially art museums, have the luxury of paying attention to each object in their collections individually. Museums describe and manage each artwork more or less in turn, whereas libraries, because of the sheer volume of their mass-produced collections, must implement mass production approaches such as copy-cataloging.[21] This difference is exemplified in cultural heritage discussions of metadata standards and corresponding digital library software systems. Libraries take pride in developing metadata standards that afford as much consistency as possible and software systems that automate as much as possible. When an institution has a collection of eight million objects and digital images of those objects, it cannot migrate them one by one, nor can it evaluate the preservation needs of each separately. The library world is much larger than the world of museums (as of 2013 there are 119,987 libraries in the United States, compared to about 17,500 museums).[22] Many of the software systems and metadata standards for digital preservation have been developed by the larger community of libraries, but are these systems adequate for adoption by museums attempting to preserve their digital art collections? They would seem to leverage resources intelligently, but they may also have the effect of flattening the collection when, in reality, each artwork may demand its own solution and much more extensive documentation. This is not to say that libraries are rigid and museums flexible; rather, in order to preserve new media culture, both need new standards that describe not only an artifact's fixed form (name

of creator, single date of authorship, etc.) but also its future potential states. And each work must be allowed to vary in different ways. Museums have a head start in their treatment of artworks, in that they can attend to each work in their collection. Metadata is just a tool in the service of institutional culture and values; it can be used to create a prison of fixity and consistency or to create a field of possibilities that mitigates flattening the same way multiple narratives mitigate quantization.

In this need for individuation, context can play an important role. Attaching personal stories and memories to the record of an artwork, describing its original behavior and external environment (not just its intrinsic material or technological makeup), or providing instructions for recreating the work can provide the context an artwork needs to survive.[23] New media artworks, in particular, cannot be treated as a series of self-contained, discrete blobs of code and image represented by equally fragmented records in a database. Museums are already adept at dealing with pieces, parts, and fragments, such as a leg from a Greek statue or an altar torn from a cathedral. Museums merely need to turn this experience, amplified tenfold, to the question of new media artworks. Museums must make the connection that new media artworks are made of fragments but are held together by context. There is no one true authentic form, no singular monolithic object. There are only clouds of code, context, and instructions within which the artwork does not exist but from which it may be reborn.

The Condition of Exclusivity

One of the first lessons we all learn when we begin to use computers is that they are not infallible; in fact, they are often downright unreliable. So, to preserve our personal memories, we are always told to back up our data. The ideal backup solution includes making multiple backups (and since digital data does not degrade when making multiple copies the way analog media do, this is easily accomplished). In order to protect those multiple backups against external disasters like fire, flood, or earthquake, they should then be distributed spatially—across different rooms in a building, different buildings on a campus, or better yet, across different cities and states. If one is really serious about digital backup, as in the case of large-scale corporations and government agencies, then you further distribute the odds by entrusting your multiple backups to different agencies to reduce the risk of failure (or more likely, misplacement) within the record system of one organization.[24] As with metadata standards, backing up is not the same as preservation, but is certainly another cornerstone.

Because of the historical situation in which most physical artworks are unique artifacts, museums have necessarily developed an entirely different, in fact opposite, approach to preservation. For the traditional artwork in the traditional museum, there is one copy in one place. All effort is thrown at that one object—the vaulted doors, atmospheric controls, electronic security, chemical treatments, and limited exposure to light via exhibition, to name but a few. Museums have learned to excel at preserving collections of atoms rather than bits. However, a rapidly increasing number of contemporary artworks in private and public collections are born digital, including many from categories that were previously not digital, such as film and video.

So what happens when institutions that have spent centuries refining a perfectly suitable monomania for the singular are confronted with objects that naturally tend toward duplication; they in fact demand it for the sake of preservation? As mentioned earlier, many museums continue to treat their digital and media artworks as sacred singular objects, going so far as to require artists to sign agreements stating they will not make more than a very limited number of copies, if any.[25] This latter tactic was developed when museums began to acquire analog media art such as film, video, and photography. It made sense for those collections because analog media degrade after too many generations of copying and one cannot constantly return to the source for fear of degrading or damaging it. So allowing but restricting copies is a concession in the face of duplicable analog media art, but it still favors few copies and the fewer the better. Even though museums take preservation very seriously, only a few are making the logical equation that the best way to preserve media art is to make, and distribute, as many copies as possible, not only across space, but across different agencies and preservation practices.

The reason for this inertia is that more than a preservation strategy was formed in the wake of caring for singular art objects over the centuries. Whole economic and cultural systems arose from this condition as well, and it is perhaps those entrenched systems that most stymie a necessary shift in thinking about preservation in the digital age. Museums, for example, are evaluated largely by the quality of their (unique) collections. What would happen to the renown of the Met if a small museum in Arizona owned the same collection? This is unlikely to happen soon as there is yet no major museum with an entirely digital art collection that could be duplicated, but the example illustrates the cultural dynamic at work. Museums compete for resources like funding and audiences on their distinctive qualities, which include their unique collections. If MoMA and SFMOMA overlap in even

just their digital art collections, how can they compete for funding from Microsoft to build the greatest digital art collection known?* As I mentioned in chapter 4, this status quo inhibits artists too. Artists often earn their livelihood through selling their work to museums and collectors, and value in the art market derives largely from exclusivity. Exclusivity is inherent in traditional art forms, but it must be created artificially for media art and thus the practice arose of limited editions and agreements about not copying digital art.[26] Artists can earn significant sums selling unique works, even those in inherently reproducible media that are made artificially unique,[27] and the price goes down in direct relation to how many copies exist now or in the future. This creates another incentive for all players to restrict the number of copies. One can hardly blame the artist for trying to make a living, and there is so far no successful alternative economic model for artists who might want to sell large numbers of their work for lower prices but "make it up in volume." The art market just doesn't work that way. There are precedents for art "multiples" (artworks released in multiple editions, such as Flux-boxes made by the art group Fluxus) and hand-made editioned artist books entering the art market. Those generally adhere to the aforementioned limited runs established by printmaking and later photography. Where there have been cases of more mass-produced artworks (usually in the form of published books such as those produced by Something Else Press, again, related to Fluxus), these have proven the rare exception to the rule and provide no widespread sustainable model for providing an artist's livelihood.† As I stated at the outset, it is important to understand the historic context and

* Jon: As chapter 9 will remind us, copyright can constrain the most duplicable of media. Microsoft came knocking on the Guggenheim's door in the early 1990s offering to digitize its entire collection—for the mere price of owning exclusive rights to those digital images. I said no thanks—but many commercial enterprises dedicated to ensuring the exclusivity of digital collections end up profiting the middlemen more than the collections.

† Jon: We can't underestimate the influence of the market (and not just on artists). Yet I also see hints that the options for media artists may be expanding, both inside and outside the art world. Caitlin Jones's 2006 group exhibition at New York's Bryce Wolkowitz Gallery sold briskly, even though the works were already available in a free version on the Internet. And new media artists like Lia, Scott Snibbe, and Erik Loyer have transformed past works into "app art," garnering downloads by hundreds of thousands of viewers.

origins of institutional practices if we are to effectively advocate for change. There are a lot of good reasons that museums do not want to just spread around their collections. So, keeping that in mind, what might we do that can better serve preservation and, in the end, the institution's own goals of public service?

From Closed to Open Institutions

We've seen that museums and other cultural heritage institutions have a long history and for most of that history they were privately owned and accessed, first by the monarchy and nobility and later by the affluent bourgeoisie. The nineteenth century saw the innovation of truly public institutions, but that openness applied to the aspects of the institution that were already outwardly oriented—the exhibition and, later, education programs—and not to the collection. In public museums today, the collections remain functionally private. Only in the last few years have museums begun to provide access to records of their collections, via the Internet, but accessing the collections themselves is not nearly as easy. Though modern museums serve the common person and public museums hold their collections as public stewardships, the common person cannot walk in off the street and ask to be taken to see the collections. It just doesn't work that way. To gain access, one must usually present the museum a letter of introduction that usually requires affiliation with another institution, such as a university. In this way, it is institutions that have access to institutional collections, not individuals.

Artists have long known that museums are partially closed systems; this awareness gave rise to artistic interventions over the decades, from Duchamp's *Fountain* to the artistic practice known as institutional critique. Institutional critique posed such questions as "How open are our cultural institutions?," "What is their function in society?," and "Who in that society do they serve, or serve best?" Many new media artists continued the tradition of institutional critique. Internet art, for instance, bypasses the gatekeepers in the museum and allows the artist direct access to a public audience. Broodthaers's "museum" on the beach at Le Coq, detailed in an earlier chapter, exemplified the closed museum—a drawing in the sand surrounded by velvet ropes and a sign that read, "Touching the objects is absolutely forbidden." In contrast, as early as 1967, author and surrealist artist André Malraux envisioned a "museum without walls" that bypassed the dilemmas of inside/outside and closed/open.[28] In the last decade, many have used the phrase "museum without walls" to describe museums in the age of the Internet. They propose that when

museums "go online" (specifically—put records and images of their collections online), they are fulfilling this vision of openness. This is true at one level, but museum websites do little to mitigate the legal and cultural barriers that institutional critique was, well, critiquing. Still, it is a step in the right direction. Could employing new media—along with relevant changes in institutional culture—answer the deeper challenges posed by institutional critique? Can we deploy the Internet in ways that integrate personal and social memory and aids in the preservation of digital culture? Can we take the next steps toward the museum without walls and create a truly Open Museum?

The Open Museum

In *Collecting the New*, Steve Dietz articulates the problems with and desire for more openness in museum collections:

> The primary issue regarding collecting "anti-institutional" net art ultimately isn't its content, but the general desire by many new-media artists for their work to continue to be freely and easily accessible—and appropriately displayed. Potentially the museum can help enable this, especially over the long term, by taking on some of the burdensome support functions, recognizing that such freely available and often easily replicable work may also impact the museum's traditional insistence on uniqueness or limited availability for objects in its collection.[29]

And Charles Leadbeater fleshes out this vision of openness in his essay "The Art of With":

> The web might open up who can contribute to the process of artistic creation, widen the definition of who is an artist. Some galleries have already begun to experiment with content submitted by amateurs and outsiders. Open source approaches would go even further, making the source code to work available—the notation—so anyone could use and reuse it. Art would be designed for adaptation and re-use. It would never be the finished item because someone might be adapting in some new way. Collaborative art of this kind would have to be broken down into reusable modules, like Lego bricks, that users could play with. . . . In this world, the gallery would become more like a babbling souk or a forum, the setting for cultural collaboration and conversation on a scale so large that it cannot be planned out in advance.[30]

Can we imagine museums whose authority is used to facilitate and engage a community rather than treat its members as passive cultural consumers? Museums own much of history's "primary evidence" or "source material." Can we imagine museums in the future that hold this source openly? Let's play out these questions with a thought experiment.

Synthesizing some of the solutions and examples offered in previous chapters, let's design an Open Museum.

The Open Museum is a framework or self-imposed certification that anyone or any institution could adopt for their new media art collection. It is not a discrete singular resource. Anyone who creates a system that meets the criteria described here has created another instance of an Open Museum. The examples provided below describe one such instance, hosted by a theoretical museum.

This Open Museum is

- A preservation repository for born-digital new media artworks,
- An online resource that allows unprecedented access to these works,
- An innovative legal, economic, and cultural framework for new media arts,
- A project exploring the values and practices of participatory culture applied in the context of fine arts institutions,[31]
- A series of experiments in the following museological proving grounds.

Use

Students, scholars, and the public can currently access images and records—representations—of artworks held in museum collections via online resources like ArtStor and via many museums' own websites. But the public and most students cannot generally access the collections themselves. The Open Museum takes advantage of the unique property of new media that allows one to share the original without diminishing it. The source code and other files for digital artworks are free for users to download, study, use, and remix into new works. In this way, even the casual student can peer under the hood and examine the inner workings of these artworks in the way that previously only privileged scholars could do with traditional collections. This gives everyone equal access to the primary evidence of history. While the Open Museum emphasizes the new possibilities of digital sources, it does not leave out new possibilities with traditional art. The Open Museum also enables artists and institutions to share images and other representations of their work in an open way. By allowing others to use and remix these selected images of artworks, the works become more widely known and used in research and instruction.

Software Tools

The Open Museum is presented online via custom-built open-source software such as ccHost, originally developed by the Creative Commons to

allow musicians to share digital music files via the website ccMixter. In addition to the content of the Open Museum being open for download and reuse, the underlying software system is also ready for others to adapt themselves.

Museum Catalog Matrix

The Open Museum system is compatible with open systems such as the Forging the Future project's Metaserver, a dynamic networked registry that creates links between related records created and hosted across different museums and archives.[32] This practical low-cost tool allows museum cataloggers to discover related records for multiple instances of an artwork and to leverage their communal work through the "copy-cataloging" that is practiced in libraries. It allows the public to discover multiple instances of artworks in private or institutional collections around the world and allows those systems to discover artworks in the Open Museum.

Metadata

The content architecture of the Open Museum mirrors a standard like the Media Art Notation System (MANS). This has several benefits. MANS represents a "score" for each artwork that contains instructions for recreating that artwork. In addition to openly sharing whatever source files may exist for a particular work, the Open Museum also shares the instructions for how to recreate that work, opening the door for artistic homage or critique, exhibition loans, and playful amateur manifestations of artworks. Second, MANS supports Accounts, a feature whereby third parties are invited to enter their alternative memories of how a given artwork was created, installed, or experienced. This allows personal and institutional memories to mix, creating a more robust context for the work. Third, the standardized data in the Open Museum can be exported, easily mapped to, and shared with other systems and institutions.

Language and Controlled Vocabulary

Artworks in the Open Museum are described by professional museum cataloggers who use standard museum terminologies such as those in the Getty's *Art and Architecture Thesaurus*. This has the advantage of bringing Open Museum records into the field of other artworks and keeps the Open Museum from being a new media ghetto. However, the Open Museum also runs a parallel terminology system, a folksonomy where terms emerge from those contributed by artists and the public in the form of tagging. The most commonly used terms rise to the top and are mapped to the formal Getty

terms, creating a by-product of mapping the two language systems. In order to accomplish this linguistic feat, the Open Museum taps into the live feed of a project like the Rhizome VocabWiki.

Law and Rights

Each work contributed to the Open Museum is licensed for use with Creative Commons licenses.[33] This allows artists to retain some rights but still allows more open use of their work than strict copyright law defaults. For instance, artists can retain (or waive) the right to always be named as creators of the work and components of the work. They can prohibit (or allow) commercial use of their materials, and so on. Additionally, the Open Museum acts as a site for source code escrow. Individuals or businesses get a tax break for uploading a copy of their proprietary software source code to be held in the Open Museum in the event they should declare bankruptcy, in which case the escrowed code is released to the public.

Social Feedback Loop

Creative Commons licenses are effective on many levels, but they do not require the person reusing a work to inform the work's original author. This omission of individual negotiation is part of what makes Creative Commons licenses feasible on a broad scale, but it, perhaps unavoidably, misses a crucial social networking opportunity. The Open Museum would add a stipulation to the Creative Commons licenses in this particular context. This stipulation, taken from the Open Art License,[34] specifies that if you download material from the Open Museum and reuse it in a project, then you must register that project with the Open Museum. You do not need to upload or even share your own project; you merely need to let the Open Museum know that it exists. As a result, the Open Museum can continually map where artworks, and components of artworks, have been remixed. It creates a valuable art historical tool and a map of artistic practice. While this stipulation is omitted from Creative Commons licenses, it is included in specific Creative Commons projects like ccMixter and tools like ccHost.

Cultural Remix

Artists' reuse of the creations of other artists in their own work is neither new nor exclusive to the digital domain. Artistic homage and appropriation has been around since art was born. But remix is different from appropriation in one significant way. Appropriation most often entails one artist using an image or process created by another artist, whereas remix allows

one artist to reuse the actual materials used in the original. That's usually impossible with traditional art; who wants to cut up their original painting just so another artist can use it? Even if this happens, it usually happens only once and benefits, at most, one other artist (as when Robert Rauschenberg obtained and then erased a Willem de Kooning drawing).[35] But when artists remix digital source material from another artist, they gain access to more than the public connotations in the work itself; they gain access to the hand and the craftsmanship (or coding skill) of the first artist. They gain access to the work's "material subconscious"—the ways in which the interaction between the source artist and medium influenced the outcome of the work. This can be played out in new remixed works not just as a rote outward effect, but as an underlying condition. Remix opens up a broad new space for the remix artist and creates a new type of relationship between her, the source artist, and the public.

Economy

Intellectual property law was created to balance the private need with the public good. It grants authors and artists exclusive rights over their work for a limited period (not a short period, sometimes ninety years after the artist's lifetime), after which the rights in the work move into the public domain. Artists are granted time to find ways to earn a livelihood from their work, which is seen as an incentive to create in the first place. Why, then, couldn't public museums act as stewards of the public good and compensate artists earlier rather than later by commissioning works for the Open Museum, after which they would enter the work into the Open Museum, apply Creative Commons licenses, and release the work to the public? The museum would earn their renown not for the quality of art they commission and obtain in exclusivity, but for the art they commission and then "give away." Artists get paid up front and still own their work, while the public is served by waiting months rather than decades to gain access and rights to use the work in question.

Nonexclusivity

The Open Museum is not a single project, database, or website that is owned or hosted by a single institution. Rather, it is a franchise. An international network of Open Museums allows many institutions to share the burden of cataloging and description as well as distributing technical storage and backup.

The Open Museum builds upon previous related open-culture systems. Brewster Kahle, of the Internet Archive, is sponsoring the Open Library

project,[36] while astronomer Roger Malina describes a parallel development in the sciences that led to his writing the Open Observatory Manifesto:

> Thirty years ago astronomers viewed the data they took (in those days photographic plates) as their personal property and their careers hinged on their controlling this data (and their students' careers depended on their access to their professors' data). Today NASA and NSF now have a contractual stipulation that all data funded by NASA must be made publically available—it's funded by public money so the public has a right to access it. This has led to a scientific revolution in astronomy—more science is now done on the Hubble data archive, than with new observations—and more science is done by other people than by the astronomers who took the data. The international virtual observatory movement has generalized this and there are now shared data analysis tools that are open sourced.[37]

Admittedly, the arts and sciences are different in many regards, but in both, the affordances of new media are occasioning us to reconsider professional and social practices.

The Open Museum has been proffered previously within museum professional discourse, and the examples above flesh out this rhetorical idea by differentiating among kinds of openness and providing ways to think of the Open Museum as tractable model. Indeed, individual components of the Open Museum outlined above have been implemented in various projects,[38] but if the challenge of a more fully integrated Open Museum were taken up by an institution, it could move the whole field forward. It would tangibly benefit social memory by spreading memory around in order to protect it; it would link formal and informal memory into a tougher historical mesh; and, by making duplicate redundant copies of media art, it would help preservation efforts. The Open Museum, or any similar approach, could turn a museum collection from a static, hidden archive into a public playlist remixed by curator and public alike.

The Open Meta-Museum and the Interarchive

Let's now imagine that these Open Museums are open not only to the public but to each other, forming a porous, continuous global museum—a museum without walls, a metainstitution—through which art flows like wine. These museums could work together to build an economic model in which artists can make a living by selling one hundred copies of a work within this new Open Meta-Museum for $500 each instead of just two copies for $25,000 each. Each museum would pay less, there would be more copies of great art to be enjoyed in more regions of the world, preservation would be better ensured, and the artist could still pay the rent. In this

thought experiment, museums compete based not as much on the exclusivity of their unique collections as on what they do with their collections. Curators could still exercise their selective process, but without being inhibited against choosing a work that has already been collected by another museum. Going further, we can imagine that this new metainstitution is open for anyone to join—not just institutions, but also the public or communities of artists. Each of these groups could store or share their own collections of works of digital art online by posting media art scores and exposing them to search engines to create a metadatabase. This is the world of shared, standardized, scalable metadatabases and metainstitutions. To use the Internet itself as the world's largest distributed database, especially for the preservation of artworks or cultural objects, requires careful and creative thinking that goes beyond mere hyperlinking, toward massively distributed labor economics and smart "semantic web" content, but it is worth imagining and may even be within the realm of the possible.

During the 2005 "Refresh" conference on the histories of new media art, science, and technology held at the Banff New Media Institute, a group of individuals representing organizations such as the journal *Leonardo* and the online Database of Virtual Art (now the Archive of Digital Art) gathered around a dinner table to brainstorm how to connect various collections of digital art that were already accessible on the Internet, but distributed around the world in heterogeneous databases maintained by separate organizations.[39] They dubbed the model they developed there the "Interarchive."[40] The standard institutional approach to their idea would be for one organization to take the lead in creating a monolithic central union database to which institutional partners could contribute records about artworks. The monolith would then be accessible to the public online as a central repository about digital art. But this approach, which remains the default model for most collaborative cultural heritage projects to date, was unsatisfactory for this group for several reasons. First, developing and then maintaining the monolith would require heavy, centralized infrastructure in the form of equipment and staff. Second, the cost of participation would be high enough that it would rule out individual contributions, allowing only institutions to contribute records. Another expensive, bloated, behemoth project that feasted on federal dollars was not the answer. Surely the distributed model and lightweight low-cost technologies of the Internet offered alternatives.

The group devised an alternative model that would require no new central systems and would allow anyone to contribute, from an individual artist to an organization like the Database of Virtual Art to a large university

or museum. In this model, each contributor would create a record for each artwork using a shared metadata standard such as the Media Art Notation System outlined earlier. For organizations with large sets of records, this process could be automated. Individuals wishing to contribute only a few records could use an open-source template. Next, each contributor would place their metadata-encoded records on their own web server. There would be no need for a database or specialized application to deliver these records; they would simply store the files on any public web server, exposing the records to web search engines such as—but not limited to—Google. This would remove centralized control and allow anyone (artists, for instance) to participate without having to register or develop an institutional affiliation. This also would make the whole thing massively and quickly scalable. Lastly, these metadata records would be accessed by the public via a simple Internet search. The Internet search is configured to look for a specific string of characters that occurs in every MANS document (its XML declaration) together with the specific search term. Any search using these criteria would then find all the digital art records (scores) online that pertain to the search terms, effectively creating a highly distributed database. One could use, for instance, Google's Advanced Search (or Yahoo's, or anyone else's) to configure the above search ad hoc, or one could instead develop a webpage that did this automatically. In fact, this is exactly what the Creative Commons' search interface does; it lets one search the Internet for content that may be reused and remixed legally.[41] To contribute your content to this distributed database of free culture, you need not send it to the Creative Commons or register it with Google; you simply add the required metadata to your own webpage (in this case, the Creative Commons license), where it can then be discovered by someone else's search. The elements necessary to build a distributed database need not be centralized. Multiple individuals and organizations could create their own portals into the distributed database of digital art—this Interarchive.[42]

The Interarchive was a model that came out of a dinner discussion about how to connect heterogeneous new media art resources, but not all such proposals are so informal. More recently, in 2008, art writer and consultant Bronac Ferran submitted a report to the Arts Council England entitled "Rethinking Ownership," in which Ferran proposed a plan for a national distributed collection of digital art.[43] Neither the Interarchive nor the British national distributed collection have been built to date, for, despite their light-tech, cost-effective designs, there are significant obstacles to overcome. For instance, the permissive openness that characterizes these proposals also reduces the consistency and problematizes quality control of

the resulting resource. I can imagine a "crowdsourced" solution to this problem, in which individuals get to rank the usefulness of records they find, pushing less useful records to the bottom. But would this social media solution make the Interarchive rigorous enough to serve scholars? Only a real-world test will tell. The Interarchive and the Open Museum are not offered here as a panacea to the very real challenges of building cultural heritage networks. Rather, as with the Media Art Notation System, they are useful for thinking though the requirements of such systems and demonstrating that new approaches can be tractable.

Exclusivity and uniqueness are institutional assumptions born from specific historic situations and from the material properties of some artworks, but not all. They are not necessarily natural or immutable conditions of cultural heritage collections. Despite their sometimes worn and rigid practices, cultural heritage institutions remain charged with practicing canonical social memory, and collectively they command vast resources toward that goal. The preservation of new media art is stymied by a host of related historic conditions like art market models, legal threats, and assumptions about museums' reputations and earned income. If we develop new preservation methods alongside innovations in these related arenas, we may orient the discourse away from happenstance attitudes, such as exclusive ownership and closed collections, and toward the more lasting institutional values of public service, education, access, and preservation.

8 Generation Emulation

Jon Ippolito

Community Service

The last chapter charted one way for organizations accustomed to authenticating and controlling culture to evolve in the twenty-first century—namely, sharing that responsibility with a larger community. Rick's template for an Open Museum suggested ways that remixers from the artistic public at large could, for example, check out and resubmit modified works from an institutional repository. And there are signs that institutions may be warming up to the idea of sharing their collections more openly. In 2012, Sebastian Chan, the Cooper-Hewitt's director of digital and emerging media, released the metadata from the entire Cooper-Hewitt collection via a Creative Commons license on GitHub, a popular code-tracking repository that makes it easy to share and repurpose data.[1] A year later, the Cooper-Hewitt acquired its first piece of code, an iPad app called *Planetary*. In a move reminiscent of Rick's Open Museum, Chan's team added it to GitHub so viewers could play with the source code, granting them permission to "replicate, modify, and transport it to other hardware platforms and devices."[2] Encouraged by the overwhelming success of participatory media, a few other mavericks in the library and museum communities have begun tentatively dipping their feet in the waters of Web 2.0[3]—accompanied by a chorus of conservative voices warning about the dangers of letting down the barricades to the infidels.[4]

As of this writing, the strategy of crowdsourcing culture is still enormously controversial among professional curators and conservators. Yet by far the biggest success story for new media preservation comes not from an institution—not even from an institution collaborating with a community—but from a community bootstrapping a preservation initiative on its own. While professional conservators have only managed to future-proof a tiny sliver of new media artworks created since 1980 in any systematic

and extensible way, a global community of dispersed enthusiasts has safeguarded the lion's share of a different genre of early computational media: video games.[5]

The typical game enthusiast has little in common with a salaried conservator besides a devotion to the art form to be preserved and a talent for the craft of preserving it.[6] (These days, of course, both the amateur and the conservator are likely to have a computer, though you can bet which one knows better how to use it.) The amateur has no white gloves, lab, or a cadre of assistants—outside of an IRC channel, anyway.[7] Yet game enthusiasts wield a weapon in the battle to preserve new media more powerful than any in the arsenal of traditional conservators. Emulation, defined by RAND computer scientist Jeff Rothenberg as the ability of a new computer to impersonate an older one, is the chief technique of game enthusiasts. This chapter evaluates the advantages and disadvantages of this versatile technique in recreating key works of new media art, and hints at the Pandora's box that emulation opens for issues of authenticity, a topic that will return in chapter 10.

The fact that this chapter will get a bit geeky at times shouldn't be a surprise given the fact that we're profiling a community of programmers. (Feel free to skip to the final "Recommendation" subsection if all this talk of computers makes your eyes glaze over.) Of course, reveling in technical details may seem to contradict the claim made in this book's introduction that no technological fix can solve the obsolescence of new media. We stand by our claim: no *medium-dependent* solution will work for all of culture. What's exciting about emulation is that it offers a solution that is at least partly medium-independent, as should be clear when we see how nesting older emulators inside new ones makes them extensible into the future. More important than the technical demographic of the emulation community, however, is its institutional status—which is that it has none. Game emulators are almost exclusively produced by amateurs working outside the institutions we usually turn to for safeguarding our heritage.

As indicated in chapter 1, to emulate a work is to devise a way of imitating the original look of the piece by different means. The term can be applied generally to any facsimile of an artwork's components, as is the case with the refabrications and reconfigurations that are essential to the preservation of conceptual, minimal, and performative art. In the digital media realm, however, emulation has a specific definition. An emulator is a computer program that "fools" the original code into assuming that it is still running on its original equipment, thus enabling software from an out-of-date computer to run on a contemporary one.

To date, only a handful of museums have experimented with emulation. For its examples, this chapter will draw on the most ambitious test bed to date,[8] the 2004 exhibition "Seeing Double: Emulation in Theory and Practice," which paired artworks in endangered media side by side with their recreated doubles—and sometimes triples—in newer media, offering visitors a unique opportunity to judge whether the emulated works captured the spirit of the originals. Ostensibly this exhibition was a test of emulation as a preservation strategy, but in a sense it was also a test of the ability of a hidebound institution run by the art world's elite to adapt to and learn from a successful preservation practice developed by a community of amateurs.*

* Rick: In a 2007 conference on new media preservation, Kurt Bollacker of the Long Now Foundation declared that there was one area of cultural content that would need no help from institutions to be preserved: porn. Games may fall into a similar category, in that they are popular enough that enough people will spend the time to preserve them outside an institutional context. However, would this strategy really carry over to a fine art context where sometimes a work is collected because it is important, though it is not popular? Or perhaps I'm taking a short-term view here; grassroots groups have not yet risen to the task of preserving new media art in great numbers, but perhaps the acned modders of today will grow to be the digital museum docents of the future.

Advantages of Emulation

Extensibility

Like any type of software, emulators differ in quality and versatility. The best, however, can be applied across a range of platforms—and thereby decades—in a way few other preservation technologies can. While some emulators only simulate a given software environment, deeper emulators operate on the level of hardware, impersonating the very microprocessor chips at the heart of a digital computer. While such deep emulators may be harder to write, they have several advantages, as emulation expert Jeff Rothenberg has pointed out.[9]

First, a chip-level emulator can run any program that originally ran on that microprocessor. For example, the emulator Virtual PC can run on a Power-PC Macintosh any operating system, like Windows or Gnu/Linux, that ran on the Intel x86 chip. Virtual PC can also run any application, such as Microsoft Word or Adobe Photoshop, that ran via those operating systems, as well as any handmade code, such as an artist's video or website, that happened to run on it.

Rothenberg further points out that software specifications change frequently—think of the many Linux patches or Windows service packs[10]—and differ from one distributor to another, which makes writing an emulator that imitates a software environment like trying to hit a moving target. Hardware, on the other hand, has to be mass-produced by third-party manufacturers, which means that computer makers like Dell and Apple detail their specifications in a way that ensures different machines will behave the same. This in turn makes it easier for writers of emulators that imitate hardware environments to match those specifications.*

* Rick: We may not have to write different emulators for each OS version and configuration, but even with chip-level emulation, we must still make sure we have the correct Linux patches and Windows service packs, and all proper OS configurations, for our artist software to run. Not to mention how peripherals interfaces are tricky to emulate. Hardware emulation is better than software, but still leaves us with a complex environment to replicate.

Finally, and importantly from a preservation standpoint, chip-level emulators can be nested together to transition from one platform to another. Rothenberg is fond of demonstrating this principle by running a Windows-based emulator for the EDSAC, a forerunner of modern computers built in 1949, inside the 2005 Macintosh-based emulator VirtualPC. This daisy chain of emulators—Mac emulates Windows emulates EDSAC—spans a computing history of fifty years on a single machine. Thirty years from now, of course, the Macintosh could easily be extinct too; however, if some preservationist writes an emulator to simulate a 2005 Macintosh on the prevailing platform of 2040, anyone will be able to run Rothenberg's daisy chain inside this new emulator, and so on into the future.

Given this extensibility across platforms and decades, emulation represents a vast improvement over a preservation technique like migration, which must be reperformed case by case for each work on each platform, and for which there is minimal added benefit to having performed a migration in the past. In emulation, by contrast, once you've emulated a popular chip to preserve, say, *Space Invaders* for the Atari, you've also inadvertently added to the lifespan of every other game or artwork that runs on the Atari's chip.

Quantity and Quality

Given that most video game emulators are not the product of software engineers working for a commercial enterprise like Virtual PC but are

Figure 8.1
Screenshot of FCEUX emulator running *Super Mario Brothers*.

hacked together by acned kids on laptops in bedrooms, the quantity and quality of game emulators is astounding. To consider but one gaming console, amateurs have written over a hundred Nintendo Entertainment System (NES) emulators for twenty platforms, from Playstation to the XBox, from the Apple Newton to the iPod. Wikipedia lists thirteen NES emulators for Microsoft Windows alone.[11]

The quality of these emulators is far higher than might be expected from amateur programmers. Despite their geographic dispersal, these saviors of pop culture sometimes move beyond isolated lifeboat solutions to conduct coordinated rescue operations. Homebrew emulator makers regularly give away their masterpieces, and often the code behind them, for free on the Internet; despite some spirited rivalries, they often work from each other's code and as a result their products improve over time.

For example, the FCEUX emulator, at the time of this writing the top-ranked NES emulator on the prominent site Emulator Zone, can trace its

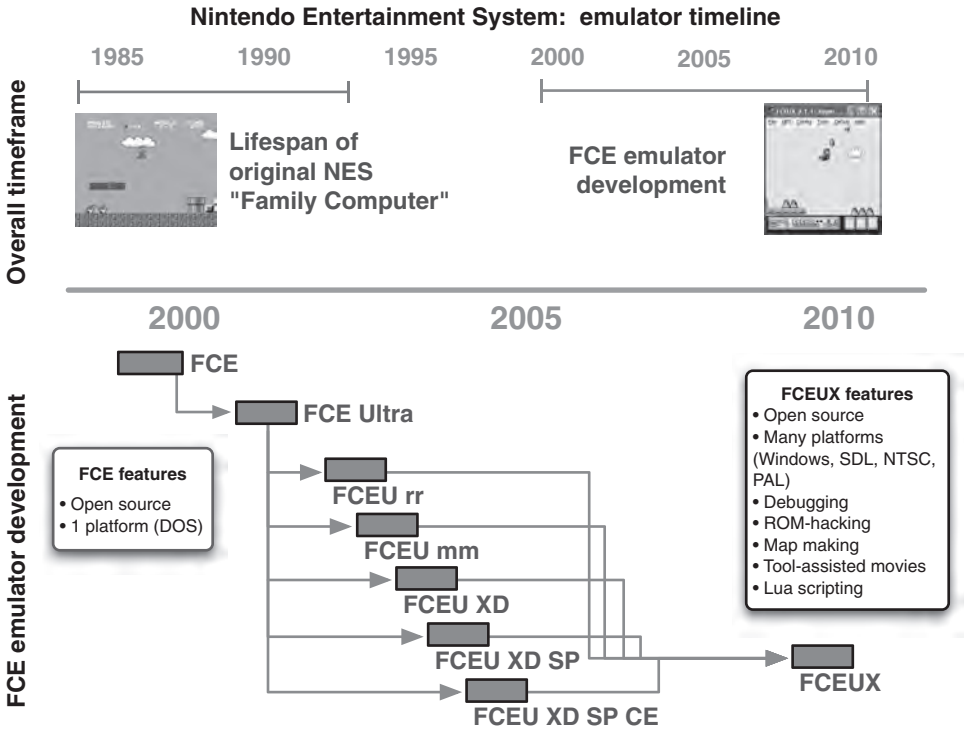


Figure 8.2
Development timeline of the Nintendo Entertainment System and the FCE family of emulators built for it.

genealogy back to a complex family tree of a dozen other emulators. (See figure 8.2.)[12] I cannot think of a single instance of software created by the professional preservation community in this supple way, passed from hand to hand over decades, diverging, reconverging, and constantly improving without a single institution or copyright holder at the wheel.

Use as a Guarantee of Quality Control

Emulators may enable vintage gamers to relive decades-old memories of Italian plumbers stomping evil mushrooms, but they also permit users to explore facets of games that could not be investigated otherwise. For example, emulators can be used to create "tool-assisted speedruns"—optimized gameplays recorded as screen videos and shared via a set of timed keypresses that can be played back on the actual console. These "perfect games" are vastly easier to perform with a good emulator, whose user can

slow down the speed of the game, or even reduce it to one frame at a time. When speedruns first propagated over the Internet, some fans initially viewed this use of an emulator as cheating, but since then a sizable subculture has emerged that considers speedruns a legitimate practice in itself. Importantly for preservation, this fan base views speedruns not just as competitions but also as a means of investigating and learning about games. In fact, among the speedrunning community, terms like "glitch abuse" and "luck manipulation" have positive connotations, for they reveal their users' ability to wield emulators creatively.

There's probably some cultural value in discovering that a speedrunner who abuses the "walk through a wall" glitch can shave an hour off *Super Mario 64*, but perhaps more useful for preservation purposes is the fact that speedrunning can actually uncover problems with particular emulators. Executable instructions for optimum gameplay should work the same on every console, but if the emulator is nondeterministic—e.g., it adds some randomness that was not present in the original console game—then this infidelity to the original system will be betrayed when the emulator fouls one of the "perfect games" discovered by speedrunners. Likewise, most robust emulators allow users to save states of a game and return to them later, which is essentially how speedrunners manage to "go back in time" and rerecord an optimum performance at every stage of the game. When such "save states" do not capture all the details of the state of the system, again the "perfect game" will fail, pointing out another flaw in the emulator.

The ability to control the playback speed of an out-of-date program has already proven an important feature of emulating digital art, as suggested by two works from the exhibition "Seeing Double." Mary Flanagan's software artwork *[phage]* digs up old images and texts from your hard drive and displays them whizzing past your screen against a black background. When Flanagan migrated *[phage]* from its original environment on a 1998 Windows 98 computer to a 2004 Windows XP box, the improvement in microprocessor speeds over the interpolated years accelerated the originally meditative experience of photos and emails drifting by the screen into a frenetic display of elements rushing by at breakneck speed. By contrast, emulating this original Director animation on a 2004 Macintosh via Virtual PC had the effect of slowing down the moving elements to a more appropriate rate, due to the emulator's added delay in processing. Ironically, in this instance, a defect of the emulator turned out to be an advantage.

A more reliable guarantee of consistent playback speeds is to introduce "wait states" in the code to reproduce the original pacing more accurately.

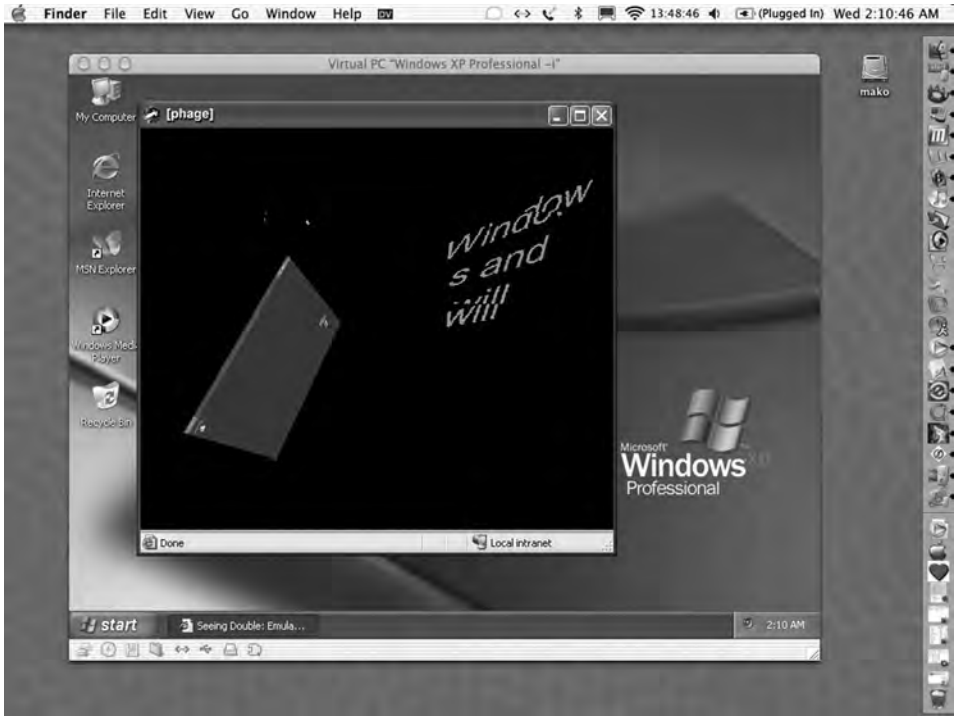


Figure 8.3
Mary Flanagan, *[phage]*, 1998: Original Shockwave application running in Windows XP, which is itself running in Virtual PC on Mac OS X.

This was the technique that artist John Simon used to compensate for the effect of Moore's law on migrating his computer sculpture *Color Panel* from a 1999 Apple laptop to a 2004 Apple laptop. *Color Panel*'s colorful blocks rearrange themselves into various abstract animations, based on an idiosyncratic "clock" algorithm written by the artist; Simon's wait states ensured the new hardware would respect the original timing of this dance of pixels. Technically, this alteration makes the re-creation a migration rather than emulation, but Simon kept the spirit of emulation by leaving most of his code untouched.

Whether pure or impure, these experiments in emulation demonstrate an important way that digital artifacts differ from traditional media. To "use" a watercolor is literally to consume it: every time a viewer removes it from a solander box, the oil on her fingertips deteriorates the paper and the sunlight required to view it fades its colors. By contrast, a digital file

left on a disk for too long will most certainly become unreadable due to changing software and hardware formats; the only way to ensure its longevity is to reuse it constantly.* By this measure, gaming zealots are the most diligent of conservators, obsessively playing and replaying their favorite works on different platforms over different decades.

* Rick: Constant availability has been proposed by some larger museums, but is this a feasible option for smaller institutions or collectors? It takes resources to keep a digital work up and running continuously. We may need to migrate the storage medium, but that's different from keeping the whole apparatus of the work running. Perhaps we need solutions that allow either continual or interrupted use?

Misuse as Spur to Creativity

If continual use is already a preservation strategy, then misuse—in the sense of modifying the original without regard for authenticity—would seem the opposite. Nevertheless, misuse can be a productive strategy for anyone working creatively with technology,[13] and emulation is a handy tool for "modders"—programmers whose art form is modifying vintage code. When combined with low-level editing tools such as a hex editor,[14] emulators help game modders to change the character's appearance, backgrounds, or music, and allow advanced modders to alter even the gameplay itself. Such game elements are typically embedded in a game ROM, that is, the read-only memory of a game cartridge that modders circulate as a separate digital file that can be loaded in an emulator.

Emulators are thus invaluable for artists and others who want to remix and redistribute an existing game. However, this fact may make cultural historians nervous about the proliferation of "inauthentic" games floating around the Internet; what if the only version of *Tomb Raider* to survive is the "Nude Raider" mod, which replaces Lara Croft's clothes with pixelated flesh? The fact that emulators help transform as well as preserve is thus a boon to artists and a bane to institutions. This contrast is a familiar one, due to the lag institutions find themselves in at the beginning of the twenty-first century. Although we'll return to this problem in chapter 10, for now let's assume that the function of an institution is to support creators rather than vice versa, and so let's take a look at some of the ways artists in the "Seeing Double" exhibition misused emulators for productive ends.

As one of their contributions to "Seeing Double," the artist duo jodi (Joan Heemskerk and Dirk Paesmans) chose to remix a game from the

1980s created for the now obsolete ZX Spectrum computer, called *Jet Set Willy*, in which a diligent pixelated housekeeper tries to clean up after a rollicking party. The Spectrum's interface differed from contemporary computers in two important ways. First, the keys used to write BASIC programs were not normal alphanumeric keys; instead, programmers typed entire commands with a single key or combination of keys. As Joan Heemskerk explains, invoking the GOTO command on the Spectrum demanded not typing the four letters G-O-T-O, but punching the key labeled with the word GOTO plus any required auxiliary keys, such as Alt or Ctrl. In a second difference from today's computer interfaces, users loaded games on the Spectrum not from a disk drive but from an audiocassette on which the game was encoded.[15] All of this would have made modding the original game completely impractical, had jodi not been able to access the source code via an emulator—which had the side benefit of letting visitors to "Seeing Double" play jodi's *JET SET WILLY Variations* both on the original hardware and emulated on a contemporaneous computer running Windows XP.

Artist Cory Arcangel contributed another game hack to "Seeing Double" in one of his signature media, the NES cartridge system. To hack the cartridge of the light-gun game *Hogan's Alley*, Arcangel pried off the chip corresponding to the game graphics, rewrote its programming to include new game characters, and soldered it back onto the original cartridge. He left unchanged the chip that controlled the logic of the game itself, as well as the light gun used to interact with it. The result was *I Shot Andy Warhol* (2002), a "shooting gallery" game which replaces images of innocent bystanders with pixelated graphics of the pope, rapper Flava Flav, and restaurateur Colonel Sanders, and substitutes the image of the bad guy with one of Andy Warhol.[16]

The impact of Arcangel's original intervention—hacking an obsolete game cartridge at the level of hardware—would be lost in an emulated version.[17] In the short term, storage of the original equipment—with potential migration of the television—is the ideal option for preserving this piece of technological nostalgia. As Arcangel put it, "For me the whole point of the work was the hardware intervention, the fact that I slaved over this ridiculous 6502 Nintendo language. If I hadn't been able to make a cartridge that ran the original code, I wouldn't have made the work." That said, the process of modifying the cartridge was laborious enough that Arcangel had to test his modifications in advance before making the cartridge—and he acknowledges that this would have been "next to impossible" without the emulator.[18]

Challenges of Emulation

We'll return to the conflict between institutions and artists over the "misuse" of culture in chapter 10, but clearly emulators offer a powerful way to preserve culture when the goal is fidelity rather than fertility. That said, emulation is not as good a solution for works that depend on idiosyncrasies of hardware, platform, context, or even the generation of the viewer.

Hardware Idiosyncrasies

Chapter 3 mentioned Nam June Paik's work *Crown TV*, which would not be suitable for emulation due to its dependence on a hardware-dependent hack of an analog TV's cathode ray tube. jodi's *JET SET WILLY Variations* also included a cathode ray tube as part of the original video monitor that came with the ZX Spectrum; while jodi did not hack the monitor per se, the artists did feel something was lost in the translation from CRT to the computer's liquid crystal display.

As mentioned above, an emulator was invaluable for the production of this work, so the curators chose to exhibit jodi's game on both a Spectrum emulator running in Windows XP as well as on its native platform, a vintage Spectrum from the 1980s. Nevertheless, while the software behaves identically on both machines, the emulated version of *JET SET WILLY Variations* lacks many of the particularities that jodi admired about the original hardware. For one thing, seeing the game on Windows XP gives the viewer no clue that Spectrum games once ran off audiotape. As Joan Heemskerk notes, "the Spectrum loads from a cassette, and if you unplug the electricity everything is gone—like a performance." Heemskerk goes on to describe how the crisp look and antiseptic feel of a flat screen differs from the warm buzz of a cathode ray tube:

> The ZX works with a TV signal, so the screen is fed by antenna cable. A line is not a line. A piece of red on an LCD display is just straight, one color, but on a TV it's totally lively. Even if you put a white against a black, the TV tube cannot hold the line, and it bleeds or bows.[19]

Clearly these differences transcend this particular case, and defy software emulation in any work that depends on the look of analog electronics. Curiously, some game fans have created software deliberately designed to mimic the look of CRT screens; whether such artifice runs the risk of overcomplicating a work originally based on vintage hardware may have to be a case-by-case decision.[20]

Figure 8.4
Grahame Weinbren and Roberta Friedman, *The Erl King*, 1983–1985, recreated 2004. Interactive cinema installation, dimensions vary with installation. Collection of the artist. Installation views from "Seeing Double: Emulation in Theory and Practice," Solomon R. Guggenheim Museum, New York, March 18–May 16, 2004. Photographs by David Heald © SRGF. Left: the original version; right: the emulated version.

Platform Idiosyncrasies

Grahame Weinbren and Roberta Friedman's *Erl King* was the centerpiece of "Seeing Double," if for no other reason than the fact that its doppelganger required the most imaginative reengineering. Hailed as one of the first interactive video installations in 1982, by 2002 this work was on its last legs, dependent on hardware like analog video disc players and a 1982 Sony SMC-70 computer that would soon cease to function and could not be replaced. While the emulation was a triumph in that viewers surveyed could not tell the difference between the original and emulated versions, it is also a cautionary tale about the effort and cost that can be required in emulating elaborate works.

Specific features of the Sony SMC-70 computer contributed to what artists like Weinbren and Friedman could achieve in the emerging medium of interactive cinema.[21] For example, to produce a seamless interactive narrative, the artists and their collaborators wrote a custom PASCAL program,

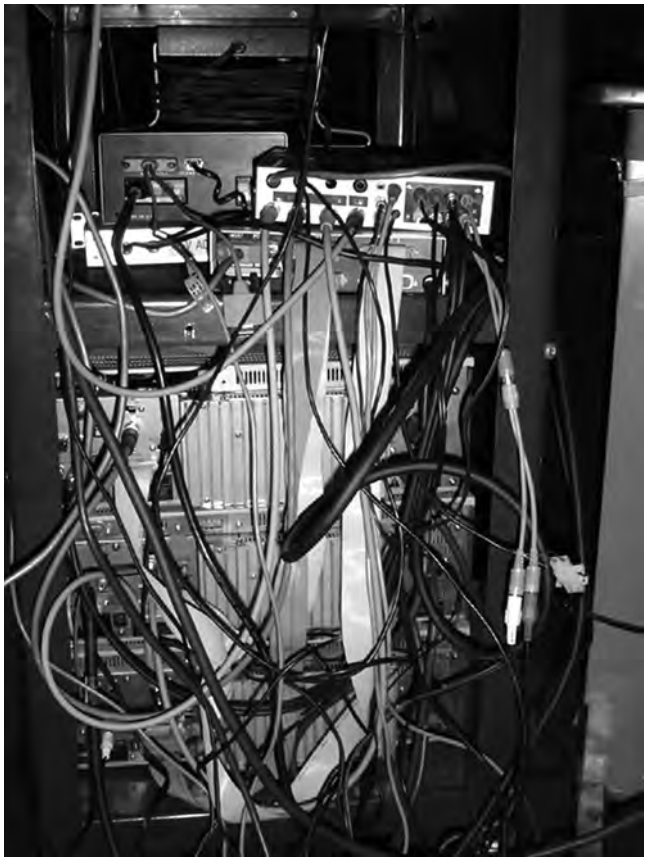


Figure 8.5
The 104 cables required to run the original hardware for *The Erl King*. Photograph courtesy of the artist.

loaded at runtime into the computer's cache disk, that displays a new video sequence when viewers interrupt the narrative by touching the screen. Due to its unique syntax and complexity, this code merits historical interest beyond its function in *The Erl King*; indeed, Weinbren and Friedman intended to share the program with other artists to help them create their own interactive video installations.

The artists worked together with the Guggenheim's variable media team and consultant Jeff Rothenberg to digitize the video and audio, and software engineer Isaac Dimitrovsky programmed a new interpreter for the original PASCAL code. When the PASCAL code sends a command to load audio, video, text, or graphics files from their original storage devices, the

interpreter emulates the function of the video switcher, the graphics cache, and the laser disc players to ensure that video and sound clips play at the right times. This re-creation is not emulation in the deepest sense, for the interpreter mimics only the PASCAL program's calls to hardware peripherals, and not the entire computer on which it runs. Nevertheless, the old code still calls the shots—quite literally—while the new code replaces obsolete hardware so that *The Erl King* can function in its intended way.

The elaborate process of transplanting *The Erl King*'s organs (hardware) while leaving intact its spirit (code and video) was only possible because of a dedicated team of collaborators. Talented technicians, an eager and forthcoming artist, original software and hardware that were still accessible, and organizations willing to fund and promote the endeavor all contributed to this preservation "perfect storm."[22] It's hard to imagine spending two years and tens of thousands of dollars to recreate every interactive video installation from the 1980s, much less every endangered example of media art.

That said, *The Erl King* transformation was instructive in several ways. In the course of thinking through the best video format for the next re-creation, the investigation uncovered an innovative way to preserve and display video.[23] In addition, the process revealed that emulation as a general strategy could be successful for complex works, but that the extensibility of that solution depends on the prevalence of the platform being emulated. Few other artworks were written in PASCAL or in the SMC-70s operating system, C/PM, so the interpreter Dimitrovsky wrote for *The Erl King* won't be terribly useful for art at large. However, if comparable effort were spent to write an emulator for a more common chip—say, hardware by the now-defunct company Silicon Graphics, employed by artists such as Char Davies, Golan Levin, and Karl Sims—the effort and expense could rescue an entire class of endangered works.

Contextual Idiosyncrasies

In chapter 7, Rick cited the perennial tendency of museums to collect and display fragments. The visual elements in Mary Flanagan's *[phage]*, a program typically downloaded from the Internet, are mined from the viewer's hard drive, and in fact much of the work's excitement stems from its revelation of forgotten emails and personal photos dredged up by the program.[24] Of course, when the work is exhibited in a gallery, the hard drive is someone else's, so there's little chance of stirring up powerful memories in the viewer.

This loss of resonance is not exclusive to emulation but frequently occurs whenever a context-dependent work is extracted from the Internet

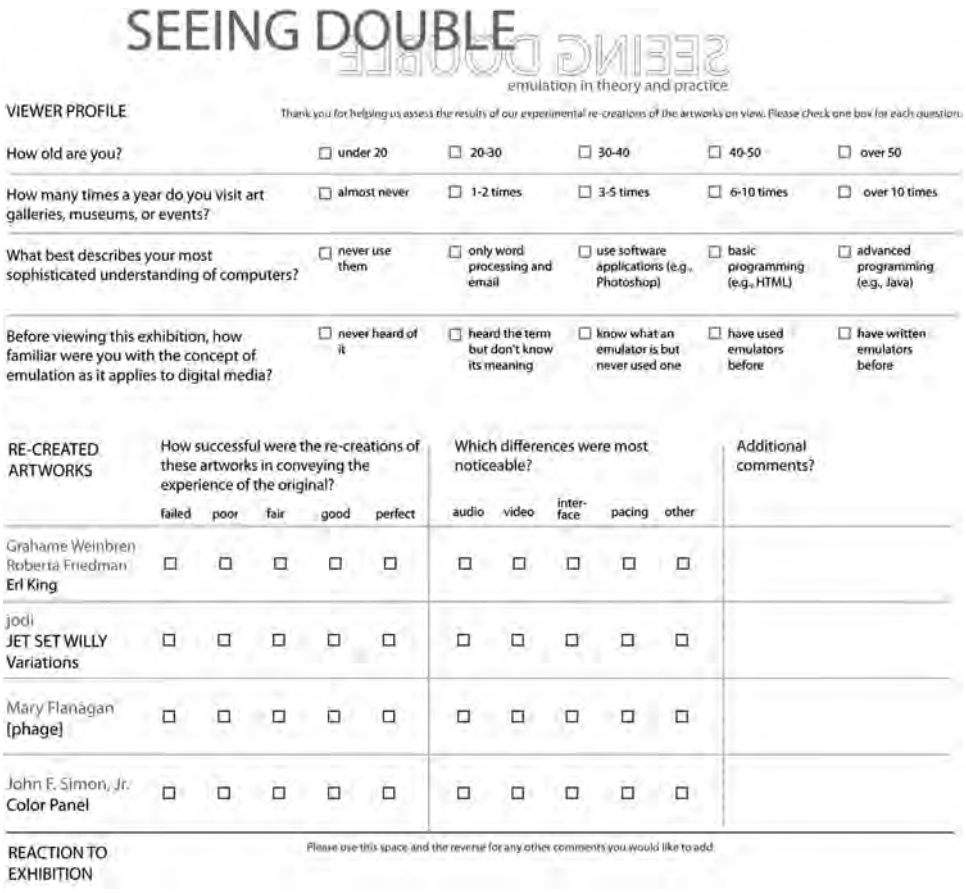
and placed on a gallery pedestal.[25] More common than dependence on a personal configuration is dependence on external links; a website like Olia Lialina's 1996 *Anna Karenina Goes to Paradise* contains many hyperlinks to pages that have since disappeared,[26] while Mark Napier's 1998 *Shredder*,[27] meant to transfigure other webpages, doesn't work with the many Flash-based sites that cropped up in the early 2000s.

Fortunately for problems such as these, emulation offers a way to reattach these works to a context, at least if we view emulation in the broad sense of simulating an original environment. For it's possible to download and store a pool of sample webpages, characteristic of the period and technology of the artwork itself, and then deploy these with the artwork as a sort of prosthetic context. We may not be able to emulate the entire Internet, but we can at least see how *Shredder* acted on contemporaneous versions of nytimes.com or guggenheim.org.[28] *

* Rick: But as with Flanagan's work, the fun of *Shredder* was in typing in your *own* website to watch it get shredded. Still, a fragment is usually better than nothing; just ask the Venus de Milo.

For the exhibition "Seeing Double," the artist and curators decided that the most appropriate hard drive to exhibit would be the artist's, and so Flanagan gamely put her own digitized memories on display. But her work was shown in three versions: the original, playing on a 1998 Windows 98 computer; a migrated version, playing on a 2004 Windows XP box; and an emulated version of the original, playing in Apple's 2004 OS X via Virtual PC. The artist and curators chose, sensibly, to match the period of Flanagan's three hard drives to each of the three preservation strategies. For the stored original on Windows 98, they used Flanagan's own hard drive image circa 1998. For the migration to XP, she loaded an updated version of her hard drive from six years later. And for OS X, she "emulated" the original ME hard drive by copying her disk image from the real 1998 hard drive to the Virtual PC version. This is a concrete example of emulating context rather than a software application per se.

As it isn't possible to store an original computer indefinitely, the exhibition organizers asked Flanagan whether she preferred the migrated or emulated variant; in response, Flanagan noted that the emulated variant had more accurate pacing. As mentioned above, in *[phage]*'s case, this slower pace was caused by the delay inherent in running two contemporary processors on the same machine. This was an accident. As a commercial software company, VirtualPC has little incentive to build controls for slowing down performance; why would a Mac user running a Windows



SEEING DOUBLE

emulation in theory and practice

VIEWER PROFILE

Thank you for helping us assess the results of our experimental re-creations of the artworks on view. Please check one box for each question.

How old are you?	☐ under 20	☐ 20-30	☐ 30-40	☐ 40-50	☐ over 50
How many times a year do you visit art galleries, museums, or events?	☐ almost never	☐ 1-2 times	☐ 3-5 times	☐ 6-10 times	☐ over 10 times
What best describes your most sophisticated understanding of computers?	☐ never use them	☐ only word processing and email	☐ use software applications (e.g., Photoshop)	☐ basic programming (e.g., HTML)	☐ advanced programming (e.g., Java)
Before viewing this exhibition, how familiar were you with the concept of emulation as it applies to digital media?	☐ never heard of it	☐ heard the term but don't know its meaning	☐ know what an emulator is but never used one	☐ have used emulators before	☐ have written emulators before

RE-CREATED ARTWORKS	How successful were the re-creations of these artworks in conveying the experience of the original?					Which differences were most noticeable?					Additional comments?
	failed	poor	fair	good	perfect	audio	video	interface	pacing	other	
Grahame Weinbren Roberta Friedman **Erl King**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
jodi **JET SET WILLY Variations**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Mary Flanagan **[phage]**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
John F. Simon, Jr. **Color Panel**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

REACTION TO EXHIBITION

Please use this space and the reverse for any other comments you would like to add.

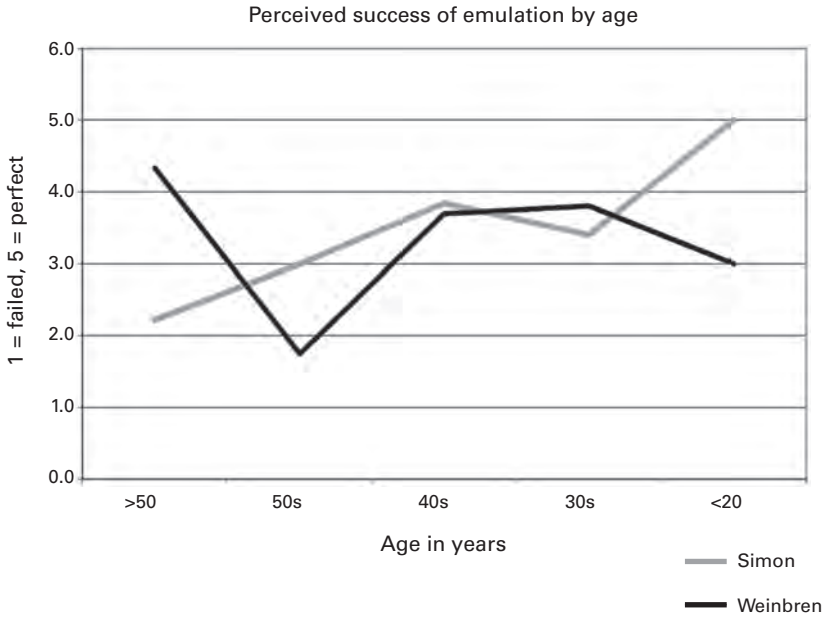
Figure 8.6
Viewer survey from the exhibition "Seeing Double," 2004.

emulator ever want her Access database to go slower than the fastest possible speed? But game enthusiasts are interested in more than just business productivity; they're sensitive, like preservationists, to the look and feel of a cultural experience. So control over pacing is one more example of a feature that preservationists are more likely to find in amateur rather than professional software.

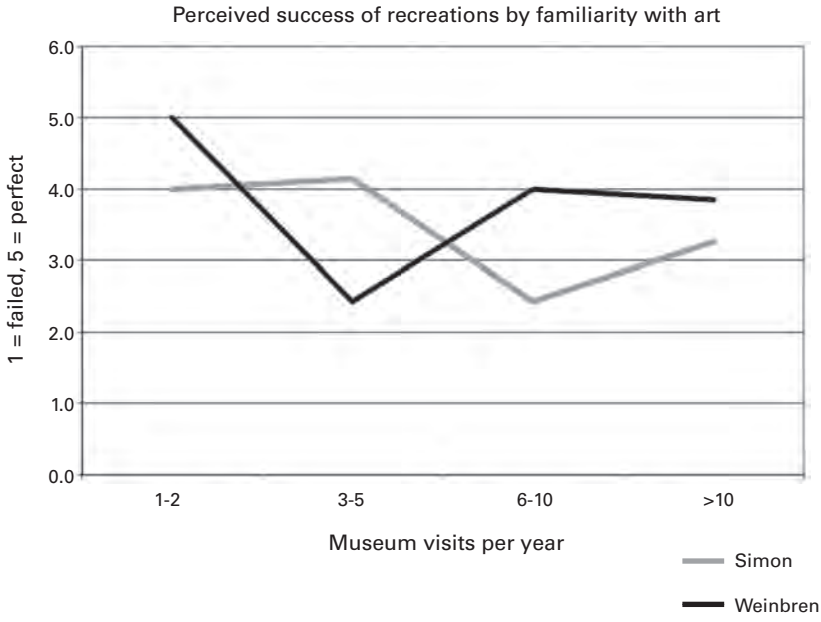
Generational Idiosyncrasies

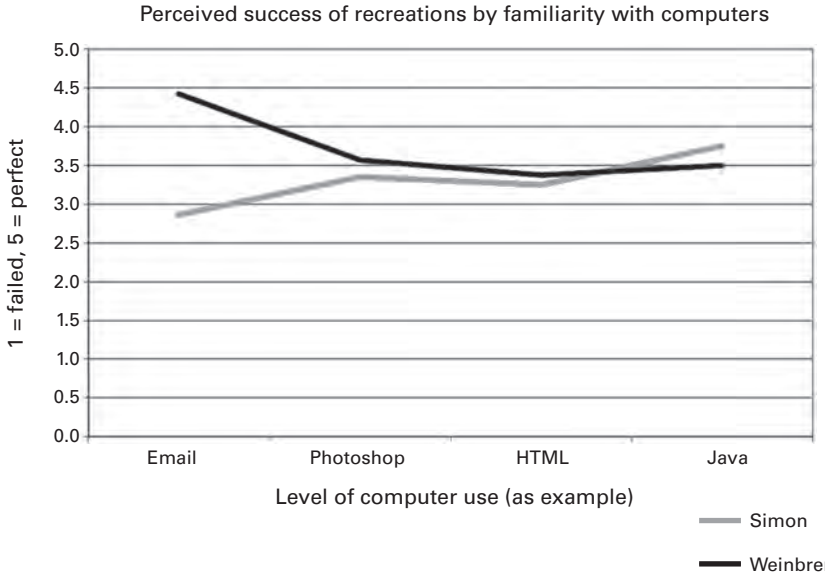
One of the objectives of the "Seeing Double" exhibition was to assess the success or failure of the re-creations on view. The Guggenheim recorded the impressions of artists and preservation experts and featured anecdotal responses in a public symposium and on the web.[29] The curators also tested the reactions of a sampling of the general public via a survey handed out to forty visitors (see figure 8.6).

Overall, the reactions were positive, in the sense that viewers rated the emulations as "good" representations of their originals (see figures 8.7–8.10) across a variety of genres and media, with seemingly negligible

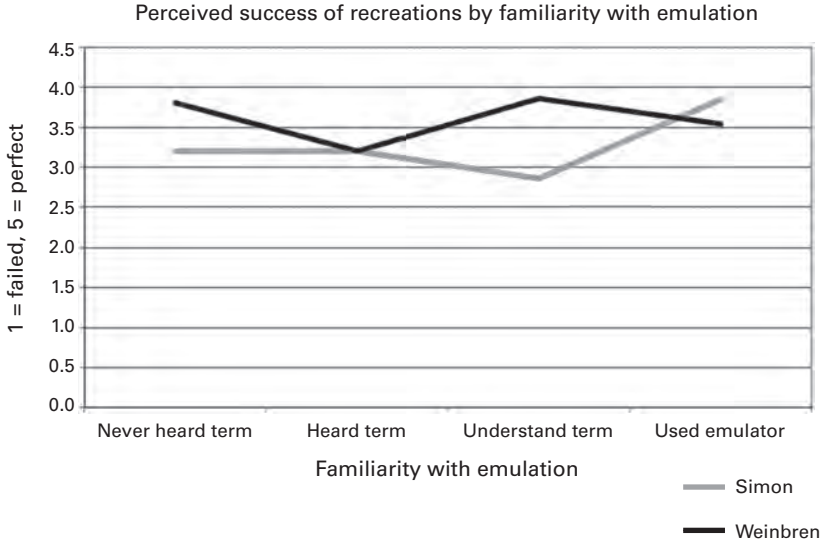


Figures 8.7–8.10
"Seeing Double" survey results: perceived success of re-creations by age, familiarity with art, familiarity with computers, and familiarity with emulation.





Figures 8.7–8.10
(continued)



Figures 8.7–8.10
(continued)

variation across the demographic spectrum. However, if the data are combined so that the horizontal axis corresponds to a measure of "digital savvy"—where familiarity with computing and emulation increases and age decreases as points move from left to right—the graph (figure 8.11) suggests a subtle but discernible difference of opinion.[30] Respondents with the least digital savvy were more likely to approve the *Erl King* re-creation than the *Color Panel* one, while those with the most savvy came to the opposite conclusion. (The reversal of the age axis reflects the preponderance of technical sophistication among younger visitors to an art museum.)

What can we make of this discrepancy? Recall that the re-creation of Weinbren's *Erl King* deliberately emulated the look and feel of the original as much as possible, from the action of the video to the material of the kiosk itself. For example, Weinbren chose to embed the flat screen into the kiosk panel above the touchscreen, which meant that apart from slight differences in brightness and resolution, this screen was indistinguishable from the CRT of the original installation. In fact, the old and new versions looked so similar (figure 8.4) that some visitors asked why the curators put two identical works in the show. This misreading prompted the curators to add a glass front to the kiosk base in order to show the differences

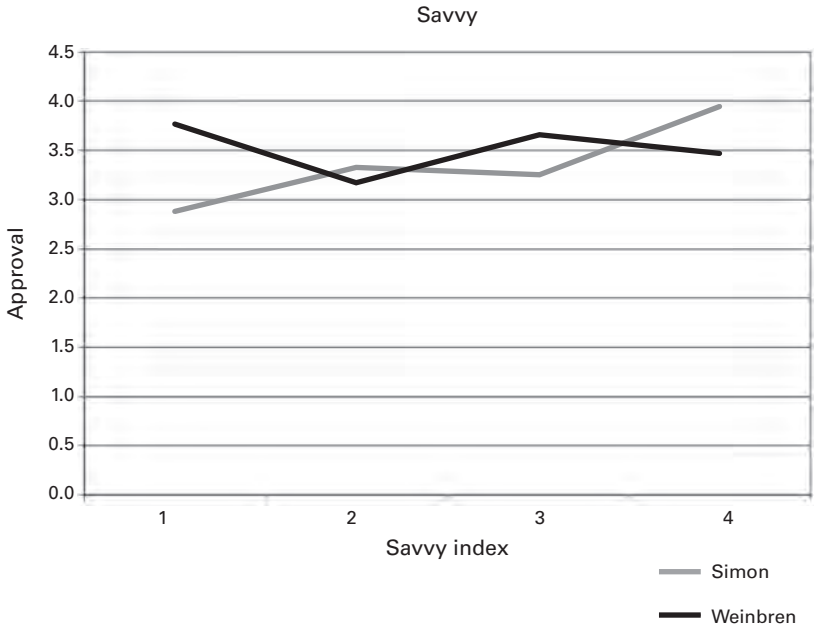


Figure 8.11
"Seeing Double" survey results: perceived success of re-creations by all four demographic criteria combined to represent viewer "savvy."

between the original hardware—104 cables and all—and the solitary desktop computer that constituted the new hardware.

By contrast, artist John Simon migrated to a laptop with a larger and brighter screen for *Color Panel* v1.0.1 than for *Color Panel* v1.0—a fact which viewers less familiar with computers apparently judged against his re-creation. For technically sophisticated viewers, however, the fact that Simon's code wore a new suit was less relevant, as these respondents were more likely to accept changes in look and feel as long as the code behaved the same. Whether due to a specific experience with game emulators or a general understanding of software, the acceptance of emulation as a preservation technique thus seems to vary with age and technical sophistication.

This difference matters because we are not used to looking to youth for expertise, especially when it comes to long-term cultural survival. Since "Seeing Double," the Maryland Institute for Technology in the Humanities, University of Illinois at Urbana-Champaign, Stanford University, and the Rochester Institute of Technology conducted an ambitious examination of emulation as a preservation strategy for case studies ranging from *Spacewar!*

(1962) to *Second Life* (2003) as part of their project Preserving Virtual Worlds. The consortium's final report lamented "the disconnect between active collectors and programmers building software such as emulators" and encouraged "museums and other collectors to start the exploration process into emulation," with a goal "to unite various grassroots development teams into a larger community dedicated to the preservation mission."[31] To begin building bridges between the amateur and academic communities, the organizers of Preserving Virtual Worlds joined the International Game Developers Association and held a conference called "Play—Machinima—Law" in 2009.[32] Now, it's questionable whether many emulator-writing twenty-somethings would attend meetings of the IGDA or a conference at the Stanford Law School—or, for that matter, would be eager to unite under a single banner rather than continue to tinker with their own pet projects. Nevertheless, without some kind of outside support, fan-made emulators can fall into neglect and disrepair, making the bridging of these generational and cultural gaps all the more important.

Recommendation: A Tiered Approach

Perhaps the best way to address the challenges raised for emulation by these cases from "Seeing Double" is to remember that digital media afford a "both/and" rather than only an "either/or" approach. To adopt a tiered approach to emulation might mean acknowledging dependencies via techniques like storage and migration, but augmenting them with emulation when these strategies fail in the longer term.

For example, storage can be useful in documenting what is lost by emulation, as demonstrated by another work by jodi from "Seeing Double." *All Wrongs Reversed © 1982* is a video recording of ten programs written in BASIC, running on the vintage ZX Spectrum, that slowly paint rudimentary black-and-white patterns on the screen.[33] In a move reminiscent of Robert Morris's decision to film his live performances as documentation,[34] jodi produced a video screen capture of an unseen programmer typing in commands and seeing the results. The DVD is not interactive, but can be stored or migrated in video format and in some ways mimics the visual properties of the Spectrum screen better than the emulated version running on a contemporary PC. Such recordings may help fill in the gap to explain what is lost in emulation, or to help improve the act of emulation once the original hardware is toast.

For his part, Cory Arcangel points out the connection between emulation and reinterpretation:

In thirty years a laptop running that game is going to mean nothing to the public. So I want *I Shot Andy Warhol* to be exhibited with a real light gun, the Nintendo, and preferably a period TV set. In fifty years if you searched the world over and there were no Nintendos, you could emulate it, but I wouldn't want a gallery to go out and spend $18,000 to rebuild light guns. I would want someone at home to be able to download and play around with the source code on his or her own emulator.

Arcangel acknowledges that part of emulation culture is being open to remix—a topic we will return to in chapter 10:

Other people have already been porting my work to other versions. Somebody wrote me and was like, "Hey I got it to work on a Gameboy emulating the Nintendo," and I was like, "Cool." Because I also participate in behind-the-scenes emulation culture. Everything I learned about programming comes from homebrew culture, and it's important for me to give the code away so someone else could learn from it.[35]

Emulation is, to paraphrase Oscar Wilde, rarely pure and never simple. Artists such as Cory Arcangel, jodi, and Robert Morris may choose emulation in combination with other preservation strategies, such as storing obsolete equipment or recording staged performances. When manipulation of hardware is critical to the artwork, as with the electronic sculptures by Nam June Paik or John Simon, emulation may not be as appropriate for the short term as storing or migrating the original components to their up-to-date equivalents. And even in cases where emulation is the ideal solution, as in works by Mary Flanagan or Grahame Weinbren and Roberta Friedman, practical logistics and cultural factors may force artists to augment pure emulation with creative solutions of their own.

These compromises do not refute the value of emulation for recreating ephemeral artworks, but they do suggest that the intent of the artist may be a better guide than a one-size-fits-all technical solution. And sometimes that means emulation, even if it's impure. As Grahame Weinbren explains:

The breakthrough technology of the laser disc is that it allows the sequencing of images to be determined at the time of presentation, rather than fixed during the production process as would be the case with a film or videotape. This in turn means that a system can be set up so that the viewer can determine the sequence. In this way it is random access, not digital technology, that animates and releases the *Erl King*. Most of the equipment that runs *The Erl King* is now twenty years out of date. If the piece is to last into the future, it will have to lose its dependence on dinosaur machinery (and today's hot devices are always the dinosaurs of tomorrow). In some cases the apparatus that runs a piece is an indispensable part of the work, but for *The Erl King* it is irrelevant. The apparatus is no more than what makes the interactivity possible, so a digital version of the piece, whatever equipment it runs on, will be exactly the same piece. But it is necessary that the computer code and video precisely

match the original, and for that reason we decided to write a computer program that interprets the original computer program for a contemporary computer environment. All hardware is emulated, i.e., the video players and the switcher are now digital devices, parts of a computer program. Thus, *The Erl King* has been transformed from analog to digital.[36]

By 2013, preservation professionals at the Library of Congress's summit "Preserving.exe: Toward a National Strategy for Preserving Software" were treating emulators less as a bastard than a favorite child. The Library's Leslie Johnston admitted:

We were given a brief sneak peek at [a] pilot for the Olive Executable Archive from Carnegie Mellon University, and were witness to fully playable Virtual Machines of games. The Multiple Arcade Machine Emulator is so successful a project, that, after 10 years, they have a short list of the games they *cannot* emulate. New York Public Library has been testing interactive visualizations of theatrical lighting design that run using files that are part of their Theatrical Lighting Database. The emscripten project provides a robust framework for emulation in the browser. . . . I was convinced this week that emulation may serve our needs better than hardware, except for the need to read the media in our collections to preserve their content. We cannot all become museums of computer hardware.[37]

Even more encouraging than emulation's endorsement by Library of Congress staffers is the fact that some of these emulators have begun to converge in the manner of FCEUX. A band of developers including the Internet Archive's Jason Scott have made progress merging the Multiple Arcade Machine Emulator and emscripten to produce JSMESS, a JavaScript-based emulator that simulates platforms like Atari, Gameboy, and Sega directly in a web browser.

Nevertheless *The Erl King* remains as of this writing the only case I know in which a collecting institution sponsored the development of an emulator to preserve a cultural artifact.[38] I hope there will be more. In the meantime, it would be criminal not to look outside of the institution's walls for help preserving what's inside them. As Jason Scott says of JSMESS:

There's no vendor, there's no standards body, there's certainly no government or parent body that's controlling the creation of these items. In some ways that's scary, in other ways that's very liberating.[39]

IV Law

9 Death by Law

Jon Ippolito

The Fates of Media Culture

Of all the competing divisions inside museums, universities, and related cultural institutions, the legal department often holds the most control for the least public profile. Laws in general, and copyright in particular, play a powerful role in the creation, acquisition, and collection of contemporary art. Having learned law as it pertains to paintings and sculptures, lawyers who work for such collections have stepped bravely into the murkier niceties of digital assets like JPEGs and JavaScripts, where intellectual property is the only property. And so it has become common practice among museums to acquire a signed piece of paper in lieu of a candy spill or Internet artwork, and numerous artists and galleries have made the paradigm shift of peddling licenses and certificates instead of pigments and videotapes.

Yet while the legal apparatus of copyright may enable forms of collecting that can live beyond the lifespan of the work's original material, the increasing intrusion of intellectual property into the cultural milieu of creativity can have indirect effects that restrict or prohibit access to works or their re-creations in the future. Today's headlines are rife with news of well-intentioned people who've fallen victim to attacks from overreaching copyright lawyers, from the music industry threatening stable owners playing classical music to horses and grocery clerks humming the Rolling Stones as they stock the shelves, to Sony suing programmers who try to teach their robotic dogs to dance and FedEx suing a man who made his own furniture out of FedEx boxes.[1]

The Fates of Greek mythology operated beyond the purview of mere mortals to determine their destinies, spinning out lives only to cut them short when they deemed fit. This chapter looks at how lawyers have become the Fates of contemporary media, privately deciding the lifespans of cultural creations in many different media.[2]

Case Studies

Words: Martin Luther King, Jr., "I Have a Dream"

You'd need to have lived under a rock for the past fifty years not to have heard of the "I Have a Dream" speech by Martin Luther King, Jr. Unfortunately, copyright may prevent you from hearing the speech itself for another fifty years, whether you're living under a rock or not.

In 1963 King delivered the seventeen-minute speech on the steps of the Lincoln Memorial in Washington, D.C., to 200,000 people and millions more on live television and radio. CBS figured that was tantamount to giving it away, but the U.S. Eleventh Circuit Court of Appeals supported a 1999 suit from King's estate to prevent the network from playing the speech without permission. The court saw King's speech as a performance from a script, akin to plays and television broadcasts, and hence a "limited publication" covered by copyright rather than the public domain.[3]

The "I Have a Dream" example is uncharacteristic of copyright infringement cases in that the Little Guy (the King family) is suing the Big Guy (the entertainment industry). And it's easy to understand why the King family might feel entitled to ten dollars from each listener[4] after U.S. president Richard Nixon sold his papers to the government for $18 million.[5] Yet despite its idiosyncrasies, this case still boils down to a tradeoff between private and public benefit. Although CBS and the King estate settled out of court, the fact that the court was inclined to judge in favor of the copyright holder—indeed, to expand copyright to cover a speech that most lay people would assume to be public domain—shows how precarious access to culture can be, even when it's shared in the most prominent public space in the nation.[6]

King's speech was, of course, a political rather than an artistic act, but politics, like other social activities, often provide the fodder for creative response and expression. And while there's no doubt that King's oratory skills make his rendition of his speech especially stirring, a recording of a speech can sometimes distance it from its present relevance. Inspired to reinterpret counterculture politics in contemporary dress, new media artist Mark Tribe organized a series of reenactments of famous speeches from the 1960s and 1970s in public spaces from 2006 to 2008. Far from mere "period pieces," these speeches implicitly underlined the parallels between the Nixon and Bush presidential administrations, between the Vietnam and Iraq wars, and between other social issues that echoed across four decades. Ironically, Tribe had no trouble with copyright[7] even though the first performance in this series was drawn on a speech given by Martin Luther King,

Jr's widow, Coretta Scott King, at a peace march in New York City's Central Park in 1968.

The proliferation of unauthorized "I Have a Dream" speeches on the Internet points at a more significant irony. In the age of digital media, civil disobedience operates in a climate of oppression not from racist neighbors or militaristic governments, but from legal strictures that protect corporate interests—as a case study of a different audio recording will show.

Sounds: Danger Mouse, *The Grey Album*

Copyright forbids the unauthorized rebroadcast of creative works, whether "I Have a Dream" or "Lucy in the Sky with Diamonds." But artists don't always need to borrow another creative work wholesale; often they simply want to copy an inspiring snippet for use in their own cloth. A painter who admires Velázquez's gray must mix it on her own palette, but digital composers can sample a Beatles' backbeat directly using audio editing tools. Some remix artists loop that sample, overlaying their own vocals or instrumentals. Other musicians are clever enough to puzzle together new compositions entirely from pieces of other artists' work, a technique known as "mashup." In fact, some mainstream musicians release albums entirely for this purpose, as when rapper Jay-Z issued a CD in 2003 called *The Black Album* with a cappella versions of his songs.

Within a year of the *Black Album*'s release, enterprising audio artists had already married it with other material to make new albums; one would soon become infamous. Brian Burton, known as DJ Danger Mouse, fused vocals from Jay-Z's *Black Album* with unauthorized samples from the 1968 *White Album*, perhaps the Beatles' most famous LP. Burton released the tracks freely online, later claiming it "was not my intent to break copyright laws. It was my intent to make an art project."[8]

The frisson of Jay-Z's explosive rap against the Beatles' Liverpool accents was nothing compared with the contrasting reactions from the recording industry and the Internet public. EMI, the Beatles' record label, promptly tried to halt distribution of *The Grey Album*, at which point open-culture activists Downhill Battle organized an act of online civil disobedience called Grey Tuesday. On February 24, 2004, 170 websites posted copies of *The Grey Album* for free download over twenty-four hours; Downhill Battle claims over 100,000 copies were downloaded on that day alone.[9]

One of the features that makes mashup culture so fertile is that it's easy to work from someone else's mashup to make your own. *The Grey Video* is a mashup of a mashup, in this case in a different medium from the original. Created by a team known as Ramon and Pedro and set to one of the tracks

Figure 9.1
Danger Mouse (Brian Burton), cover for *The Grey Album* (2004)

from the *Grey Album*,[10] this black-and-white music video begins like a vintage recording of a Beatles performance but soon goes awry as audio and video footage of Jay-Z in concert insinuates its way into the performance. Working with scenes from the Beatles' film *A Hard Day's Night*, the directors used video-editing tricks and computer-generated images to show John Lennon breakdancing and Ringo Starr scratching LPs in the manner of contemporary DJs.

The Grey Album may never have appeared on MTV[11] but it swept across the Internet, where dispersed distribution channels allow other remix artists such as Negativland and John Oswald to circulate mashups freely while staying one step ahead of lawsuits by the music industry. Though the artists often claim they are interested merely in expressions of artistic freedom, it's hard sometimes not to read the more provocative mashups as rebellion

Figure 9.2
Ramon and Pedro (Laurent Fauchère and Antoine Tinguely), *The Grey Video* (2004), video still.

against the way that the entertainment industry uses the law to prop up an outdated business model.[12]

Games: RSG, *Kriegspiel*

French theorist Guy Debord, the leader of the Situationist International in the 1960s, coined the term *détournement* to describe something very akin to the remixes so popular among musicians of the digital age. Like remixing a song, to *détourne* is to repurpose some element of culture, often from the mainstream. Unlike most remixes, détournement reuses the original source quite faithfully, but orchestrates a different, sometimes opposite, message from the original. Curiously, a dozen years after Debord's death, the re-creation of one of his own works provoked a scandal that challenged the legal limits of détournement.

Although best known for his 1967 book *The Society of the Spectacle*, which rejected the idea of copyright and blamed mass culture for the alienation of man,[13] Debord eventually dissolved the Situationist International and devoted time to devising a board game based on war—perhaps an odd

Figure 9.3
RSG, *Kriegspiel* (2008), game still. Alexander R. Galloway, producer and programming; Carolyn Kane, research; Adam Parrish, programming; Daniel Perlin, sound; DJ /rupture and Matt Shadetek, music; Mushon Zer-Aviv, design. Screenshot courtesy Alexander R. Galloway. Image courtesy of the artist.

project for a Marxist historian, but one that Debord claimed before he died to be his only work of lasting value.[14] The public disagreed, though, and his game was a commercial flop.

Enter Alexander Galloway four decades later, a software artist and critical theorist in his own right who decided to recreate Debord's physical board game as a virtual application that two players can play over the Internet. Working with designer Mushon Zer-Aviv and others in the collective RSG, Galloway released the updated version of Debord's game, called *Kriegspiel*, as a free online experience and homage to the original. If the English translation for *détourne* is "turnabout," then *Kriegspiel* turned the tables on Debord by resuscitating a key work of which many of his disciples were unaware.

Unfortunately for Galloway, Debord's widow, Alice Becker-Ho, did not seem to think turnabout was fair play. Insisting that RSG's work violated Debord's copyright, she sent cease-and-desist letters to Galloway in an attempt to close down this artistic re-creation of her late husband's game. It's hard to understand why: her husband had explicitly disavowed copyright for seminal works like *Society of the Spectacle*; the game had already

been commercially released in a very limited edition with little success; and RSG's version was given away for free. Perhaps the most disagreeable irony of Becker-Ho's reaction lay in the obvious care that Galloway and his collaborators took in rendering Debord's homely little game in the most technically and culturally sensitive manner. True, the Java version included spiffy three-dimensional graphics and real-time feedback about legal moves and the like—but the details of the game, from the look of the figurines to the rules of gameplay, were painstakingly produced with great faithfulness to the spirit of the original.

As we saw in the last chapter, the re-creation of vintage games is more than a defensible cultural heritage project; its zealous fan base is a powerful ally for digital preservation, having managed to popularize the potentially arcane technology of emulation.[15] Yet as the Debord case suggests, a recreator, no matter how well intentioned, can earn the wrath of a copyright owner, no matter how Marxist.* Indeed, lawyers for the gaming industry have tried to quash the trade in emulators and vintage game images, or ROMs, even when the original game is no longer produced or the company that made it is out of business.[16]

* Rick: How many such lawsuits are brought by artists' estates once the artist is dead? Your examples so far involve a proxy for the artist like an estate or label. Even if an artist supported remix, artists' estates often take an opposite stance unless they have left explicit instructions to the contrary—another case of the default being the most conservative position and having a chilling effect on culture. Maybe the greatest gift an artist could leave would be to emblazon their tombstone with a Creative Commons license.

Codes: John Klima, *Glasbead*

Software artist John Klima is one of a handful of artists to make their names exploring virtual reality for artistic ends. He's a master of weaving together data from a variety of sources in a three-dimensional world, having created virtual globes from NASA data, flocking bots that swarm according to real-time currency trading, and music interfaces whereby Internet users make collective music by swinging virtual mallets on a glowing sphere.[17]

In large measure, virtual reality never fulfilled its promise of becoming a pervasive medium for transporting its users to alternative worlds created from pixels rather than protons.[18] Klima's success may in part be due to his eschewal of the clunky and expensive immersive extreme of VR, in which

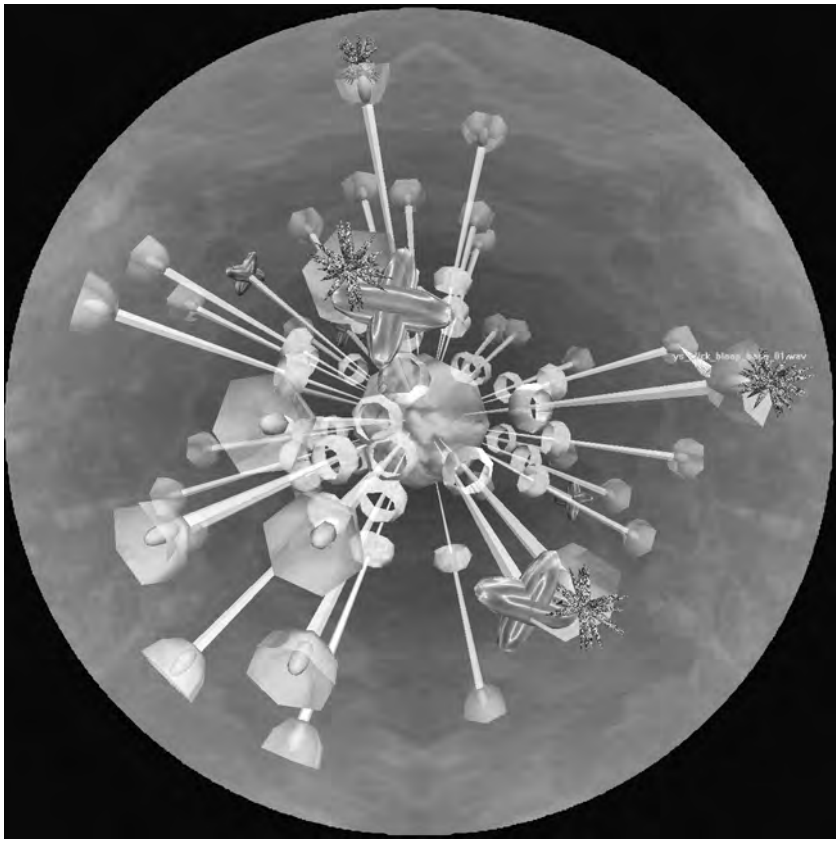


Figure 9.4
John Klima, *Glasbead* (2000), screenshot. Image courtesy of the artist.

the viewer dons a headset or force-feedback device or data glove, in favor of more familiar computer interfaces such as a mouse or trackball.

As a "fringe" technology, virtual reality is prone to quick obsolescence; the best-known artworks of fellow VR pioneer Char Davies received a death warrant when the company that produced the hardware for her immersive worlds, Silicon Graphics, went belly up. Klima invested in a less exotic platform, building his environments in Sense8's WorldUp toolkit, which could run on Windows ME at the end of the 1990s. Sadly, a few years later, when Windows XP was released as a successor to ME, the upgrade caused a fatal floating-point error that crashed his virtual worlds, and it seemed that all artistic VR of the turn of the century would die from technological obsolescence.

But it's a frame job: in Klima's case, the law, not the software, is ultimately responsible for his works' demise. Klima is confident he could debug the glitch if he had access to the code, but Sense8's draconian, hardware-specific licenses locked him out. More recently, Klima has been working in open-source 3D software like Blender, where the law falls on the side of open rather than closed culture.[19] At least now he doesn't feel like a mechanic forced to drive a car with a hood that's bolted shut.[20]

Bugs: Steve Kurtz, *Free Range Grains*

Thanks to overzealous copyright laws, artists working in time-based media and software have endured the embarrassment of receiving a cease-and-desist letter, appearing in court, or watching their works crash when they upgrade operating systems. Thanks to the USA Patriot Act, however, biotech artist Steve Kurtz was hauled off by the FBI while federal agents in hazmat suits ransacked his home, impounding his computer and manuscripts, and removed his wife's body from the county coroner.[21] The creative use of biological media can provoke an extreme reaction from authorities—in part for justifiable reasons, in part for political ones. To many observers, Kurtz's case was an example of the latter.

This tragic episode in Kurtz's life began when he awoke at his home in Buffalo, New York, to discover that his wife had died of congenital heart failure. When the police arrived after Kurtz called 911, they saw the couple's petri dishes in their home lab—fodder for an upcoming exhibition on genetically modified agriculture for the Massachusetts Museum of Contemporary Art. The FBI then detained Kurtz for twenty-two hours without charge, despite his tasting the harmless bacteria in front of an officer to prove he wasn't a bioterrorist.

Of course, genetically modified materials raise real concerns due to their ease of mutation and proliferation, and even some artists have criticized Kurtz for using them without careful safety procedures.[22] However, upon hearing of this case, numerous well-known artists and scientists came to Kurtz's defense, among them the journal *Nature* and Mary-Claire King, the biologist credited for demonstrating the genetic basis of breast cancer, who argued that Kurtz's materials were "politically, not physically, dangerous."[23]

Perhaps this is because Kurtz's goal was not to create more frankenfood but to demystify genetic engineering. One of the artworks scheduled for exhibition at Mass MoCA and seized by the FBI, *Free Range Grains*, allowed lay visitors to test food labeled "GM Free" for the presence of genetically modified ingredients. Four years later, all charges

against Kurtz were finally dropped, but the lesson for any creator who wants to work with biotech art is that pharmaceuticals that splice one genome into another get patents, while artists who put *E. coli* in a petri dish can get jail time.

Leaving aside the question of whether Kurtz's actions were responsible, his case demonstrates the different standard society places on private individuals versus scientific laboratories, which are free to create the most virulent strain of bird flu imaginable in order to procure attention and funding.[24] As we'll see in chapter 11, biological replication may prove a valuable tool for future preservation, because encoding data in genetic material can guarantee its automatic proliferation. Nevertheless, legal constraints on private wetware experiments may stifle this form of preservation just as copyright has stifled game emulation. If genomics are poised to become a computational medium of the future, then the laws we put in place now could decide the extent to which ordinary citizens will be able to contribute to or influence the direction of this novel storage technology.[25]

Webpages: The Wayback Machine

There are many victims in the war against digital obsolescence and amnesia, but one clear victor is the Internet Archive. Begun by Brewster Kahle in 1996, this digital library encompasses many collections, of which the most famous is the Wayback Machine, a service that allows users to type in a web address and then view archived versions of webpages corresponding to that URL. While the Wayback Machine cannot capture all of a website's contents, the "snapshots" it acquires tell a fascinating story of the evolution of web design and usage. By 2009 the Wayback Machine already had more text than the Library of Congress.

Perhaps the most remarkable aspect of the Wayback Machine is not its rapid growth or incredible volume, but the fact that it's still here. For Kahle never asked permission to archive three petabytes of other people's webstuff; he just did it. Though a bit more buttoned down than fellow "pirates" like Danger Mouse and Negativland, Kahle shares their expressed disinterest in deliberately pissing off copyright owners; he just wants to save webpages from certain doom as the individual servers and DNS records they depend on expire.

The Wayback Machine has been the target of surprisingly few lawsuits, perhaps because of its stated interest in only archiving websites of people who want them preserved.[26] That said, the Wayback Machine assumes that everyone wants her or his site preserved unless it is told otherwise, an

"opt-out" policy that is the mirror opposite of U.S. law's own assumption that all creators want their work copyrighted unless they explicitly say otherwise. Fortunately, the Internet Archive makes opting out easy for every Tom, Dick, and Harry.com that doesn't want to be part of the archive: site owners can just add a "robots.txt" file to their website that prevents the Wayback Machine from indexing its pages.

Unfortunately, that convenience hasn't prevented companies from suing the Internet Archive when either they didn't follow the robots.txt exclusion or the technology failed. Curiously, however, copyright infringement has not been the center of the major suits to date, but merely a means of contesting evidence due to a third-party suit. The best known case happened in 2003, when a healthcare company was sued for trademark violation using evidence from the Wayback Machine. The healthcare company then turned around and tried to sue Kahle and company for violating the Digital Millennium Copyright Act (DMCA) and the Computer Fraud and Abuse Act.[27]

The suit was settled out of court, but the takeaway is that copyright can be a loose cannon wielded for a variety of motivations—and that those who create and preserve culture often get caught in the crosshairs.*

* Rick: Glad you brought up motivations. Motivations are important in the discourse around copyright. For instance, in many discussions, greed is the implicit if not explicit motive attributed to corporate copyright protectionism. However, in the cultural heritage sector, greed does not often factor into the copyright discourse; rather, tropes of integrity and authenticity are invoked, sometimes sincerely, sometimes as a smoke screen for the cultural authority of established institutions. It's important to identify and address the motivations head-on if we're to communicate clearly and resolve such problems.

Profit over Preservation

As mentioned in the introduction to this chapter, intellectual property has in recent decades played a significant role in preserving new media culture, in that it allows museums and other institutions to collect works in variable media via certificates. Nevertheless, as more and more creators exploit new media such as electronic networks, biotech, and remix culture, the concept of ownership "does the exact opposite of what it was

originally intended to do: instead of promoting creativity and protecting creators, it inhibits creativity and puts creators at risk."[28]

But the law isn't just what's penned in the U.S. Constitution; like the word "technology," the word "law" stands for a bundle of social constraints that undergo constant contestation by everyone from senators to sheriffs, from ethics professors to entertainment lobbyists. In recent years, the entertainment and software corporations have been the ones winning that contest, resulting in the legal doctrine of copyright maximalism and an arsenal of technical ploys to foil digital piracy. Whether encryption schemes like digital rights management (DRM) actually deter piracy is an open question; the untold dollars that Sony spent developing its XCP anticopying technology were easily defeated by sticking a piece of ordinary tape on the outer edge of the CD.[29]

Functional or not, such antipiracy schemes often thwart reasonable access or compromise the rights of consumers, provoking librarians and software developers to decry provisions of the Digital Millennium Copyright Act as antipreservation.[30] Undeterred by the XCP fiasco, however, Sony slipped a hacker's tool called a "rootkit" into music CDs to keep them from being copied; this hidden program insinuated itself into users' hard drives and communicated secretly with Sony about files accessed by the user. Ironically, the rootkit illegally used code previously written by hackers to defeat DVD encryption.[31] Maybe Sony's executives decided that they had to violate copyright in order to protect it?

Regardless of the motivations of companies like Sony, scandals over these revelations seem so far only to have reinforced such media conglomerates' determination to control the production and distribution of culture, regardless of its effects on society at large. Pressured by the movie industry, the office supply store Staples began stocking self-destructing DVDs,[32] which morph into a gluey drink coaster forty-eight hours after you open the package. In response to the failure of DRMed music and books to run on iPods and Kindles once the industry's authentication servers go dark, music and movie industry lawyer Steven Metalitz told the Copyright Office, "We reject the view that copyright owners and their licensees are required to provide consumers with perpetual access to creative works."[33] And just to make it clear, Sony Pictures CEO Michael Lynton remarked, "I'm a guy who doesn't see anything good having come from the Internet, period."[34]

Bruce Sterling called DRM "a giant cultural-suicide service,"[35] but it's not as if this service is voluntary for producers and consumers of digital culture. Human mortality has always been a given, but one of the motivations of

an artist is to create works that endure beyond her lifespan. Even the merciless fates of ancient Greece spared the *Discobolus* and *Iliad* while they cut down Myron and Homer. The twenty-first-century crackdown on shared culture, and the black hole it will leave in this period in history, on the other hand, is more like a form of cultural genocide—one for which the law acts as an accomplice, if not the chief perpetrator. Overzealous copyright lawyers are making the work of digital preservationists much easier, since if they have their way there may be no accessible culture left to preserve.

10 Unreliable Archivists

Jon Ippolito

Coping with Mortality

The previous chapter surveyed two ways that the current state of intellectual property law and its attendant enforcement schemes endanger social memory: by adding layers of obsolescence to existing cultural works (the Beatles' *White Album* wrapped in digital rights management) and by chilling new forms of creative production (a cease-and-desist letter sent to Danger Mouse for remixing that album). This chapter asks whether the very remix culture targeted by this second kind of copyright overreach might offer an unconventional solution to the problem of preserving works that don't start out as remixes.

This is a scary prospect. To preserve by remixing would dethrone the authenticity of intent and material at the center of debates on preservation, and instead validate communities that propagate cultural memes with more regard for creativity than fidelity. Authenticity may be the gold standard for professional conservators and emulator coders alike, but reinterpretation is the standard operating procedure for the legions of online creators who mash up photos, music, films, and game references into promiscuous hybrids of continually evolving remixes. Though this twisted form of preservation has been growing since the dawn of the twentieth century in the form of fanzines, it has recently exploded thanks to easy access to tools like ACID Pro and websites like Mozilla's PopcornMaker.[1]

As unnerving as it may be to the average archivist, the continuous reperformance of communal culture has a venerable pedigree as a preservation strategy. This chapter will explore whether the oldest culture to persevere is carved into a stone tablet in the British Museum or reenacted every year in the songs, dances, and oral histories of indigenous cultures. And if the latter, might it be more effective to deputize an army of amateurs to serve as preservation vigilantes rather than rely on the sheriffs of storage?[2]

Before we can answer this question, however, we need to resolve a paradox about the transformative quality of memory. For, as we saw in the conclusion of chapter 6, what makes memory distinct from storage is its reliance on transformation over stasis as an engine for reviving the past. The notion that preservation involves transformation runs counter to any layperson's understanding of cultural heritage. Yet the paradox is familiar to anyone who has actually tried to preserve a legacy, be it a conservator in Rome deciding whether to clean soot off the Sistine Chapel or let it accumulate,[3] or a teenager in Reno deciding whether to use Scotch tape to fix a torn Kodak photo or replace it with a digitized JPEG. The question is not whether to allow transformation, but which transformation to choose.

One school of thought in preservation is not to choose any—that is to say, to allow whatever transformation is natural to a work's medium to take its course.[4] Unfortunately, as this book's three "Death by . . ." chapters suggest, the path of least resistance for new media artifacts inevitably leads to their extinction. That said, while the job of the preservationist is often seen as battling mortality,[5] in reality most recognize that death is not only inevitable in the long haul but may not even be the worst-case scenario for the shorter term. The worst-case scenario might be to keep a work alive in a way that betrays its original spirit. While there was a vigorous debate by professional conservators over whether to scrub Michelangelo's Sistine Chapel, there was no support for inpainting the missing faces of Leonardo's *Last Supper*. In the art world, wrinkles are often preferable to face lifts, and sometimes even pulling the plug on a patient is better than keeping alive a body without a spirit.[6]

Even when death is the only outcome, the way it is approached can make all the difference as to whether the experience is affirming or devastating. A look at some of the stages of grief made famous by Swiss writer Elisabeth Kübler-Ross may help us understand the varieties of response to the loss of a cultural legacy.

Acceptance

Of the several stages Kübler-Ross chronicled, the final and seemingly most emotionally mature is acceptance. The difficulty of accepting an individual's death is usually relative: the fact that grandpa isn't coming back from the grave may be harder to accept for the deceased's six-year-old grandson than for his sixty-year-old cousin. The loss of something belonging to an entire village or society is more widely distributed but still has its limits. When the historic Main Street of Milo, Maine, burned to the ground in 2008, the townspeople were deeply affected; we can only guess at the grief

suffered by the scholarly community of Europe and North Africa when the Library of Alexandria did the same, though few shed tears for its vanished scrolls these days. Has the world accepted the loss of, say, the Aztec or Sumerian civilizations, or have we just forgotten about them? And is there a difference?

I think there is. To accept someone's death is not to forget about it, but to come to terms with it while the person's memory is still present—and perhaps even while the person is still alive. Of course, the window for accepting the loss of something we hold dear is limited by its lifespan, and the lifespan of many new media formats is closer to that of a hamster than of a human (to borrow Bruce Sterling's memorable phrase).[7] Yet work that is born digital—which is to say, born almost already obsolete—provokes issues of mortality from the get-go. Artists were early adopters of the web, and by 1999, when the web was a mere six-year-old, curator Tjebbe van Tijen was already urging his colleagues to accept the death of what he called "traceless art":

> Is it for the pleasure of the moment itself or for posterity that we act? We cannot and need not keep track of everything. Forgetting is a necessary basis for knowing. . . . What if all the artifacts, all things judged worthwhile, for some reason at some moment in time, would have been still with us. . . . Too much preservation is suffocating, does not leave enough space for new creation. . . . One could ask if a lot of what is by some classified as "Net Art" should not be seen as . . . art for just for the moment itself [like] the ceremonial sand drawings of the Navajo, only meant to exist during the ceremony, to be blown away by the northern winds afterwards.[8]

As noted in chapter 3, process-oriented artists of the 1960s often accepted the mortality of their media, and some of their digital descendants from the 1990s designed works intended to leave, in van Tijen's evocative terms, "silicon traces washed away by the digital tide." Viewers of *The Impermanence Agent*, a software artwork by Noah Wardrip-Fruin, Brion Moss, Adam Chapman, and Duane Whitehurst, saw traces of the project gradually wash away in the course of their normal web browsing. Signing onto the proxy server for *The Impermanence Agent* produced a separate browser window that initially contained a story about the death of Wardrip-Fruin's grandmother. This small window—the "agent" of the work's title—lingered on the screen even as viewers surfed away from the artists' website in their browser's main window.[9] By inserting a proxy server between the user's browser and the Internet, *The Impermanence Agent* harvested text and image excerpts from the subsequent websites visited by its users—a snippet from Amazon.com here, a fragment from someone's Geocities page there—and used these to overwrite portions of Wardrip-Fruin's story in the smaller window with new

content. In the end the structure of the original narrative remained, but was retold in the words and pictures of the user's recent browsing history. *The Impermanence Agent* thus reenacted, in the microcosm of surfing the web, the overwriting of stored impressions essential to memory.[10] Other works that deliberately play off of, or even encourage, the disappearance of digital data—including Mark Napier's *Digital Landfill*,[11] Garrett Lynch's *Things to Forget*,[12] and William Pope L.'s *The Black Factory*[13]—remind us that there would be no memory without loss, and thus impermanence may be the natural state of things.[14]

Igor Štromajer chose a direct approach to putting his works out of their misery: euthanasia. Each day for thirty-seven days in 2011, he deleted another work of net art from his intima.org server in what he described as "an act of love":

> It was not a spectacle, nor an act of aggression or anger. . . . It was simply . . . something you have to do, to follow. Things appear, things disappear. . . . It is impossible to preserve the net art works in their original form, because there is no original form anymore, browsers have changed, external links are broken, external linked servers are down, pop-up windows are blocked, Java functions differently. . . . Memory is there to deceive, not to tell us how it was.[15]

A more quotidian, if even more unsettling, example of creative acceptance from the web forum *Slashdot* offers a curious amalgam of personal and digital mortality: a man who entombed his "geek" brother inside a computer.

Figure 10.1
Alan Watson's computer "urn."

I've not seen this topic covered here before even though it's one that will concern us all at some time: what to do with our corporeal remains after we've left for that great data bank in the sky. For my recently departed brother (long illness, don't smoke!), I thought this nice SPARCstation would be a cool place to spend eternity. Yes, he's really in there (after cremation). I kept the floppy drive cover but for space reasons removed the floppy drive, hard drive, and most of the power supply. I left behind the motherboard and power switch and plugs to keep all openings covered. The case worked quite well at his memorial party. His friends and family were able to leave their final good-byes on post-notes. Anyone who wanted to keep their words private could just slip their note into the case through the floppy slot. All notes will be sealed in plastic and placed within the case. There has been one complication. His daughters like the look of it so much they aren't now sure if they want to bury him.[16]

Storing away a departed family member in an aging plastic box in the family's living room may not be as futuristic as William Gibson's or Hans Moravec's visions of achieving immortality via silicon, but it is a much more realistic emblem of the precarious nature of flesh and circuits. (Who knew that Post-its would outlive the floppy drive?) This precariousness was not lost on another *Slashdot* user:

A rarely visiting cousin came over and made a Mii avatar on my Wii box. Subsequently, he died a violent flaming death in a car accident. Irrationally perhaps, I feel like it is my solemn duty to keep 'him' alive on my Wii. Make backups of him. Transfer him to my friends' Wiis.[17]

The popularity of participatory media has resulted in a virtual whirlwind of data that continues to swirl through a disembodied cyberspace after their creators are dead. Think of executors charged with combing through a relative's "effects" on the deceased person's hard drive, or Facebook's policy of archiving the pages of its dead users (leading to emails reminding you to "reconnect" with deceased friends), or TV news reports of the sound of hundreds of mobile phones ringing among the corpses in the 2004 Madrid train bombings. As appealing as it may sound to live on after death as ghosts in the machine, we should remember two caveats. First, these disembodied deceased do not live on as ectoplasm but as echoes—fragments of email messages, long-gone websites still appearing in search results, photo accounts on Flickr that will never be updated or deleted because the owner has died and the password died with him. Second, these cases of computational media outliving humans are the exception rather than the rule, for their lifespans are still a fraction of their users'; think of how many mobile phones the average person goes through in a lifetime, or how much longer the average Geocities user will

live than the homepages each created, which Yahoo retired at the ripe old age of fourteen.

Denial

The opposite of acceptance is denial, and its appeal is hard to, well, deny. Apart from being an unappetizing topic to bring up at cocktail parties, death just doesn't make sense metaphysically. The calls of birds, the blur of cars driving past, the remembered hopes and imagined fears that wash past us in both waking and dreaming states—these are the only lens by which the living know the world. It's tough to swallow that these qualia will someday disappear and yet the planet and galaxy will keep on spinning. To stave off this unhappy prospect, some people erect physical or psychic bulwarks against mortality: Catholics put their faith in God; extropians invest in fringe life-prolongation research (baseball player Ted Williams had himself freeze-dried, for example). As they get older, some people surround themselves with physical things, as though to ask, "How could I possibly disappear, when I have so much stuff?"[18] Yet on a rational level, most people have trouble denying that they will someday take one last breath and buy the farm.

It's even harder to deny the impending death of ephemeral artifacts like video formats and websites; there are just too many counterexamples to ignore. But some people still try. By 2010 most of the press about data in social networks focused not on its ephemerality, but on its apparent permanence, noting that the web doesn't forget that Instagram photo of yourself as a "Drunken Pirate" just because you're applying for a teaching job.[19] Google and Facebook have amassed fortunes by holding onto user data, an economic reality one participant at the 2001 "Preserving the Immaterial" conference foresaw when he opined that a surefire way to safeguard digital data would have to emerge someday, because too many banks and other powerful social institutions depend on it.[20] *

* Rick: I recognize here the sign of the savior-of-the-future—this technocratic faith that, between the powerful interests in preserving information and the progress of technology, a preservation solution will inevitably emerge from outside the cultural heritage sector. The rapture of bits will rescue us all! This attitude recalls the faith that banks and powerful institutions could never make mistakes like those that led to the economic crash of 2008 because there was too much at stake. With preservation, there is so much at stake that we cannot afford to wait to see if a future savior emerges from a cave on the side of Granite Mountain.

The dependence of today's economy on persistent data is real. Today's economy also depends on fossil fuels, but that doesn't mean oil wells will never run dry. Our society doesn't always have the power (or the willpower) to confront threats that happen piecemeal rather than in conspicuous calamities; millions more die in car accidents than in plane crashes, but nightly news and federal safety commissions focus on the latter because abrupt disasters involving many people at once are more newsworthy. The impending loss of digital heritage affects everyone, but it happens in small moments from everyday life, when Aunt Mabel's new computer won't read a favorite CD or can't find a bookmarked website—not the sort of events to prompt a presidential speech or congressional resolution.

To be sure, numerous companies are at work on technical panaceas, both for their own data and for Aunt Mabel's.[21] In 2005, Microsoft applied for a patent for "immortal computing," a design for digital artifacts that could preserve information for future generations.[22] Using this hypothetical technology, users could email cards to commemorate their grandchildren's eightieth birthdays, or preserve interactive holograms of themselves to be positioned at their tombstones. While some of these scenarios sound like scenes from a sci-fi B-movie, Microsoft's proposal includes some practical strategies, including avoiding storage mechanisms with movable parts, interfaces that can be swapped out as technology advances, alternative energies such as thermal or inductive power to run the interface, and instructions in multiple languages or pictograms (à la the Rosetta Project).[23] Microsoft even suggests that users may be able to protect their data via DNA or biometric scan so it can be accessible only by certain future users.[24]

As sunny as this forecast sounds, Microsoft's track record in keeping your data safe from the future is clouded—quite literally. One of the company's most conspicuous forays into the distributed data storage known as cloud computing was also one of its most conspicuous failures: customers depending on Microsoft to backup T-Mobile's Sidekick phone lost thousands of their contacts' phone numbers and addresses when the software giant's inauspiciously named "Danger" cloud crashed. Bruce Sterling eloquently noted the verbal fog of mismatched expectations produced when real-world vulnerability is marketed as eternal ether:

> The Cloud "crashed"? How can a cloud "crash?" The cloud "failed"? Did you ever see a cloud fail? A cloud "service disruption"? Would the term "drought" do for that? Clouds blow away with the winds, evaporate with a hot sun, they thunderstorm, they spew tornadoes, they dissipate . . . "the dark side of cloud computing has no silver lining."[25]

More insidious than this technical fragility, because intentional, is the vulnerability implied by Microsoft's "for your eyes only" feature of its immortal computing system. This "feature" recalls the specter of digital rights management (DRM) that we saw haunting the preservation cases in chapter 9, and reminds us that we only know of Microsoft's future plan for an immortal computing innovation because the company filed a patent for it. This is a familiar story: company X announces exciting new way to access culture, but then, to protect its financial interests, it imprisons this culture in an intellectual property scheme that all but guarantees it will be unusable in the long run. You don't have to wait for the twenty-third century to see how proprietary standards fail to preserve the culture of the twenty-first. Microsoft dropped support for its "PlaysForSure" music DRM within years of its launch, leaving industry partners who had agreed to support PlaysForSure MP3s without any legal or technical recourse to access them in the future, and prompting *Wired* magazine to rechristen Microsoft's initiative "Screwed for Sure."[26]

Bargaining

Between the two extremes of covering our eyes with our hands versus throwing up our hands in resignation lies a third way to accommodate loss. Bargaining is a strategy that Kübler-Ross identified as an attempt to postpone death, often by negotiating with God or some other power in exchange for a reformed lifestyle ("Please let me live long enough to see my grandchildren; I promise I'll start going to church"). Curiously, the devout appear more prone to this negotiation, even when it involves doctors rather than supreme beings.[27]

In the eyes of most therapists, bargaining has always been at best a temporary strategy, and generally one resorted to in vain. Yet recent research suggests that recordings and other substitutes for lost experience may help people overcome grief.[28] If we view bargaining as a tradeoff, perhaps it's not such a bad model for how to keep new media culture alive. The question is, what are we willing to give up in return? The answer, as we shall see, is control—and this is where preservation can fall afoul of the law.

Bargaining is a more realistic strategy for keeping data flowing than for keeping a sculpture intact or a human heart beating. Digital artifacts operate by a logic of "both/and" rather than "either/or." As most digital files can be cloned without loss, a preservator can migrate a work without affecting its original version. Conservators bent on rescuing an equine sculpture from the smog in Athens might move it to the British Museum, but this has the unfortunate side effect of leaving a gaping hole in the Parthenon.[29]

Migrating an audio file from WAV to Ogg Vorbis, by contrast, doesn't require removing the original file. When faced with restoring Douglas Davis's *The World's First Collaborative Sentence* (1994), an early work of Internet art, curator Christiane Paul and conservator Ben Fino-Radin didn't have to choose between displaying the original, obsolete version and migrating the work to a functional update. They simply offered both to the public.[30] Artist Olia Lialina's aptly titled ongoing project *Last Real Net Art Museum* offers a more proactive approach.[31] Here the creator invited other artists to remix the pieces of her frame-based HTML narrative *My Boyfriend Came Home from the War* (1996) before it became obsolete. Lialina's *Museum* is a website that exhibits over two dozen variations, in an assortment of media from PowerPoint to Post-it notes, along with a detailed accounting of everyone who played a role in the work's creation and re-creation. If the effect of analog preserving is often fragmentation, the effect of digital preservation can be proliferation: the act of preserving becomes a palimpsest, writing new versions into the cultural niche formerly occupied only by a single version.

Unfortunately, this proliferation runs counter to a long-standing metaphysics underpinning the concept of preservation, namely its conflation of what is authentic with what is original. These two concepts are intertwined in the very word "archive," derived from the ancient Greek verb *arkhein*, which means both "to rule" and "to begin."[32] Copyright law chooses to bridge these seemingly unrelated etymological roots—what Jacques Derrida in *Archive Fever* called "commandment" and "commencement"—by equating the job of safeguarding culture with the job of policing how the past translates to the future.

Of course, that's not the contemporary definition of an archivist, an omnivorous hunter-gatherer who stockpiles everything related to her subject. A Jackson Pollock collector would be satisfied with framed canvases; a Jackson Pollock archivist would also covet a sketch on a cocktail napkin or a receipt for a gallon of Duco. Yet it is the etymological definition, of guarding against deviations from original artifacts, that undergirds the law's increasingly fanatical attempts to curb the circulation of digital culture.

To be sure, American and European laws picture the original authority differently. When cable magnate Ted Turner decided to colorize black-and-white MGM films to make them more appealing to an audience used to Technicolor, U.S. law supported Turner as the copyright holder, while a French court empowered director John Huston to halt the showing of a colorized version of his movie *Asphalt Jungle*. The French ruling turned on

the European doctrine of moral rights, which essentially give the creator veto power over new instances of editing and publication. Part of the motivation for maintaining moral rights is the failure of U.S. doctrine to stop cases such as that of Picasso's *Trois Femmes*, a painting cut into one-inch squares by two art investors and sold as "original Picassos."[33] While European law looks to the creator to determine authenticity, U.S. law looks to the owner. In a society driven by exclusive copyrights and DRM, to possess something is to own the right to destroy it.[34]

Nevertheless, both legal traditions are premised on the analog logic of "either/or" fragmentation: either you have the original Picasso or you have a bunch of fragments in its place; either the original black-and-white *Asphalt Jungle* or the colorized version. When musicians remixed the *White Album*, however, the music recorded by John, Paul, George, and Ringo remained, as did George Lucas's version of *The Phantom Menace* when Mike Nichols removed its Jar Jar Binks character to produce *The Phantom Edit* (aka *Episode I.II*). The original lingers, but is joined in the same space by other renditions. Indeed, most digital artists inadvertently generate multiple versions of their works in the very act of creating them, simply because that's how new media work.[35]

We are free to evaluate these variations; I, for one, can't stand colorized films. Still, for a critic to favor the *White Album* over the *Grey Album* is quite different from EMI's suing the *Grey Album* out of existence. Given that we can't be sure which variation will survive into the future, many viewers would prefer to have a distorted mirror on the past than none at all.

And there are success stories in proliferative preservation where the benefit of crowdsourcing clearly offsets the range of quality of amateur contributions.[36] Author Neal Stephenson argued in 1999 that Unix, the forerunner of Linux and Apple's OS X operating systems, evolved precisely this way:

> Unix, by contrast, is not so much a product as it is a painstakingly compiled oral history of the hacker subculture. It is our Gilgamesh. [Such epics] . . . were living bodies of narrative that many people knew by heart, and told over and over again—making their own personal embellishments whenever it struck their fancy. The bad embellishments were shouted down, the good ones picked up by others, polished, improved, and, over time, incorporated into the story. Likewise, Unix is known, loved, and understood by so many hackers that it can be re-created from scratch whenever someone needs it.[37]

Photosynth, a project by Microsoft and the University of Washington, can marry a preexisting 3D model of Paris's Notre Dame cathedral—

showing just the geometry, without any visual texture—together with the hundreds of photographs tagged "Notre Dame" by amateurs who uploaded them to the photo-sharing site Flickr. By automatically mapping each photo onto the correct vantage point and angle using a computer vision algorithm, Photosynth lets viewers explore a virtual Notre Dame at almost any range of detail, from distant views of its skyline to detailed close-ups of its facade.

Rather than map crowdsourced images onto a shape, some applications perform the reverse reconstruction by deriving a shape from crowdsourced images of its surface. Reminiscent of the replicators featured in *Star Trek*, 123D Catch (formerly Photofly) compiles multiple photos of a physical object taken with a smartphone into a virtual model that can be printed out using a 3D printer. It isn't hard to imagine an architectural historian using Photosynth to reconstruct, say, how Times Square has changed over the decades, or imagining a conservator using 123D Catch to preserve replicas of endangered three-dimensional objects, whether at risk of theft (such as the solid-gold Mask of Agamemnon) or of degradation (such as artist Matthew Barney's Vaseline dumbbells). But you don't have to be an expert to use it; when 123D Catch launched, its photo-to-3D service hit eighty uploads per hour, with amateur preservationists making casts of everything from sneakers to crab arms.[38] Comparable software has enabled Harvard archaeologists to fix ancient artifacts[39] and revealed ancient art on the pillars of Stonehenge.[40] The San Francisco Museum of Asian Art invited the creators of 123D Catch to capture a handful of sculptures from their collection, and made all of the digital files freely available for anyone to download and even print using 3D printers.[41] As hybrid examples of proliferative preservation, these applications employ software written by experts to collocate images taken by lay photographers. While no 3D print can capture all the nuance of an analog artifact, the proliferation of distributed doppelgangers might have left some record of the countless museum artifacts lost due to natural or human catastrophes. 3D scanning and fabrication can also help repatriate objects taken from indigenous communities, though many ironically are more amenable to proliferative preservation than the colonial museums that appropriate their culture.[42]

Matthew Kirschenbaum's book *Mechanisms* offers a more unlikely example of crowdsourced preservation. William Gibson and Dennis Ashbaugh's digital project *Agrippa* was supposed to be a lesson in ephemerality, a poem that erased itself when read. The press release claimed,

> The Collector/Reader, when encountering this new object, will be forced to make a radical choice; between "possessing" the story and images, by activating the disc and opening the pages of the book, ending up with only a relic or memory of its content, or keeping the story and etchings "intact," but never actually experiencing what each contains . . . at least until some super-bright Hacker cracks the original virus, penetrates the form and retrieves the text.

It took only days for a "super-bright Hacker" to post the text to news groups, and its fan base has preserved it online ever since.[43]

In a more deliberate attempt at crowdsourcing preservation, the Internet Archive's Jason Scott created a wiki meant to catalog all file types called "Just Solve the File Format Problem"; within a month the wiki had over 500 file types documented in technical detail.[44] Pamela Wright of the National Archives and Records Administration expected progress to take months or years when she invited Internet visitors to transcribe handwritten documents, but three-quarters of the texts were already transcribed by the end of the first week—and in some cases translated.[45] And in a rare example of crowdsourced migration, the New Museum invited the public to bring in art-related media on aging formats such as VHS tapes and floppy disks, which experts lovingly digitized and uploaded to the Internet Archive.[46]

Open-source champion Eric Raymond once claimed, "Given enough eyeballs, all bugs are shallow." Perhaps there's an analogous axiom for preservation?

A (Pre)history of Proliferative Preservation

Relying on preservation vigilantes may sound unprofessional, but they served culture well for tens of thousands of years before priests and preparators came along. In the battle of the proprietary versus the prolific, the historic record may be debatable, but the prehistoric is not. Euro-American preservationists fool themselves into thinking that stone tablets and figurines in museums are the oldest artifacts on record. But the oldest cultural knowledge survives not in durable formats but in social ones. Witness *Megatherium*, a beast that died out tens of thousands of years ago but still survives in the stories of Indians of the Brazilian rainforest.

Twenty feet tall, as strong as a dozen gorillas, covered with matted hair covering a bony carapace—the giant ground sloth made such an impression on the tribes of the Amazon that nearly every tribe has a word for this creature, which most call the mapinguary. Repeated storytelling has kept alive accounts of human encounters with this prehistoric animal.

Figure 10.2
Reconstruction of *Megatherium*, courtesy of Wikimedia Commons, http://en.wikipedia.org/wiki/File:Megatherum_DB.jpg, accessed January 27, 2013.

Indigenous storytellers "remember" features of the mapinguary that paleontologists cannot read from the bones, like how *Megatherium* smelled: the name mapinguary means "fetid beast." When an Amazon native matter-of-factly related seeing a mapinguary at the natural history museum in Lima, a researcher was able to corroborate the mapinguary's prehistoric pedigree: the museum has a diorama with a model of the *Megatherium*.[47]

Paleontologists have begun to accept other indigenous stories as genuine memories, including a giant, man-eating bird known to science as Haast's eagle, extinct for 500 years but alive in Maori legend.[48] The performative model of preservation dates back even longer than birds and beasts, however. All life is based on regeneration, as confirmed by a study concluding that 98 percent of the atoms in a human body are replaced by other atoms taken in by the body *each year*.[49] Even the synaptic membranes between neurons that hold our memories are constantly degrading and being replaced.[50]

All of this is hard to understand from the perspective of museums and archives, which depend on the dedication of a staff of experts in a centralized institution to safeguard cultural memory. The proliferation of recorded media in the last century would seem to underscore the necessity of media specialists and climate-controlled warehouses to look after all those silver gelatin prints and reels of celluloid. Even performance theorist Peggy Phelan writes that "performance cannot be saved, recorded, documented, or otherwise participate in the circulation of representations of representation."[51]

Yet this refusal to accept the preservative power of performance has political costs. As Diana Taylor notes, friars who arrived in the New World in the fifteenth and sixteenth centuries claimed that the indigenous peoples had no past because they had no writing. During the Conquest, imperial centers in Spain and Portugal controlled indigenous populations by prohibiting performative practices such as dance and ritual in favor of archival practices such as writing:

> Nonverbal practices—such as dance, ritual, and cooking, to name a few—that long served to preserve a sense of communal identity and memory, were not considered valid forms of knowledge. Many kinds of performance, deemed idolatrous by religious and civil authorities, were prohibited altogether. Claims manifested through performance, whether the tying of robes to signify marriage or performed land claims, ceased to carry legal weight. Those who had dedicated their lives to mastering cultural practices, such as carving masks or playing music, were not considered "experts," a designation reserved for book-learned scholars. . . . The rift, I submit, does not lie between the written and spoken word, but between the *archive* of sup-

posedly enduring materials (i.e., texts, documents, buildings, bones) and the so-called ephemeral *repertoire* of embodied practice/knowledge (i.e., spoken language, dance, sports, ritual).[52]

Taylor's use of the word "repertoire" is suggestive of the malleability of reperformed culture.[53] Although she notes that dancers often swear they are performing exactly the same dance as their predecessors, Taylor contends, "As opposed to the supposedly stable objects in the archive, the actions that are the repertoire do not remain the same. The repertoire both keeps and transforms choreographies of meaning."[54] Taylor also notes that sacred dancing, mask carving, and other indigenous methods of preservation survived the attempts by conquistadors and the church to stamp them out. Books can be burned, the many divergent old testaments ramrodded into a single King James edition,[55] but the performative traditions of indigenous people from Oaxaca to Okinawa live on.[56]

Taylor's repertoire is emphatically embodied rather than written, with explicit contrast to print and implied contrast to scripted media such as radio and television. Yet it is less broadcast media's dependence on *scripts* than their dependence on *hierarchy* that ties them to the conservative view of the archive as regulating adherence to the original. Open software programmers, Wikipedia contributors, and YouTube mashup filmmakers constantly script and rescript the digital repertoire; new media writing escapes the centralized control characteristic of broadcast because it is editable. Furthermore, new media are not exactly disembodied in the way that a prerecorded show playing on a screen is disembodied. New media may be nongeographic, but they network people into being active producers rather than passive consumers, and even when mediated by machines, they execute rather than represent. This means that many of the "bodies" that perform new media—a browser running JavaScript, a Playstation running C++, an Intel CPU running machine language—can be modified and distributed inside emulators and other virtual environments. If anything, the fact that the digital repertoire can propagate by a dispersed populace using DIY tools makes digital media even more uncontrolled than the analog repertoire.

In chapter 6, Rick asked whether we want the public to don white gloves when handling digital artifacts, or to take them home. As outlandish as preservation through proliferation may sound to "civilized" ears, it is the practice native to indigenous and new media creators. Much as professional conservators might fear an army of amateurs, such "unreliable archivists" have kept their culture alive by retelling and rescripting while highbrow electronic artworks decay into inert assemblages of wire and plastic in their

climate-controlled crates. The twenty-first century may never know the remarkable luminescence of Hesse's sculptures, but the future of the mapinguary and Mario is assured.

If the custodians of culture want to add Nam June Paik and Camille Utterback to that future, they'll need to fund more than conservation labs and climate-controlled vaults. Artists' studios, Usenet groups, and remote villages are where culture is birthed and resurrected by its indigenous producers. Permanent exhibitions nourish art less than temporary exhibitions, where works are upgraded and displayed before being routed to their next venue. Conservators need to understand strategies such as emulation, migration, and reinterpretation and make sure the artists they work with understand them too. And museums need to allocate their budgets not just to renting storage space but also to funding the process of creating, and recreating, art.[57]

Challenges of Proliferative Preservation

Loss of Artistic Integrity

Of course there are downsides to trusting amateur preservationists to do the job of professionals.[58] The most common complaint, and one that resonates with the figure of the Law as a guarantor of authorial pedigree, is the loss of artistic integrity through deviation from a work's original intent.*

* Rick: Intent or *form*? Intellectual property discourse often focuses on form instead of intent, but the relationship between those two is central to the debate. To preserve form preserves aspects of the work outside of the author's intent (and thus the work's "material subconscious"), but, as you noted earlier, focusing exclusively on the form can preserve the wrong aspect of the work and lead to wildly inaccurate results.

Yet economic pressures already bring about a similar "degradation." Chapter 9 showed how the commercialization of art can lead to laws that deter amateurs from recreating or distributing works, but it can also encourage proliferation and diversification. In a departure from the definition of variable media used in this book, theorist Lev Manovich uses the term to emphasize the ramification of a cultural product into many markets and formats: because Marvel Comics makes money from licensing its superheroes, *Spiderman* the comic becomes *Spiderman* the movie, and the musical, T-shirt, lunchbox, action figure, and so on. And as we have seen, Ted Turner tried to make older movies more

palatable to contemporary audiences by colorizing them or editing smoking scenes out of classic cartoons;[59] as disturbing as these reinterpretations may seem, they are perfectly consistent with U.S. law, which respects the current owner of an artifact more than its original producer. The nouveau riche oil baron who bought a Beverly Hills mansion with cash in the 1970s, only to paint over its outdoor statuary with gaudy colors, was perfectly in his legal rights to do so.[60]

Before we rush like Ayn Rand to rescue high art from the debasement of low culture, however, we might want to remember that it is sometimes the creator herself who plays to the crowd. The ancient Greek statues upon which the Californian facsimiles were modeled were originally colored with rich polychrome surfaces. For his part, George Lucas added updated special effects to the first three *Star Wars* movies of the 1970s so they would stand up technically alongside his prequels from the 2000s, and made some seemingly minor alterations that changed important aspects of character development. Most infamously, Lucas added a blast effect behind the head of actor Harrison Ford, to show that his character only shot the space villain Greedo in self-defense; in the eyes of hard-core *Star Wars* fans, this whitewashing of the formerly unsavory Han Solo diminished his return to grace at the end of the film, and they responded with a vigorous online campaign to protest that "Han Shot First."[61]

Nevertheless, fidelity to a creator's intent can still be a handy measure of the success of an artistic re-creation—if we remember that the digital logic of "both/and" allows us to preserve multiple variations on a work. The opinions of artists as to how their work should be preserved form the kernel of the Variable Media Questionnaire, mentioned earlier. Begun at the Guggenheim in 1998 and currently maintained by the Forging the Future alliance, the questionnaire tracks opinions about how artworks may change in the future when their current media expire.[62] The artists' own opinions formed the core of the first version of this questionnaire, as they answered questions such as whether props should be stored or remade for each performance, or whether software should be migrated or emulated. Subsequent versions were revised to gather feedback from many sources, from experts such as the artist's technicians or curators to members of the lay public, so as leave a broader historical record as the basis for future decisions about the best way to preserve a work. In this revised model, the creator remains at the center of the question of authenticity, but she is surrounded by successive rings of interested parties whose views on the work may or may not coincide with hers.[63] Archivists using the Variable Media Questionnaire still have to make judgments as to how to preserve a

work, but these judgments are based on interpretations of the work rather than interpretations of the law.

Loss of Artistic Value

There is another type of control that would be lost if preservation were entrusted to its vigilantes: not how works are preserved, but which ones. It's a given for many preservationists that we can't save everything,[64] and therefore that the same institutions should be responsible for both curation and preservation: a museum's curators select what's worth preserving, and its conservators preserve it. However, the explosion of emulators and participatory media in general has shifted the management of cultural legacy to the masses, and when the community at large starts making decisions about which culture to preserve and which to delete, it makes the traditional gatekeepers awfully nervous.

You need look no further than Wikipedia to see how gravely a dispersed culture of preservation threatens the cultural hierarchy of art. Thousands of Wikipedia articles are devoted to minor variations of software and games, whereas avant-garde art is very scantily represented. Geek culture, with its attendant valorization of gaming, sci-fi, and science, is the default.[65] For the value of new media art to be measured by the volume of short-term interest alone would force Natalie Jeremijenko and jodi.org to vie for popularity with professional wrestling and *World of Warcraft*. A case in point is the Wikipedia "articles for deletion" entry on Mezangelle, a language-cum-art form created by artist Mez Breeze that is well known inside the Internet art community. One of the numerous Wikipedia editors voting for its deletion cited the mere 100 Google search returns for "Mezangelle net.art," whereas Google returns over 200,000 hits for Klingon, the fictional language made famous by *Star Trek*.

Sometimes it's not highbrow culture that proliferative preservation threatens but a highbrow interpretation of a cultural artifact. At the high point of John F. Kennedy's funeral, the soldier performing taps stumbled over a note; this unlikely misstep by the nation's premier bugler, which some observers saw as a mark of the depth of emotion of the moment,[66] was edited out of some rebroadcasts on TV and radio because it was unfamiliar. Neil Armstrong's first words on stepping foot on the moon underwent the opposite transmutation, from sense to nonsense. Armstrong actually said, "One small step for *a* man, one giant leap for mankind," but after interference made it hard to hear the transmission clearly, newspaper editors penned the headline, "One small step for man, one giant leap for mankind." Once the meme got out of his hands, Neil Armstrong was

powerless to stop the induction of this similar-sounding but meaningless phrase into the annals of history.[67]

We don't want the cultural significance of a digital relic to be reduced to a popularity contest, or the history of new media will be a history of Nigerian bank scams and Paris Hilton videos. But to fall back on elitist criteria is to reinforce an antidemocratic approach simply because it is more venerable.* Indeed, in the cases of Kennedy's bugler and Neil Armstrong, it was the editorial elite of broadcast media, not a host of amateur citizen journalists, who perpetuated warped renditions to the point that it is difficult to recover the original. As before, however, the "both/and" dynamic of digital culture offers a way out of the unsatisfactory choice between democracy and value, by encouraging many "future histories" of a digital object. While this inclusive approach may result in a longer staying power for mass and popular culture, that doesn't necessarily relegate elite culture to a shorter shelf life, for several reasons. First, niche culture may still live on in the "long tail" of an increasingly inclusive preservation matrix.[68] Second, if advocates of elite culture are right, popular culture will die out in the long run anyway for lack of enduring relevance. (If few eighteen-year-olds in 2013 are Frank Sinatra fans, why should we expect eighteen-year-olds in 2030 to be Justin Bieber fans?) Finally, even if many tools for re-creation, such as emulators, are now available to the general public, in the end some works will require the intellectual and technical resources of museums to recreate, at which point some degree of editorial selection may be inevitable. That said, I'm betting museums will lean heavily on popular culture for crowdsourced tools like emulation and archives like Wikipedia.

* Rick: Without wanting to sound antidemocratic or snobbish, this sort of makes the case for cultural organizations preserving exactly the great stuff that no one else will; the island of misfit toys in the sea of the attention economy. To quote the public TV slogan, "If not us, who?"

Loss of Cultural Context

The loss of context is another genuine problem with the crowdsourcing of art preservation. When it was removed from its site-specific placement in Federal Plaza due to complaints about its effect on passersby, Richard Serra's *Tilted Arc* was effectively destroyed.[69] At first it might seem digital artifacts can never suffer from being "out of place," since they are by nature immaterial and hence portable. The trouble, however, is that such

artifacts may draw meaning from an original context—geographic or virtual—and then lose it as they are digitized and zoomed across the information superhighway to the far corners of the world. A good test of such contextual detachment was "Joywar," the online tussle over a documentary photo by Susan Meiselas later appropriated by painter Joy Garnett.[70] Garnett found online a dramatic photo of a guerrilla poised to hurl a homemade bomb made from a Pepsi bottle at an unseen foe. Garnett then created a brushy oil painting of this "Molotov Man," against an anonymous background. When Meiselas discovered this use of her photo and her lawyer threatened to sue, Garnett turned to her Internet art pals for solidarity, and they remixed the original photo in dozens of forms, from animated GIFs to simulated billboards to revisions of the original photo as a Pepsi Cola ad ("It's your revolution").

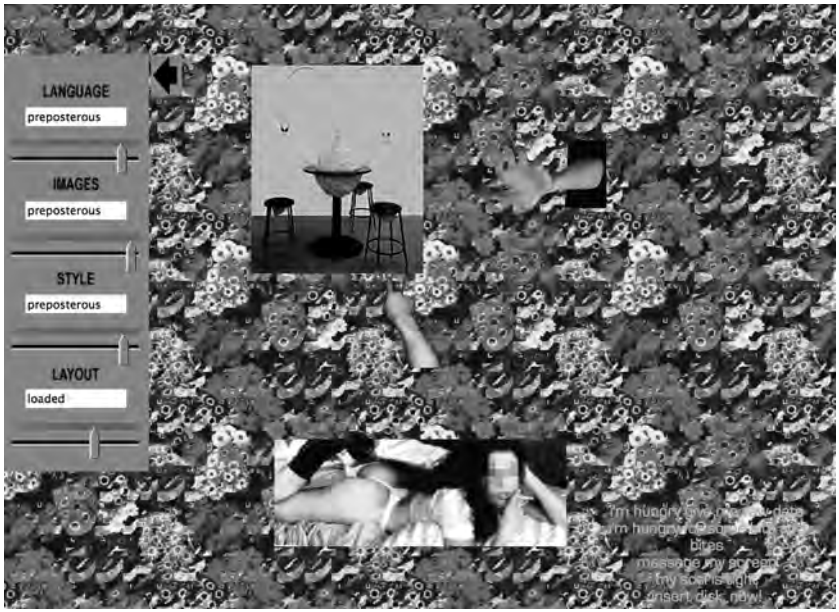
Figure 10.3
Joy Garnett, *Molotov*, 2003. Oil on canvas, 70 × 60 inches (178 × 152 cm).

While anticopyright activists cheered this exuberant show of support for artistic freedom, photojournalists cried foul. The image was not a universal corporate trademark like Mickey Mouse's ears or McDonalds' golden arches, but a specific historical moment—a Sandinista named Pablo Arauz flinging a Molotov cocktail at a Somoza national guard garrison the day before the Somoza regime would flee Nicaragua for good—caught in the lens of a photographer intent on preserving that moment. Detached from this context, the image became an emblem of all revolution, but lost its potential of enlightening a larger audience about the political history of Nicaragua. The untethered image was replicated and mutated, stripped of the "metadata" that was most important to the image's creator.

One defense of the loss of context in proliferative preservation is to argue that art's role is not to represent representational experiences but to transform them. In the words of one Joywar commentator, "The very act of pressing the shutter of a camera is a decontextualization."[71] Modernism encouraged artists to extract experiences from their context and reframe them—to think outside the box. Recently this detachment characteristic of modernism has come under fire not just by copyright maximalists, but by movements like Connected Knowledge, which advocates a third, contextual approach to sensitive information.[72]

Digital media, however, empower artists with even more transformative power than their modernist predecessors, by allowing them to bend the box as well as what is inside it. One example is *The Unreliable Archivist*, a work commissioned by curator Steve Dietz on the occasion of the official archiving at the Walker of the influential art site *ada•web*, mentioned in chapter 3. Created by Janet Cohen, Keith Frank, and me, *The Unreliable Archivist* questions what it means to archive or "fix" a dynamic medium such as the web. The work's conceit is that a future archivist has preserved the texts, images, and styles of *ada•web* but has mixed up which pages they belong to. By manipulating sliders that run on a scale from "plain" to "preposterous" for such parameters as language, image, style, and layout, the user of *The Unreliable Archivist* can recombine elements of one *ada•web* page with elements of another—say, the terse aphorisms of Jenny Holzer's *Please Change Beliefs* with the gaudy pink background of Julia Scher's *Securityland*—suggesting a view of the site as a range of permutational possibilities rather than a predetermined set of seamless "pages." In a curious way, this scrambling may be more faithful to the dynamic of the web than preserving the integrity of each "page," for what we think of as seamless pages on the web are merely dynamic reassemblings of JPEGs and

Figures 10.4–10.6
Janet Cohen, Keith Frank, and Jon Ippolito, *The Unreliable Archivist*, 1998. Interactive networked code. Screenshots.



Figures 10.4–10.6
(continued)

JavaScripts that travel along different routes from different sources and are only combined once they appear on the viewer's screen.[73]

To an archivist intent on policing deviations from the original, artists who also remix the context are even more worrisome than those who only remix the art. However, it's worth remembering that traditional conservation practices are really bad at preserving context. Mounted in a glass vitrine against a white wall, a canoe prow in the Oceania wing of the Metropolitan Museum of Art becomes a modernist sculpture rather than an emblem designed to scare the bejesus out of Maori enemies. And so, in the spirit of bargaining, sometimes it may be preferable to preserve a transformed (or transformable) context than no context at all. Thanks to the Internet, an entire community of unreliable archivists can (unwittingly) preserve the context for a work of art even when the work itself disappears, as curator Dominic Quaranta notes:

> Some time ago I was looking for an old piece of net.art, *FuckU-FuckMe* by Alexei Shulgin. The link from http://www.easylife.org/ doesn't work anymore; in other words, the work is not available anymore at its original location (http://www.fu-fme.com/). Luckily, a web user was brave enough to make the original website available at the

URL http://www.welookdoyou.com/fufme/. Cool: reproduction means survival. But I was even happier when I googled "FuckU-FuckMe," and I found out a plenty of interesting responses to the project: magazines describing it as the "gift of the week," people asking in forums how they can buy it. . . . This is in my opinion the best way for this project to survive; and this should be preserved on a first level.[74]

This potential for crowdsourcing the preservation of context is one reason that the Variable Media Questionnaire now encourages input on an artwork's essence not just from the creators and curators close to a project, but from those with no more claim to authority than the average gallery-goer. Sometimes this might lead to revelations that are often left out of history books, such as the fact that many of the collaborations in Maurice Tuchman's landmark 1971 show "Art and Technology" at the Los Angeles County Museum of Art didn't actually work at the opening.[75] Crowdsourcing accounts of art from the past may crack some of history's precious veneer, but it may also reveal truths—or at least different perspectives—that are obscured when only curators and critics write the history books.[76]

Loss of Material Context

A common criticism leveled at emulation and migration as preservation strategies is that they detach a work from its original hardware. This detachment is all the more obvious for the kinds of reinterpretations discussed in this chapter. As noted in chapter 8, works like *Crown TV* and *Hogan's Alley* resist translation into other media because their artistic meaning is bound up with a specific apparatus such as a cathode ray tube or light gun. Some art historians and conservators would claim that this is true of the majority of cultural artifacts, leaving the variable media paradigm a viable strategy only for conceptual art and its descendants. Others go further in their critique, arguing that the notion that any work could exist in more than one medium implies some kind of Platonic essence that can be preserved independently of the paint strokes or pixels that make up its material existence. This critique appears all the more telling given that the variable media paradigm was influenced by the study of conceptual and process art,[77] and that the Variable Media Questionnaire asks artists to consider the "ideal state" of their works.

This subtle critique is important, but misguided. For the variable media paradigm claims not that an artwork is divorceable from its material substrate, but that it already has many material substrates. A single-channel video by Pipilotti Rist is likely to employ a new projector every time it travels to a new museum. The bricks purchased for a favela installed by Marjetica Potrč are different for a New York installation than for one in

Figure 10.7
Grahame Weinbren and Roberta Friedman, *The Erl King*, 1982–1985. Interactive cinema installation, dimensions vary with installation. Various installation views demonstrating how this work has taken different forms over time.

Johannesburg. Mark Morris's *Nutcracker* looks completely different from Mikhail Baryshnikov's, which looks different from George Balanchine's. A Java applet by John Simon looks larger or smaller, brighter or duller, and runs faster or slower depending upon whether its viewer has a 1998 Powerbook or a 2008 MacBook. Even a Rembrandt oil painting can enjoy multiple material conditions over time, as its linseed oil polymerizes and blue skies turn yellow; as its frame is repaired or replaced; as it tours from Rijksmuseum to the Pompidou; as its audience views it through spectacles, contact lenses, and artificial corneas. For works of art, material dependence is not irrelevant, but multiple.

With this multiplicity in mind, the variable media paradigm starts from an assumption not of universality but of differentiation. From this perspective, an artwork consists not of the Platonic essence to which every physical instance aspires, but the accumulation of attempts to achieve the artist's intent as rendered in different browsers, resolutions, durations, and publics. From a Platonic perspective, all of these attempts would be failures, in the sense that no material presentation could ever exactly match a thought in

Figure 10.8
Nam June Paik, *TV Garden*, 1972. Video installation, dimensions vary with installation. Various installation views.

someone's head.[78] According to the perspective of variable media, however, a work is not a single idea, object, or experience but an unfolding series of triangulations between all three. As curators, critics, and yes, lay viewers, we can judge some of those triangulations to be more successful than others.

Loss of Authorial Context

While European law's focus on "author's rights" may chill the kind of proliferative preservation discussed in this chapter, to jettison the concept of authorship altogether may be throwing the baby out with the bathwater. Debates over the authenticity of a portrait attributed to Rembrandt are more than simply exercises in honing connoisseurship skills for the art market; they are also a means of training the eye to discern a particular artist's creative process. The discovery of Andrew Wyeth's infamous *Helga* paintings—brushy nudes of a voluptuous neighbor painted by an artist better known for his antiseptic renderings of straitlaced Yankee life—irrevocably altered the meaning of his work as received by his viewers and critics. Individual works such as John Cage's unscored composition *4′33″*, in which a performer deliberately avoids making any sound for four minutes and thirty-three seconds, would make little sense to a listener with no knowledge of the method in Cage's madness, as motivated by his reaction to serial music, his discovery of Zen Buddhism, and his previous compositions.[79] So it would seem at first blush that allowing reinterpretations of a work to proliferate uncontrolled would eclipse the authorial pedigree of such works, in the process obscuring the insights into creative evolution that authorship makes possible.

Yet a closer look reveals that the pedigree of a typical artwork already involves more than one person. Even a work as radical as *4′33″* springs from more than just Cage's own head: serialist composer Arnold Schoenberg's criticisms inadvertently led Cage to sidestep the "wall of harmony"; Zen teacher D. T. Suzuki inspired Cage to privilege presence over product; and Cage's many collaborators, such as David Tudor and Merce Cunningham, helped him find a musical form to embody the philosophy of "interpenetration without obstruction."[80]

If we accept that artworks have multiple contributors, then reinterpreted works suddenly appear to have a *richer* authorship function than standalone works. A good example is La Monte Young's *Composition 1960 #10 (to Bob Morris)*, which consists merely of the instruction, "Draw a line and follow it." Genealogies are sometimes referred to as "lines"; as a brief thought experiment, let's set Young's work loose upon itself by following the artistic line this proto-Fluxus work drew in four decades of the history of art.

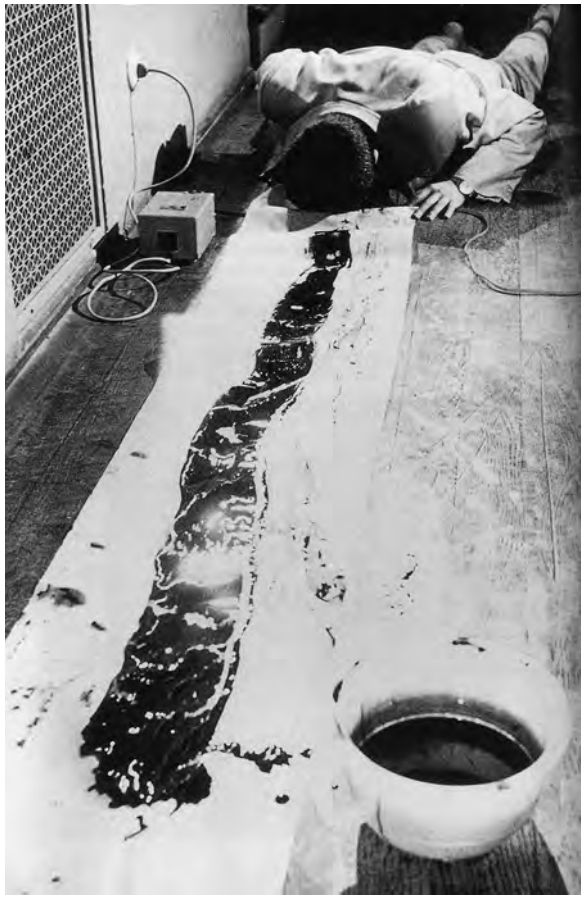


Figure 10.9
Nam June Paik, *Zen for Head*, 1962, reinterpretation of La Monte Young's *Composition 1960 #10 (to Bob Morris)*. Performance still at the Städtisches Museum, Wiesbaden, August 9, 1962. Photo copyright dpa.

Figure 10.10
Janine Antoni, *Loving Care*, 1992. Performance still, Anthony D'Offay Gallery, London. Reinterpretation of Nam June Paik's *Zen for Head* (1962), a reinterpretation of La Monte Young's *Composition 1960 #10 (to Bob Morris)*.

By far the best-known interpretation of this score is Nam June Paik's 1962 performance, when he dunked his head (or, on other occasions, his tie) in a bucket of ink and then dragged it across a paper scroll on the ground. Sadly, when catalog essays or captions cite Paik's performance, they rarely mention its predecessor *Composition 1960 #10*; instead, they cite the title by which it has come to be known, *Zen for Head*. In turn, a successor to Paik's own work appeared in 1992 with Janine Antoni's performance *Loving Care*, in which Antoni used her long hair to paint the floor of London's Anthony d'Offay Gallery with a brushy coating of Loving Care hair dye. To be sure, Antoni says she did not know of Paik's work until later, and was instead inspired by the hygienic aesthetics of Mierle Laderman Ukeles, artist-in-residence in New York City's Department of Sanitation.[81] Yet citations of Antoni's work rarely mention Ukeles or Paik, just as citations of Paik's don't mention Young, despite the obvious lineage.

Now, Paik and Antoni deserve full credit for their variations on their predecessors' work, for they threw themselves—quite literally—into their interpretations. While a music critic would cringe if a conductor played a Mozart *adagio* at a *presto* tempo, Young's conceptual score was loose enough to permit a wide interpretive license, including Paik's audacious take on Zen artlessness and Antoni's flair for extrapolating feminine qualities to absurd excess. But just as it would be misleading to credit a recording of the *Jupiter* symphony by mentioning Toscanini's name without Mozart's, so it is misleading not to give Young credit for Paik's performance and Ukeles credit for Antoni's.

This is one problem that two suspects we've fingered for the crime of cultural disappearance, the Law and the Institution, may help to rectify. Artists and other creators can avail themselves of enlightened legal instruments that preserve authorship but permit reuse, such as the Creative Commons Attribution (cc-by) license. Even better, they can distribute their works in creative communities like The Pool[82] or the Open Museum under licenses such as the Open Art License, which require remixers to register their own variations back in those communities so we can all track how the work evolves under different authors.[83]

As Rick implied in chapter 7, archives, libraries, and other collecting organizations can do their part by expanding the metadata strictures by which they pigeonhole variable media culture to accommodate more fluid forms of creativity. They can credit technicians and other collaborators in wall texts and catalog captions, and adopt a performative paradigm for reinterpretations that will establish an author stream far more encouraging—to authors of all kinds—than the single-artist name on a typical wall label.[84]

If new media culture is kept alive by proliferation, then unreliable archivists are the keystone species of the digital ecology. As threatening as they may seem, the art world elite would do well to find a way to live symbiotically with these amateurs, because the creativity they bring to the job of cultural perseverance can inject a much-needed vitality into the professional archive and its dusty shelves.

11 Variable Organisms

Jon Ippolito

If you take the Christian bible and put it out in the wind and rain, soon the paper on which the words are printed will be gone. Our bible is the wind and rain.
Salish elder[1]

The last chapter asked us to consider whether culture might be preserved in far-flung places like Usenet groups and fanzines as well as in museums and libraries. But what if the archive is neither in the library down the street nor on a far-flung server, but under our skin?

In a church in Valencia, microbiologist Pilar Bosch inspects a seventeenth-century fresco damaged by salt blooms from pigeon nests and by glue from botched restoration attempts in the 1960s. Dipping a brush into a petri dish, she swabs the fresco with a gel containing live *Pseudomonas stutzeri* bacteria, which have been bred in a laboratory specifically to hanker for salt and glue. She then heats the wall with lights to give her microscopic minions the munchies. Within 90 minutes, the fresco is fresh again.

On a camping trip in rural Maine, a barefoot schoolgirl stumbles upon a suspicious-looking plant. "Do you think that's poison ivy?," she asks her teacher. "Let's find out," he replies, and tugs a single hair from her head. Placing it on his phone's genomic decoder port, he speaks the phrase "Photo of poison ivy" into the phone and pauses as the Library of Congress search page churns on the screen. "Why is it taking so long?" asks the girl. "It's extracting a record of all the books in the world from your DNA," the teacher explains, "so it takes a few seconds . . . there we are." The girl looks at the image on the screen. "Phew!," she exclaims, "good thing I didn't step on that."

The first scenario happened in 2011;[2] the second is set in the future. This chapter asks how far off that future might be—a future in which an organic archive preserves via processes like genetic replication and mutation rather than storage and migration.

Digital tools like GarageBand and GIMP may grant the unreliable archivists of the last chapter the power to proliferate culture, but this power pales by comparison with the fecundity of genetic processes. From natural ecosystems to synthetic genomes to genetically engineered algorithms, evolved systems are able to calculate, create, and copy with a robustness that remix culture cannot match; given the new millennium's obsession with genomics and biomimicry, evolutionary paradigms are likely to play an increasingly important role in many disciplines in the coming decades. Our individual memories are organic, after all—why shouldn't our social memory be?

A look at some examples of current research into lifelike software and wetware will shed light on the special adaptabilities and vulnerabilities of animate artifacts, and help us speculate about whether organic processes might help preserve information-based culture in all its forms.

A DNA Computer?

Unless you're a biotech buff, all this talk of genetic algorithms and organic archives may sound farfetched. It's true that OS X isn't likely to run off cytoplasm anytime soon. Nonetheless, in the last few decades researchers have been laying the foundation for a rudimentary DNA computer, starting with Leonard Adleman's proof of concept in 1994.[3]

DNA has its own underlying digital code, in that the genes responsible for building birds, bugs, and bacteria are all just combinations of the same four nucleotides. Trained as a computer scientist, Adleman realized that the two kinds of nucleotide pairs (adenine-thymine and cytosine-guanine) that make up DNA could represent the 1s and 0s that make up computer code. That means a sequence of bits stored in a computer's memory, like 100110101, can be represented by a sequence of nucleotides stored on a strand of DNA, say, ACCAACACA. A digital computer works by searching for a bit sequence (100110101) on its hard drive, reading the information encoded there, and interpreting these bits as an executable command. A cell's RNA, analogously, can search for the gene sequence ACCAACACA on its DNA, make a chemical imprint of the nucleotides encoded there, and build some new molecule from those instructions.[4]

Adleman was able to exploit this analogy to get a few milliliters of DNA to solve a tricky mathematical problem, though it required a fair amount of pouring test tubes and other human handholding. Since then, other scientists have stored Shakespeare and JPEG images in DNA,[5] engineered *E. coli* genes to solve basic logic problems,[6] stored data in live

neurons,[7] concocted a DNA cocktail that can read digital images,[8] repurposed a virus to act as "biological WiFi" for a community of cells,[9] and designed a cellular operating system ambitiously called CellOS.[10] Meanwhile, a parallel line of research has performed the reverse, by emulating wetware in software. Computer scientists have made circuits that simulate connected neurons[11] and the synapses between them,[12] and created a synthetic ecosystem for digital organisms that has evolved a rudimentary form of memory.[13]

As momentous as these achievements may seem, they are all consequences of Rick's conclusion from chapter 4: any system that can emulate a Turing machine can act like a universal computer. So the day may come when we compute not with bits but with genes.

Which Is More Stable, the Inert or the Animate?

Before we get caught up in a swirl of biotech industry hype, let's play devil's advocate. If you've been paying attention in this book's previous chapters, you might think that safeguarding culture by trusting in natural rather than technological processes would be tumbling from the frying pan to the fire. As Bruce Sterling has argued,[14] the very substances that sustain life are the most harmful to human-made artifacts—and especially to electronic ones. Let sunshine warm a watercolor or water wash a keyboard, and you're imperiling the life of your artifact. And of course, as chapter 10 reminded us, things that are alive are mortal; a defining characteristic of life as we know it is that it can die.

Yet the preservation community has drawn on nature for inspiration, and help, before. Taxidermists recruit beetle larvae to clean the meat off bones. Bruce Sterling says "entropy commands a mighty legion of ruin,"[15] but microbiologist-turned-fresco-conservator Pilar Bosch commands a mighty legion of repair. (Talk about crowdsourcing!) Meanwhile, some go beyond enlisting bugs as preservation assistants to employing creatures as the preservation medium itself. Natural history museums have replaced dioramas of taxidermied animals with real critters living in an "urban wildlife" habitat.[16] Instead of lining a gallery with didactic panels about the ancient Greek garden of Kolymbetra, archaeologists have planted a twelve-acre grove on the original site, where visitors can pick oranges and bring them home. These conservators are the inverse of chapter 7's Martha Maxwell, who stuffed animals to preserve them.

That said, a deeper approach to nature-inspired preservation is to recognize that her most powerful archive is not the macroscopic facades we

recognize as butterfly wings and orange trees, but their genetic microstructure, which perseveres through thousands or millions of years. Genes are the 1s and 0s of evolution, and cellular machinery like ribosomes are its microprocessor.

Through selective breeding, humans have already been influencing and exploiting nature's genetic legacy for millennia, as futurist Stewart Brand describes in his summary of research by *National Geographic* photographer Jim Richardson:

> For the health of future crops and livestock we need the deep genetic reservoir of all those millennia of sophisticated breeding. A million people died in the Irish Potato Famine because the whole nation depended on just two varieties of potato. . . . "For 9,900 years," Richardson said, "we've been building up variety in domesticated crops and livestock—this whole wealth of specific solutions to specific problems." . . . The famous seed vault at Svalbard serves as backup for the some 1,300 seed banks around the world. The great limitation is that seeds don't remain viable for long. They have to be grown out every 7 to 20 years, and the new seeds returned to storage.[17]

Like the DNA in Adleman's experiment, seeds in a vault are little use in preserving agricultural biodiversity without human intervention; yet as we saw in chapters 8 and 10, human preservationists don't necessarily work in research labs:

> Even with living heirlooms, the rule is Use It Or Lose It. . . . In Peru, where potatoes originally came from, Richardson visited a field at 14,000 feet where 400 varieties of potato (with names like "Ashes of the Soul" and "Puma Paw") are grown in just two acres. The local 1,300 varieties of potato are managed by a "Guardian of the Potatoes," whose job it is in the community to know the story and uses of all the potatoes. . . . The Seed Savers Exchange in Decorah, Iowa, has 13,000 members. Their catalog is a cornucopia of heirloom garden delights, and members learn how to produce and store their own seeds and then share them. "It's a wonderful example of citizens participating in the process." And we can always acquire a new taste for old foods. Teff! Quinoa! Amaranth! Randall Lineback cows! You have to eat them to save them.[18]

Despite the popular conception that "life is short, art long,"[19] carnal organisms are remarkably stable under a wide range of circumstances. And the compactness of fleshy data storage—a milligram of DNA could store the Library of Congress with room to spare—gives new meaning to the term "thumb drive":

> It's incredibly dense (you can store one bit per base, and a base is only a few atoms large); it's volumetric (beaker) rather than planar (hard disk); and it's incredibly

stable—where other bleeding-edge storage mediums need to be kept in sub-zero vacuums, DNA can survive for hundreds of thousands of years in a box in your garage. . . . One gram of DNA can store 700 terabytes of data. That's 14,000 50-gigabyte Blu-ray discs . . . in a droplet of DNA that would fit on the tip of your pinky. To store the same kind of data on hard drives—the densest storage medium in use today—you'd need 233 3TB drives, weighing a total of 151 kilos.[20]

We might better understand life forms as the longest-lasting complex structures in the universe, if we could let go of the idea of preserving a single antelope in favor of preserving the evolving being—the genetic inheritance—that is an antelope.* To be sure, most archivists aren't used to thinking of life forms as archival.[21] Indeed, librarian Suzanne Briet caused a stir when she asked whether an antelope might be an archival document. "Is a living animal a document?" she asks. "No. But . . . the animals that are cataloged and shown in a zoo, are documents."[22] Briet admits press releases, recordings, works of art, and stuffed beasts as documents; the most expansive reach of her definition includes a referent (the antelope) that has been identified with a signifier (its catalog record). While this definition seems inclusive, on examination Briet's provocation only *appears* to extend the archivist's purview to nature's creations. Perhaps predictably, her antelope is only a pretext for yet another human record. And once relegated to a cage at the zoo or stuffed on a pedestal at the museum, antelopes take on the vulnerabilities of other cultural artifacts—most notably, that they require human intervention to persevere in the face of hunger and vermin.

* Rick: Of course we want to preserve individual artworks (organisms) and not just a genre (species), but that requires only extending the metaphor. The individual artwork is not a fixed and singular organism, but rather a family/genealogy within the species; permeable, variable, but still discrete and identifiable.

But what of the wild antelope, a beast constrained not by steel bars or word limits on wall labels, but by nature's own laws? Antelopes on the Kalahari have been chased by lions, speared by bushmen, and threatened by brushfires—yet as a species they have survived more or less intact for the past 10 million years. (The fact that human poaching and habitat destruction over the last century have endangered a creature that survived a dozen ice ages doesn't speak well for civilization's talent for conservation.) Digital species, such as Microsoft Word documents stored at the Library of Congress, are tended by a cadre of archivists, backed by millions of dollars in federal research and support, yet experts fear their lifespan may not

reach past the next few decades. Why are organic artifacts so robust compared to their feeble manmade counterparts?

As an evolved entity, the antelope is sculpted in a medium that has stood the test of time. Natural organisms are canalized, meaning their genetic structure is evolved to withstand small fluctuations in their environment. A catalog text on an antelope saved as a Word document, on the other hand, is an incredibly fragile, context-dependent piece of software. Software like Microsoft Word crashes even when used in exactly the way it was intended, on exactly the operating system and chip for which it was marketed.

What would it take to give human media the stability of nature's canalized systems? Can we twist Briet's identification so that the document inherits the perseverance of its natural rather than its human partner—so that the Word document inherits the antelope's adaptability, rather than the antelope inheriting Microsoft's Blue Screen of Death?[23] To accomplish this would require more than engineering a better Word document; it would require engineering an informatic environment that automatically adapts Word documents to the media landscape of the future, the way an antelope's genetic code has adapted it to ice ages and other landform changes of the past. According to this heady vision, if the National Archives and Records Administration could be made as self-sufficient as nature, then a digital version of the Declaration of Independence would persist even if all the archivists were fired.

But don't go firing archivists just yet. First we need to look harder at the feasibility of this speculative future. In the rest of this chapter we'll examine two of its prerequisites: a technique for automating proliferation, and a function for selecting among the results.

The Automated Archive

One of the key differences between organic and institutional archives is that the fleshy variety are automated rather than deliberate. While tools of remix culture like Photoshop and FruityLoops certainly speed the process of remixing photos and MP3s, they do not necessarily accelerate the process of deciding which artifact to remix and how to do it. That process hasn't changed very much since the days when abstract painters hung out in the Cedar Tavern, finding inspiration for their next canvas in a conversation with fellow artists or in a pint of beer. By contrast, cell nuclei don't hang out waiting for inspiration, but indiscriminately instruct their ribosomes to build all the proteins encoded in their DNA. While more

exhaustive than volitional procreation, organic procreation nevertheless resembles remix culture in one important respect: it often alters what it copies.

We'll start by looking at an automatic archive with the least amount of built-in transformation—that is, one that foregrounds replication over mutation. Then we'll examine an algorithmic archive, which is the canonical way software is generative. Finally we'll move on to the genetic archive, a model of software based on evolutionary processes.

The Body as Archive

Archives that live and breathe are the beneficiaries of evolution, which is the tendency for natural processes to promote stable structures. These systems are so stable that a diverse assortment of organic archives can coexist within the same body. The human immune system has a memory; chromosomes carry junk DNA from generation to generation, organized in ways that approach a language; the brain stores a vast array of mutually contradictory thoughts. If an organism were a library, the texts would be found not simply on the shelves but on the carpet, in the walls, and in the very air.

Yet, to employ the same metaphor, it wouldn't make sense to check a gene out of a nucleus or a leucocyte out of a bloodstream the way you might check a book out of a library. Organic building blocks aren't like documents that can be consulted individually, but more like the letters from which the library's books are written; they are meaningless except in large-scale combinations. Knowledge is a property of the whole, so an organic archive can only accrue knowledge by evolving, by selecting new combinations of building blocks in response to changes in its environment.

Finally, and most importantly for our purposes, an organic archive doesn't need conservators and librarians to tend it; given the right combination of energy and nutrients, it can reproduce itself. Artists like Joe Davis have already begun exploiting this fact to preserve rudimentary artworks via biological replication. Working in the 1980s with researchers at Harvard Medical School and the University of California at Berkeley, Davis encoded a Y-shaped symbol for fertility into DNA, and then inserted this "infogene" into the chromosomes of otherwise ordinary *E. coli* bacteria. Left to reproduce in test tubes in a lab, Davis's microscopic studio assistants soon reproduced billions of copies of this rune simply by dividing and making more of themselves. "I'm the most published artist in history," said Davis.[24]

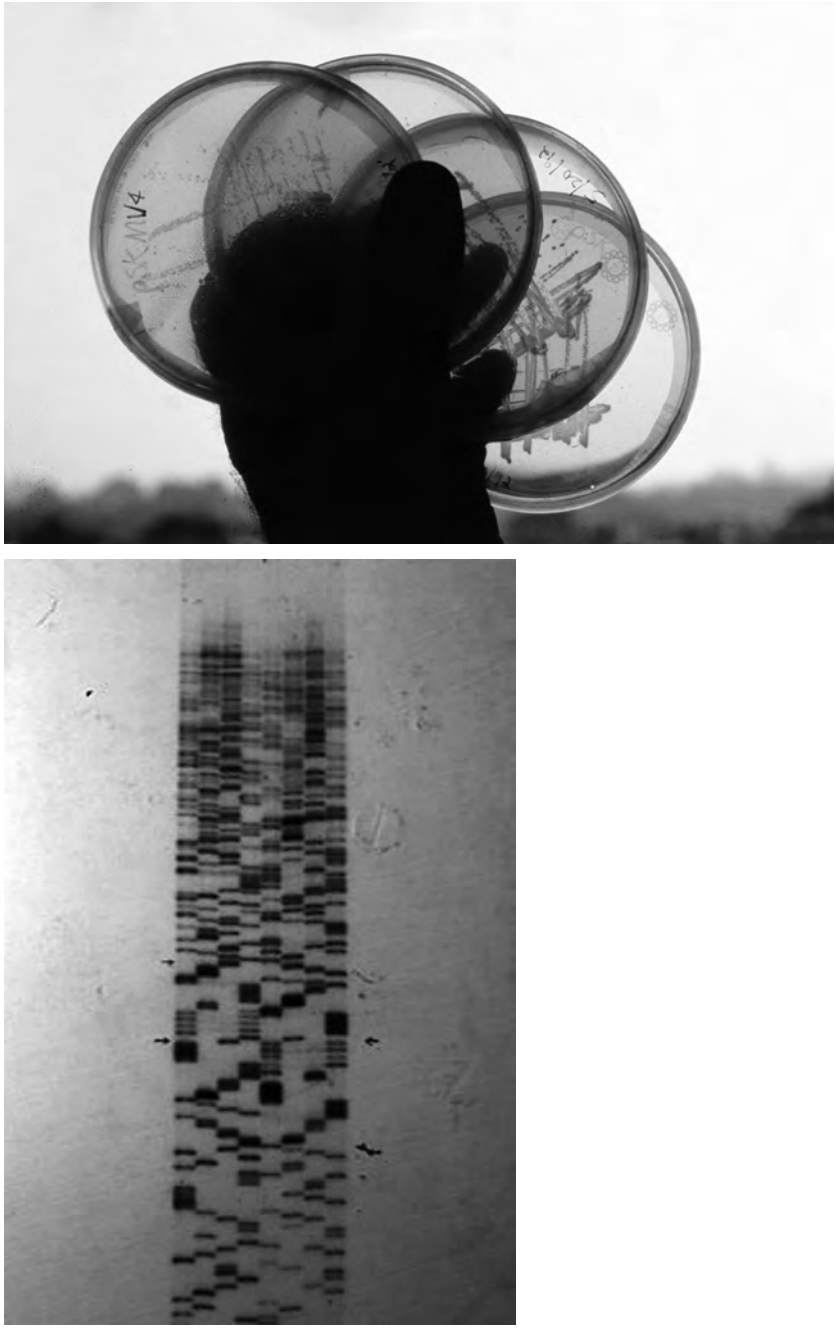


Figure 11.1–11.4
Joe Davis, *Microvenus*, 1988. Genetically modified *E. coli*. Photographs courtesy of the artist.

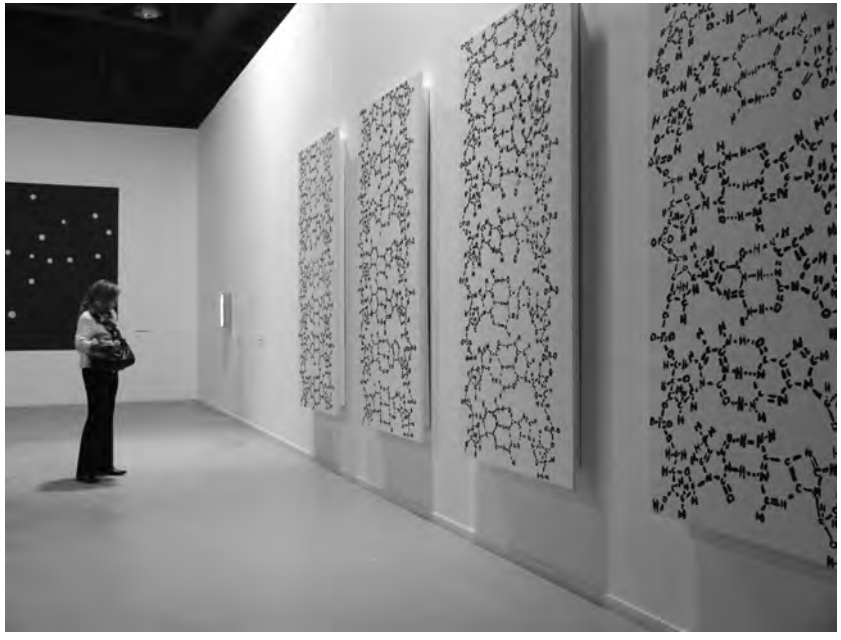


Figure 11.1–11.4
(continued)

The same claim was echoed two dozen years later by biologist George Church after he encoded his own book in DNA.[25] But Church and his colleagues performed the replication of DNA themselves—they didn't harness the power of genetic machinery to do it for them. To look at more expansive models of genetic preservation, we have to think about genes less as a static vat of chromosomal ooze and more as a computational medium. And one approach is to emulate genetic operations in silicon.

The Algorithm as Archive

Joe Davis picked an image and then automated its replication. Other artists are both lazier and more ambitious: they automate the generation of the image itself, and in the process spawn themselves an entire archive. John Simon's *Combinations*,[26] for example, starts from a reduced vocabulary—all the possible combinations of four line segments in a square. Once the user has chosen the angles and placement of the four segments, Simon's Java applet produces a grid of combinatorial drawings on the computer screen or in a plotter printout—in a manner highly reminiscent of the Sol LeWitt wall drawings mentioned in the introduction.

A comparison between *Combinations* and its hand-painted predecessor demonstrates the power of automated archives. LeWitt's assistants take weeks to complete a drawing, while Simon's program spits out the grid of permutations in less than a second. Even more, *Combinations* replicates not just a single drawing but every possible drawing with those parameters. This creation through recombination recalls *The Unreliable Archivist* from chapter 10, which allows the user to recombine elements of the web archive *ada•web*. It also recalls an unusual archival strategy from Jorge Luis Borges's story "The Library of Babel":

> A blasphemous sect suggested that all searches be given up and that men everywhere shuffle letters and symbols until they succeeded in composing, by means of an improbable stroke of luck, the canonical books. . . . [Men] would hide out in the privies for long periods of time, and, with metal disks in a forbidden dicebox, feebly mimic the divine disorder.[27]

The combinatorial library conceived in Borges's story was indeed blasphemous, for it proposed that a librarian might become not simply the custodian of all of the archive's texts, but also their author. This seemingly impossible task can be begun—if not finished—by expanding on the technique used by the heretics in Borges's library to create a self-assembling archive.[28] Of course, it would take years of manipulating metal disks in a dice box to derive an entire book at random; on the other hand, it only

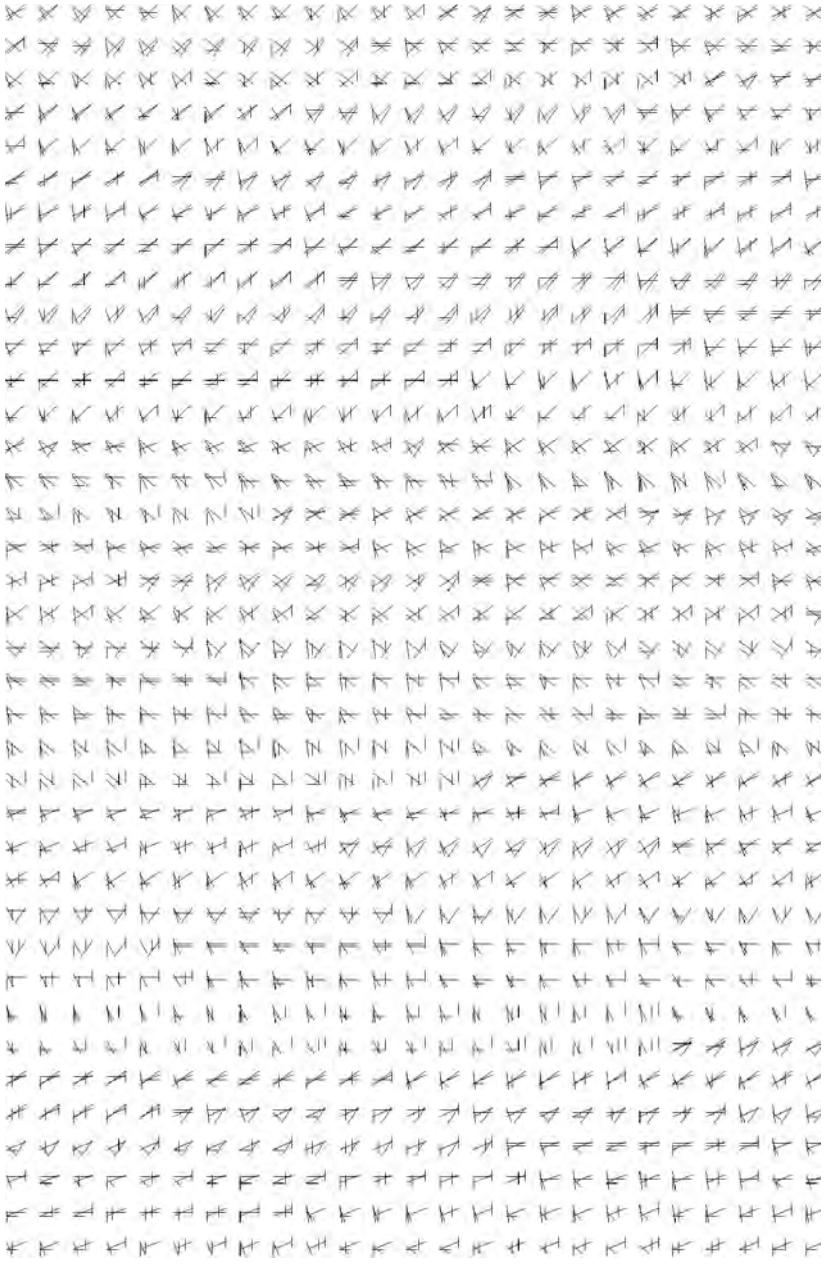


Figure 11.5
John F. Simon, Jr., *Combinations*, 1995. Interactive networked code. Screenshot.

takes a few seconds of manipulating the metal disk in a computer's hard drive to generate a book-sized chunk of random text. In fact, to write a computer program that automatically outputs every mathematically possible combination of letters and spaces would require only a few lines of code.

Simon's *Every Icon* does exactly that, except that it outputs images rather than books. Simon's description of his self-assembling archive—its card catalog, as it were—could hardly be simpler:

> Given: A 32 x 32 Grid
> Allowed: Any element of the grid to be black or white
> Shown: Every Icon[29]

The word "shown" is somewhat misleading. Once triggered by the user, Simon's applet will in good faith begin to display every possible combination of black and white elements; yet even a computer that churned out 100 new icons per second would take over 10^{298} years to draw every icon. As in Borges's library, there is always the potential of finding a meaningful artifact, but in practical terms the user is likely to be exhausted long before the icons are.* (What would the first recognizable image be? A "no smoking" icon? A bitmapped *Mona Lisa*?) Similarly, in 2011 Jesse Anderson's Million Monkeys project claimed to have written all 38 works of Shakespeare by algorithmically placing letters into the right combinations, though commenters cried foul.[30]

* Rick: And Borges's library would take even longer because there are more possible combinations of words, even in English alone, than there are possible combinations in a binary grid of 32 × 32; in fact, there are more possible combinations of words in English than there are stars in the universe. Talk about a fecund ecology!

Load one of these generative algorithms onto a laptop, place it in a briefcase along with a portable printer, and you have the self-assembling equivalent of Marcel Duchamp's portable museum, a sort of *Bot en Valise*.[31] We might even speculate that sculptures and other physical objects—at least those reducible to digital descriptions—might be archived in an algorithmic library of this sort. Add the combinatorics of Simon's *Every Icon* to the newfound powers of 3D fabbing, which carves physical objects from instructions in digital files, or nanotechnology, whereby researchers build objects molecule by molecule, and suddenly a garden that contains every possible Henry Moore sculpture now fits in your pocket.

Except that an algorithmic archive can only recreate works if it can reduce them to a simple formula.[32] While there exist artworks, even good ones, for which this is true, that won't help the vast majority of cultural artifacts for which it isn't. Three-dimensional fabrication also brings its own set of legal complications.[33]

Yet if organic processes cannot help us regenerate a nonformulaic artwork, they may still help to generate the software necessary to preserve it.

The Ecosystem as Archive

The impious speak (I know) of "the febrile Library, whose hazardous volumes run the constant risk of being changed into others, and in which everything is affirmed, denied, and confused as by a divinity in a delirium."

Borges, "The Library of Babel"

In a 2007 conference at the University of California at Berkeley that Rick organized, called "New Media and Social Memory," Stewart Brand asked whether we might encode the Library of Congress in DNA.[34] This proposal is essentially Joe Davis's infogene writ at the scale of an archive rather than an individual artwork. DNA has shown potential as a computing medium for parallel processing,[35] but in the wild DNA has a mind of its own, and is unlikely to treat cultural preservation with any more respect than it treats blue eyes or other conditions we might prefer. As Borges's quote signals, DNA is transformative—partly via mutation, partly via sexual reproduction—and this fact is essential for its role in evolution.

Of course, DNA in nature is never left to itself; it adapts to its environment over successive generations. Unlike egalitarian algorithms such as the one drawing *Every Icon*'s pictures, evolutionary algorithms are choosy. The agents that comprise organic archives, be they T cells, genes, or groups of neurons, compete according to selection criteria from their environment for representation in the overall population. DNA for a fast antelope is more likely to survive in the gene pool than DNA for a slow one; neurons that fire often will build more connections than neurons that fire rarely. Since microorganisms are prone to mutate, Davis's infogene art may soon be transformed into other runes or letters. Indeed, genetic drift is one measure of the "age" of an entire species.[36]

That said, if we are willing to accept some of the conclusions of the previous chapter about the value of unreliable archivists—no matter how miniscule these "archivists" may be—then evolutionary processes may offer a different vision of the organic archive. The field of artificial life points to one such living library, the *Tierra* project by Tom Ray of the

University of Oklahoma and the Advanced Telecommunications Research laboratory in Tokyo.[37] Ray describes *Tierra* as a "wildlife refuge" for artificial organisms; he creates this refuge by copying a population of self-replicating software algorithms onto a hard drive. These algorithms are designed to reproduce themselves in a manner similar to their notorious cousins, the computer viruses—except that they are confined for security reasons to a particular computer or computers. To this promiscuous mix Ray adds two ingredients that make the network more a Darwinian jungle than a sedate server: mutations in the program code that produce new algorithms from time to time, and a reaper subroutine that weeds out and erases any mutated algorithms that fail to function properly or cause errors. Once Ray lets the system go, it proceeds of its own accord, generating new algorithms that are most fit to survive in the population.

Unlike the self-assembling archives of John Simon, *Tierra*'s potential isn't easily summed up in prophetic encapsulations like "Given: A 32 x 32 Grid / Show: Every Icon." Since the project's inception, the autonomous evolution of *Tierra*'s digital creatures has created new algorithms that even Ray himself could not have foreseen. These include parasitic algorithms, snippets of program code embedded in other algorithms that are automatically reproduced when their hosts reproduce; and immune hosts, which have "figured out" how to prevent the parasites from hitching a ride.

Maybe organic archives are too formulaic to regenerate art, but given the creative potential of systems like *Tierra*, perhaps they could be used to evolve the software necessary to view it. Software for viewing a work, whether a video codec or word processor, is by definition reducible to some set of instructions; and in chapter 8 we saw that while hardware is brittle, software can imitate its more behavioral features. We also saw that emulators such as FCEUX can be forked, merged, and undergo mutation-like changes. Of course, in the case of FCEUX it is gaming fans who are forcing these changes on the software. But what if we could simulate these pressures to encourage the evolution of desirable traits without our direct intervention—essentially to evolve more stable formats for text, video, and other cultural media?

What Survives?

Fitness Functions

Of course, it usually takes a lot of time for nature to evolve stable systems. If evolution is really the cause of organic stability, then time measured in

years or millennia is less relevant than time measured in generations—for it is by mutation and testing that organic stability arises.

Fortunately for future preservationists, not all evolution has to happen on glacial time scales. The short lifespan of the fruit fly favored by genetic researchers, *Drosophila melanogaster*, is compensated for by its precociousness, with the result that geneticists have been able to observe evolution at work in the laboratory because each new generation only takes a week to mature. Researchers and new media artists have experimented with digital equivalents of such fast-breeding organisms, called genetic algorithms. And they have gone further by setting the parameters by which such virtual creatures evolve. Such "fitness functions" vary depending on which traits the researcher wants to encourage.

To create his *Evolved Virtual Creatures*, for example, artist Karl Sims used a random number generator to create mutations in a series of boxlike shapes whose movements and articulations were also determined by their genetic makeup.[38] Sims then ran these creatures through a series of tests, each corresponding to a different fitness function: Which creature could swim the fastest? Which could win a hockey game? By breeding successful mechanisms together, Sims stacked the deck so that the winners in each category were more likely to pass on their genes to the next generation of creatures. To be more specific, as each creature was represented by a simple computer algorithm, Sims interspliced the formulas for these algorithms to produce new formulas that are in a genetic sense the offspring of the older algorithms.

As a result, after hundreds of generations Sims's bizarre creatures could perform their tasks with recognizable competence—even though Sims never designed them to do anything except evolve according to a particular fitness function. Danny Hillis and others have proposed that similar processes might evolve useful software, such as word processors.[39] As outlandish as this may sound, Microsoft Excel 2010 shipped with genetic algorithms built in to solve certain mathematical problems.[40]

What if such an evolutionary system were trained not to create a faster or more efficient word processor but to create a more stable one, one that could read documents from a wider variety of formats and operating systems? This strategy would shift focus away from preserving individual artifacts and toward setting up the rules necessary for evolving an ecosystem capable of withstanding unpredictable changes in technology. Fortunately, evolutionary biology has envisioned a model that helps explain how individual species and fitness functions interrelate. We'll turn to this metaphorical landscape of interconnection next.

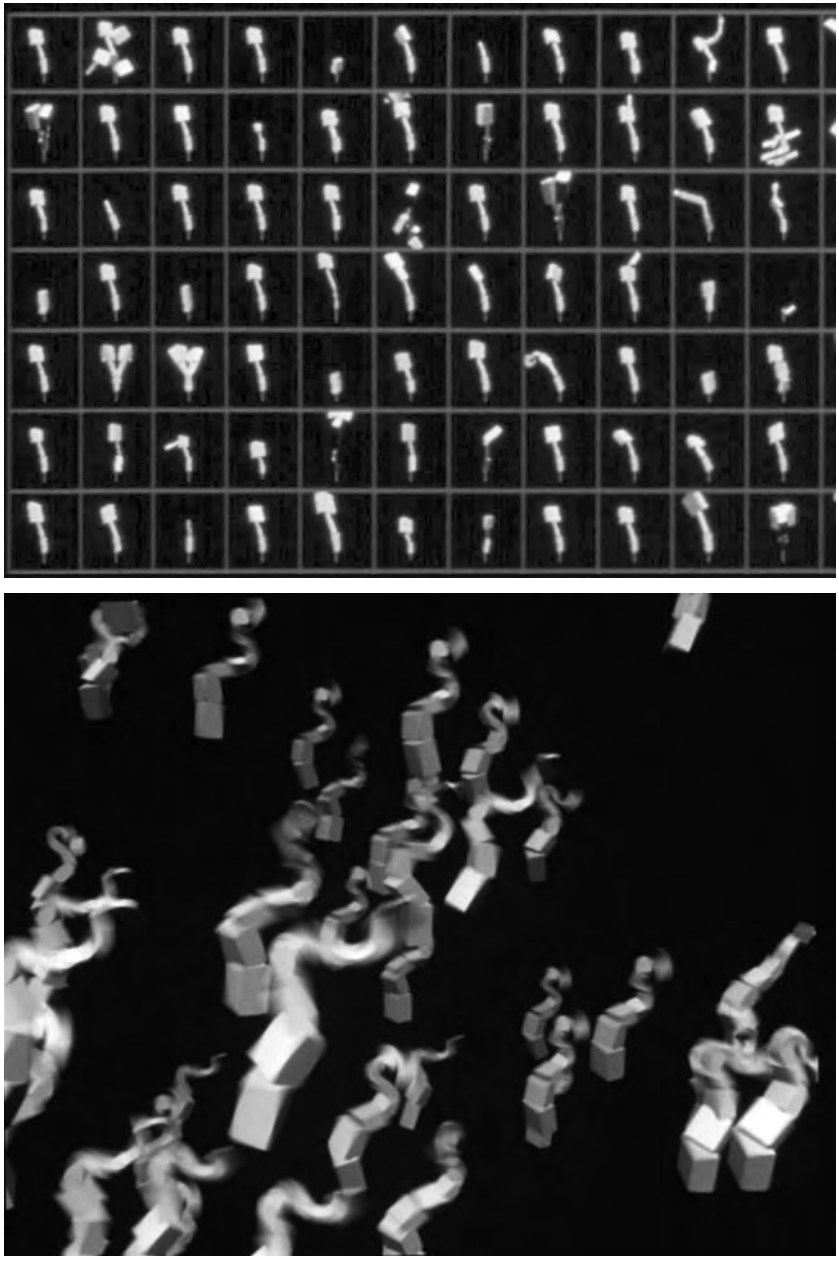


Figure 11.6–11.8
Karl Sims, *Evolved Virtual Creatures*, 1994. Code with graphic output. Screenshot.

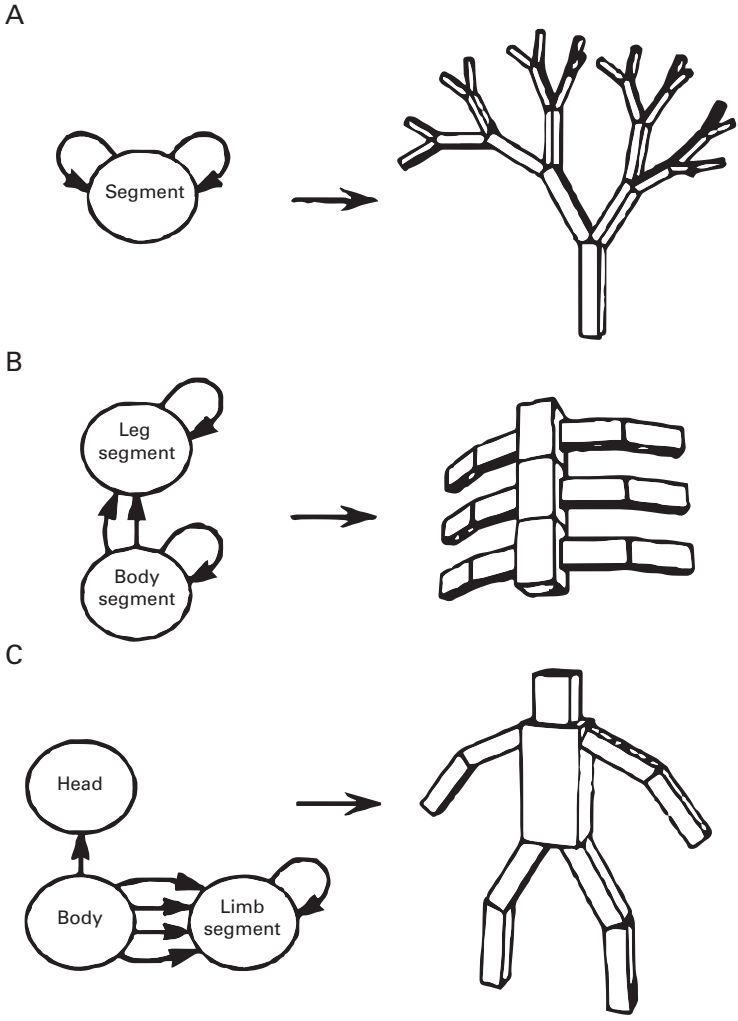


Figure 11.6–11.8
(continued)

Wind and Rain

If museums and libraries—or whatever their successors as the cultural archive of the twenty-first century may be—ultimately turn to such evolutionary models, then neither the all-inclusive automation of *Every Icon* nor the selective breeding of Karl Sims alone will suffice. To base an archive on an algorithm is to focus on the scope of the collection—analogous to a library's stacks—while to base an archive on a fitness function is to focus on what is selected—analogous to a card catalog. In a truly organic archive, however, it is meaningless to consider the collection independent of the selection criteria and vice versa. The archive of the future may not be a library but a landscape: to be specific, the epigenetic landscape.[41]

The epigenetic landscape is a metaphor used by evolutionary biologists to suggest the way the development of an organism can be subject to genetic and environmental forces at the same time. Imagine a stretch of land in which dramatic peaks and valleys have been formed by powerful seismic forces; different populations live in the various valleys of this landscape, out of touch with each other due to the intimidating ridges that separate them. In this visualization, seismic forces represent genetic influences, which tend to segregate species into incompatible gene pools; hence birds and reptiles can no longer mate, even though they evolved from a common ancestor. Nevertheless, the behavior of the population is not determined solely by this seismic topography, for rain and wind can erode previously impassable peaks into humble hills more easily traversed by the landscape's inhabitants. In this metaphor, the wind and rain represent environmental influences, which tend to encourage the evolution of new species through dramatic climatic change. (Paleontologists hypothesize such a cataclysm to explain the sudden extinction of dinosaurs and diversification of mammals 65 million years ago.)

To recast this metaphor in terms of the organic archive, the valleys of the epigenetic landscape define the possible repositories of knowledge at a given time—such as all of the types of computer algorithms currently on *Tierra*'s network. Left to themselves, these algorithms might just evolve toward a steady state in which a few species of reproducible code come to dominate and the others die out. To reinject diversity into this system, however, Ray can unleash some wind and rain—change the mutation rate, for example—and the complacent established algorithms may have to evolve anew in order to survive.

How might this abstract model be applied to evolve a more adaptable word processor? The organisms in the landscape—variations on word

processors—might be interbred to produce new variations, and those judged best able to display various documents would pass their code on to the next generation of word processors. Meanwhile, in addition to a predefined set of technical conditions—from, say, a Wordstar file in Windows 3.11 to a NeoOffice file in Mac OS X—researchers might expand the test by adding some wind and rain—random samples from an algorithmically generated set of documents and algorithms. In this way, the resilience of display software could be tested against technical contexts that don't yet exist.

The Law

Let's step back now from this "delirious vision," to borrow Borges's words, of self-evolving, future-proof artifacts. Chapters 9 and 10 argued that the laws controlling the proliferation and mutation of cultural artifacts have done more harm than good. Once we jump to the speculative organic archives of this chapter, however, we might want to encourage *more* attention from the law rather than less. While pharmaceutical research has produced blight-resistant crops and new tests for cancer, it has also produced suicide seeds and antibiotic-resistant germs. Genetic modification has had a similarly mixed effect on preservation. Scientists by 2009 had created a living clone of an extinct species by transferring cell nuclei from the preserved skin of an extinct Pyrenean ibex into the eggs of a contemporary goat.[42] In the same year, however, the U.S. Food and Drug Association approved the sale of the pharmaceutical protein antithrombin produced in the milk of genetically engineered goats[43]—in effect, engineering a new species of mammal for the sole purpose of delivering cheaper drugs, a practice known as "pharming." Given the limited resources on planet Earth, the fact that genetically modified creatures can often outcompete their natural cousins[44] suggests that tampering with biological systems could reduce their diversity rather than amplify it.[45] It may be that biotechnology does not support the both/and logic of digital proliferation but reverts to the either/or logic of analog space.

As we saw in chapter 10, Euro-American law likewise follows an either/or logic. In response to a call for using genetic manipulation to preserve an "improved" grizzly without a taste for human flesh,[46] a wag on one *Slashdot* forum commented, "Watch them try to Patent the processes that create the extinct animals. Wanna see what that trial looks like? 'The Samsung Grizzly looks too much like Apple's iBear! Cease and Desist and re-Extinct the Samsung Grizzly!'"[47]

Of course, an iPhone doesn't evolve after it leaves the Foxconn factory, but there's no guarantee that this would be true for an iBear. In a prescient Philip K. Dick story cited by video game historian Raiford Guins, one Doctor Labyrinth invents a device to safeguard Western classical music, "the most perishable of things, fragile and delicate, easily destroyed." The "Preserving Machine" ingests musical scores and transforms them into living creatures to ensure their survival: "In goes a score by Mozart and a Mozartbird steps out!" Sadly, the prodigies birthed by this machine quickly evolve beyond their original purpose and end up battling for survival in the nearby woods:

> The Schubert-animal is the first casualty, discovered ripped to shreds during a vicious attack by the Wagner-animal. Upon seeing the Wagner-animal and identifying it as the responsible party, Doctor Labyrinth laments, "But it's changed. It's changed. I hardly recognize it." The Wagner-animal mutated beyond recognition to meet the needs of its own survival. The music scores, in reanimated biological living form, live on but in ways neither anticipated by their creator nor immediately discernable.[48]

To harness the enormous parallel processing capability of a virus or cell is to play with fire; the same potential for explosive and unpredictable growth that makes genetic processes attractive as a preservation strategy also makes them a potential danger to existing creatures and their ecosystems. Critics such as Jeremy Rifkin question whether humanity is mature enough to wield the power of genetic processes responsibly, given their proliferative potential. Even technologists such as Bill Joy have expressed concern over the "gray goo" scenario, a doomsday endgame in which one species wins the zero-sum game of a planet with limited resources. In this hypothetical future, researchers accidentally unleash a self-reproducing, evolving machine or organism that overwhelms the natural (and possibly the built) environment, covering the planet with a kind of gray goo that obliterates the rest of the animal and vegetable kingdoms.

And what of the preservation of genetic artworks such as Eduardo Kac's glow-in-the-dark bunny or Davis's runic bacteria? Allowing them to breed uncontrollably in the wild may be the best way to promote their perseverance, but it accords these artists with a power far beyond what artists are accustomed to, even in the age of the Internet. After reviewing examples of synthetic life, Joline Blais and I argued in the book *At the Edge of Art*[49] that new media artists should aim less to be like a virus than like an antibody—in other words, to exploit the power of proliferation but not at

the expense of life itself. In our view, art can expose a society's weaknesses but should not undermine it altogether. Although the biotech industry would prefer that we didn't notice, genetic materials are among the most powerful weapons of mass destruction available today. So how could archivists exploit nature's proliferative powers without endangering nature herself?

As important as the task of preserving human culture may be, we have already seen the effects of its being *too* preservable: landfills piling up with plastic toys and rusting automobiles, pharmaceuticals showing up in breast milk, and space junk crashing down from orbit. In our experiments with organic forms of preservation, we should make sure that our zeal to leave behind a permanent footprint doesn't end up squashing nature in the process. It might be possible to encode the works of Shakespeare into every schoolchild's DNA for their future reference—but what unintended consequences might this have for our evolution and our planet?

One safeguard that might be worth exploring is built into Tom Ray's *Tierra* project, the "wildlife sanctuary for computer viruses" mentioned earlier. By creating a virtual petri dish in which snippets of code can mutate and reproduce, Ray harnesses a power similar to that of artists like Davis or Kac, as he cannot predict the outcome of the microscopic orgy committed by his computer programs. For example, to explore their behavior across a range of silicon ecosystems, Ray built a system that allowed his viruses to email themselves from server to server across the dispersed hard drives of his collaborators. Once let loose in this closed network, Ray's critters decided to circumnavigate the globe. Remarkably, they became a nocturnal species, always seeking the dark side of the planet where they could take advantage of CPU cycles left unused by a computer's sleeping user.

When challenged that he might be endangering everyone else's computer network if one of his viruses ever escaped captivity, Ray replied that the data packets bouncing around between servers did not contain any code that was executable on its own, but only within the specialized runtime environment of the *Tierra* software architecture.[50] To employ a term used in this book, Ray's critters live in an *emulated* world. Programs running in emulation don't have direct access to real hard drives; they just think they do. If I download a virus into a Windows emulator, it can eat up my emulated resources, but won't have access to my real resources if I don't want it to.

So it may be that combining the security of emulated environments with the power of genetic replication could provide a safe and powerful

future for cultural preservation.* Transgenic canola plants engineered to outcompete their feral cousins have extinguished their competitors in the field,[51] but a genetically evolved word processor on one hard drive needn't automatically erase an older word processor on another hard drive. Such evolved word processors may help ensure that we can read Briet's catalog record on an antelope long into the future. Nonetheless, when it comes to preserving a living antelope, there's a fine line between intervening genetically to prevent its extinction and the temptation to "improve" on the original species—and I don't believe anybody yet knows how to draw that line ethically.

* Rick: So, because redundancy aids preservation, the artwork (family) could be distributed across several environments/ institutions but still be discretely contained. Such distribution/replication could allow for each family to develop fitness functions that further aid its preservation, even within the parameters spelled out for that artwork.

Nature: From Culprit to Collaborator

Preservation, like so many human pursuits, can be viewed as an effort to impose the law of man on the law of nature. As we saw in chapter 10, the notion of law is etymologically connected to the role of the archivist in policing deviations from the original. Nevertheless, we also saw in that chapter that the attempt to overcome the mortality of artifacts—like the attempt to overcome the mortality of people—is at worst denial, at best a kind of bargaining.

It is hard to imagine nature playing a positive role from the standpoint of today's archives, with their banks of manila folders and solander boxes arrayed against nature's will to entropy. Yet in the long term it may be that archivists will no longer be able to resist letting natural processes in the door—maybe even the wind and the rain—either because of their amazing powers of perseverance, or because the artifacts under their care are increasingly created through such natural processes. Archivists who store culture using genetic processes, however, must be willing to give up even more control than those who trust in MPEGs and HTML, because transformations as extreme as emulation and migration would no longer be optional but part and parcel of the genetic approach to preservation. So we're back to a familiar tradeoff of variable media: is it better choose

a stable format with a short lifespan, or a variable format with a long one?

Perhaps future heritage organizations will choose the latter. Looking to nature for inspiration, they will craft a more self-sustaining social memory in which archivists are the nuclei that store codes for cultural artifacts, and artists are the ribosomes that reinterpret them. At that point perhaps the archive may aspire, like so many of our current institutions, to find a way to cooperate with nature instead of working against it.

V Conclusion

12 Checking In

Richard Rinehart

The variable media preservation approach Jon and I have presented so far invites critiques, debates, and open-ended questions. Below, I present some of these and, by pulling on these threads, suggest a future research agenda.

Separating the David from the Marble

One counterargument to this approach holds that it would be wrong to treat works of media art as if they were as variable as any other computable function. This view holds that the materiality of these artworks, in the form of their equipment and any other physical manifestations, is important, and that to split the physical from the logical in art would be like separating Michelangelo's *David* from the marble of which it is made. This is certainly true of some artworks (*David*) but not of all (*Unreliable Archivist*), and is true of some components of artworks but not others. What we need, in order to address this concern, are preservation systems that spur us to record which artworks must rely on their original material manifestations and which allow variability and to what extent. It's true that a blanket approach that permits us to replace any part of any artwork in the future is irresponsible. How would we make those choices appropriately? Right now, however, what the museum world has in place is a blanket approach but with the opposite assumption: that no component of any artwork may be replaced. The preservation approach for each artwork must come instead from careful consideration of that work, and preservation systems (such as metadata standards) must prompt, explicitly document, and allow for answers without regard to a priori assumptions. This consideration is not accomplished in a vacuum, and further research into the question of new media art's materiality in relation to preservation must inform each rescue operation.[1]

The Hermeneutic Problem

Another critique of the variable approach that would allow museums to recreate artworks according to recipes devised by the artist and others is that the artwork would never accumulate a historical patina. With such constant upgrading and replacing, the artwork might be kept functioning, but it would lack any sense of historical specificity or authenticity, would become unhitched from history and historical readings. If the components of an artwork are constantly upgraded, this argument goes, there will be no material clues about its origins, and this might lead to misreadings. For instance, the artwork might employ an idea that seemed relevant and contemporary at the time of its creation but would be read differently if manifested a decade later using contemporary media or technologies.[2] The use of contemporary media invites the viewer to read the work as if it were born in the contemporary moment. For instance, Ken Goldberg's *Ouija 2000* presents the viewer with a ouija board that can be played over the Internet in collaboration (to offer a greatly oversimplified description of this multivalent project). *Ouija 2000* referenced its contemporary millennial moment; according to Goldberg, specifically the mystical overtones that accompany a millennium's passing. However, if this piece were continuously recreated using the latest technology over later years, the mystic ouija board might become uprooted from that historicity and be read by viewers as referencing, say, the ghost in the machine rather than millennial fever. Thus it is argued that re-creation compounds the hermeneutic problem of reading art out of its historical context. Cory Arcangel's *Super Mario Clouds* provides a slightly different example of this problem. In 2002 Arcangel modified a 1980s Nintendo game cartridge, stripping out all game elements except the blue sky with a few scattered clouds drifting by. When this was exhibited in the 2000s, the hardware, the widely recognizable image, and the pixelated rendering of the clouds invoked a retro-tech nostalgia. Many artworks similarly use technology that is obsolete at the time of their creation to invoke nostalgia or other readings. It is difficult enough to represent that retro effect in future exhibitions, and the difficulty would be compounded if the work were constantly upgraded to contemporary media.[3] Ironically, *Super Mario Clouds* has already been rescued once by dint of its reproducibility and variability. Arcangel writes on his website, "The original 2002 code disappeared in a laptop theft, but I wrote it again using the code posted on this website as a guide." Luckily, *Super Mario Clouds* could be retrieved from the cloud and the work is, as of this writing, in version v2k9, with no sign that all this copying and updating will destroy the work.

Let us return to the critique and consider it at face value. What if, because of these arguments, we steered clear of a variable approach and employed the preservation status quo when it comes to new media art? If an artwork remains safely locked in the past because its patina has rusted its gears and it ceases to function, we have the option of simply exhibiting its nonfunctioning remains in a vitrine. Perhaps we would also provide documentation about how the work used to function. This would make the work historically accurate but artistically inaccurate. Or perhaps, rather than exhibiting the patina and documenting the art, we could exhibit the art and document the patina. The hermeneutic problem is not new—it defines art history. We just need a fresh application of all that thinking at the intersection of new media, art, and preservation.

Just Do(cument) It

It has, at times, been argued that the best we can do is to document new media art; that this is necessary and sufficient to preserve it. It's true that, because of their ephemerality, new media artworks need to be documented even more than traditional art forms, but they need more than traditional documentation. Most documentation (a photograph of a painting, a recording of a music performance) is past-oriented, recording how the work existed at some point in history. Take for example the performance work *Imponderabilia* by Marina Abramović and Ulay in which they stand, naked, on either side of a narrow entrance to a gallery, forcing visitors to choose which one to face as they press up against them to gain entry. Sliding your nervous sweaty body against the artists' is the artwork. The videotaped documentation, even when presented on a white plinth in a gallery, is not the artwork, nor even the preserved version of the artwork.[4] In previous chapters, we've looked at a type of documentation for recording the future states of a new media artwork, but it's important not to confuse the artwork itself with either past- or future-oriented documentation. Rather, the artwork lies in the space of possibilities created by documentation. Only when documentation is coupled with action, such as storage, migration, or recreation, does it become preservation. Of course, in many performances and other such ephemeral artworks, the artist fully intends the documentation to be considered part of the work. (Christo, famous for wrapping buildings and bridges, makes his living by selling preparatory drawings and photos of his installations.) The problem occurs when, lacking an alternate preservation methodology, museums codify the practice of positioning the documentation as a proxy for the artwork and leaving it at that. With new

Figure 12.1
Marina Abramović and Ulay, *Imponderabilia*, 1977.

media art, we need documentation, we need new forms of documentation, and we need it more than ever; but on its own, it's not enough.

One Is Never Enough

Critics of a variable approach perhaps rightly assert that one document, one questionnaire filled out by the artist that outlines how to recreate the artwork, is not enough of a solution to the myriad problems in preserving media art. This is of course true. So any preservation approach, especially at this early stage in the investigation, cannot put all its virtual eggs into one basket. We must treat any new preservation methods as experiments and not wholesale replacements for more traditional records and methods. Time will tell us which methods work best. For now, we should attempt to save the original software and bitstream (as long as we can), and apply

Figure 12.2
Reenactment of Marina Abramović and Ulay's *Imponderabilia* by Eva and Franco Mattes, 2007. Performance, Performa '07, New York.

every known documentation method from interviews to conservation reports to cataloging to scores.

New Media Treadmill

Some conservationists propose that the real danger to digital artworks in particular is that their key components are invisible to the naked eye; that the critical source code for a work would become forgotten on some unreadable disk in a back corner of the archive. The proposed caution is that one cannot leave a work of digital art in the vault and come back to exhibit it once every seven years; it will have become inoperable even in that short time. One must "touch" the object continuously, upgrading it between each micro-obsolescence. This is the same migration approach taken with collections of digital documentation, such as images of

paintings, and it would seem natural for museums. The proposed solution is to keep such artworks live and active, on continuous exhibition. Researchers and the public benefit from the work's constant availability, but it is also costly. The strategy is not feasible for works that include physical components that would require dedicated gallery space. This solution may be best suited to larger museums with more resources. We need preservation solutions, like this, that allow the artwork to be continually present, but we also need solutions that allow it to go offline for a period without being doomed. Preservation solutions for media art need to be economical and tractable even for galleries, individuals, and smaller museums.

The Turing Test

Another challenge is that of proof: if we recreate an artwork in the future, how will we know if we've gone too far? How will we know if we've created an entirely new work as opposed to a new version of the original work? In a way this problem begs for a kind of Turing test for new media art. The mathematician Alan Turing (mentioned in chapter 4) proposed a way of testing artificial intelligence: a subject would be placed in a room where he or she could communicate (via text) with, but not see, two other parties, a computer and another person. If, after communicating with both, the subject could not tell which was the computer and which the person, then the computer could be said to have exhibited artificial intelligence. With media art, the analogous test might involve placing an artwork in its original medium next to a re-creation of the same work. If a viewer cannot tell the difference between them, or at least accepts the difference, perhaps the re-creation can be said to retain its integrity (such as when we hear a Bach cantata over a radio). If the variable preservation method were tested successfully on newer works—where the working original could be seen side by side with its re-creation—then we might apply this preservation algorithm to older works with some confidence. It's interesting to note that the Turing test is based on the behavior and performance of the two parties rather than on their appearance, as it is often the behavior and not the look that is defining for new media artworks. In 2004, in an exhibition titled "Seeing Double," the Guggenheim Museum presented new media artworks in their original form next to the same work in an updated format (as detailed in Jon's case notes in chapter 8). We desperately need more such preservation tests as occasions to ground the discourse in real data and to engage the public as well as professionals.[5]

Two Faces of New Media Art

The Turing test for media art and "Seeing Double" beg a common question: are they testing for the integrity of the artwork as it exists in the museum collection or as it is experienced by the viewer? The two may not always be the same. This may seem surprising; after all, a painting in the museum's collection is the same whether in the vault or in the gallery, but new media are decidedly more fluid, and this raises additional challenges to preservation. For example, consider the new media work *Landslide* by the artist Shirley Shor. *Landslide* involves source code that is compiled to generate a computer program; this computer program is what resides in the collections of the Berkeley Art Museum and the Jewish Museum in New York. When the work is shown, the program is run continuously on a computer in the gallery that is connected to a projector on the ceiling. The program generates a never-ending, never-repeating abstract pattern that flows through the projector onto a small sandbox installed on the gallery floor. The pattern resembles the shapes of a map projected onto the geography below, suggestive of the shifting sands and politics of the Middle East. The shapes are constantly evolving and colliding, never at peace, until one color in the pattern finally takes over the whole sandbox and the process starts again. What the viewer experiences as the work are the sandbox and the visual display from the projector. It would be nonsensical to try to capture a snapshot of this experience for the collection by videotaping a segment of the display. The pattern never repeats, and a recording would sorely miss the point (much the same as recording random TV signals for Paik's artwork *Crown TV*, mentioned by Jon earlier, would misrepresent that work). *Landslide* naturally exists in two states: the one that sits in the collection (a bit of software on a disk) and the one that is experienced by the viewer (the visual projection and sandbox). On which version should our preservation efforts focus? Which constitutes the "primary evidence," and which the secondary? When the wall label appears next to this work in a gallery, should it label this work as a piece of code or a multimedia installation?

Of course, museum collections are littered with variable works in traditional and nontraditional media: installation works that must be assembled for exhibition, video art that is stored in one format and presented in another. The differences introduced by new media, digital media in particular, are those of degree and volume. A new media artwork in the museum collection, like *Landslide*, may consist of a piece of source code (code that could produce many different products) that is fed a particular

Figure 12.3
Shirley Shor, *Landslide*, 2006. Jewish Museum.

set of parameters and compiled to produce another piece of software that runs on a computer to produce a video projection. The source code and the resulting projection are so many degrees separated that the chain of context that connects them is very thin—so thin that it falls between the gaps in most existing metadata standards. These degrees of separation are compounded by the volume of variables. Author Bruce Sterling points out in the context of his Dead Media Project that while analog media formats like film suffer from mere hundreds of formats, digital media formats suffer from millions. Apple's iTunes store offers over 775,000 apps for the iOS alone, each capable of producing a proprietary file format. Multiply that by the number of different digital devices since they were first introduced, times the number of operating systems, times the number of applications, times the number of configurables, etc.: what you have is a preservation problem in which quantitative volume forces a qualitative shift, a landslide that permanently alters the geography of preservation.

Landslide demonstrates how the variable nature of new media art means that the work as collected and as exhibited may not be the same, and the space between those is an area ripe for further investigation. Nor is this situation an aberration within the genre of new media art; it is the new norm. It creates a new geography to which collectors and institutions must adjust.

13 Only You Can Prevent the End of History

Richard Rinehart and Jon Ippolito

If you've read the previous chapters as a casual observer of new media culture, your reaction may be, "Hmm, that's a different way to think about preservation." If you've read them as a working preservationist, you might be impatient for a punch line: "OK, I get that new media represent both a challenge and an opportunity for social memory. I get that new media art may have more in common with performance than with visual art, and that its boundaries may encompass environments, networks, and behaviors rather than just digital files. But you still haven't told me what to do with those demagnetizing videotapes/unreadable floppy disks/broken web servers on the shelf behind my desk!"

This book can't, and won't, prescribe a cure for every strain of technological or cultural obsolescence—those cures are as much a moving target as the technologies themselves. Instead, we've tried to offer an approach meant to outlive the examples we marshal to illustrate it.

If you care about the survival of new media culture, you can start right now to adopt this approach. We offer below a twelve-step program, broken down by profession, that should get us all on track.

Twelve Steps to Future-Proofing Contemporary Culture

1. Curators: Update Your Acquisition Policy

Implement and test some of the ideas presented earlier in this book. Despite calls to action, institutional response has been slow and scattered. Every museum, archive, or arts organization that deals with new media culture can help. You don't have to have specially trained staff or a big grant to do something; even baby steps would move us all forward.

a. Revisit your institution's collection policies. Don't assume, because your institution already collects video, that you've got new media covered. What needs to change? Change it.
b. Interview artists whenever you commission or collect a work of new media. Ideally, you'd use the Variable Media Questionnaire,[1] or another tool based on an appropriate standard like the Media Art Notation System, that will prompt questions that have been vetted in a larger community. But if you can't do any of that, just sit with the artist and ask her what she would like to see happen when her work is re-created 50 years from now. Turn on your smartphone camera and record it. Take notes on the back of the café napkins.
c. When you commission or collect new media art, put some language in the agreement that outlines who has the right to re-create or restage the work, and under what parameters (see (b) above).
d. Add 20 percent to the bottom line of your acquisition budget for each work to be put in a variable media endowment[2] reserved for the costs of future migration, emulation, and other efforts to keep the work alive.
e. When collecting new media, don't automatically demand exclusivity or limited runs. Explore alternate models with the artist. Co-collect a work with several other institutions and share the cost and responsibility while increasing access and chances of successful preservation.
f. Develop a source code escrow that protects an artist's rights while she is alive, but releases her work to the public once she is gone.
g. Obtain the help of external communities, or at least look to them, for new models. How could your museum tap into the gamer community to help preserve a work by Cory Arcangel?

2. Conservators: Move out of the Warehouse and into the Gallery

Go beyond storage to test the migration, emulation, and reinterpretation of new media artworks. Spend less money on crates and climate control, and more on funding the process of creating, and re-creating, art. Rotate your collection shows as often as possible, because exhibiting a work renews it more thoroughly than any inventory or condition check.

And the next time you exhibit a slightly worn new media artwork in a gallery, museum, or festival like the ZER01 media art biennial,

work with the artist to try one of these strategies. Document your findings and share them with all of us. Don't be afraid to talk about failures; the cultural heritage community could learn from the sciences that even negative results contribute to knowledge. The Guggenheim picked up the ball with the exhibition "Seeing Double" in 2004; DOCAM's annual conferences[3] ran with the idea from 2005 to 2010; ZKM and its partners ran still further with their exhibition "Digital Art Conservation"[4] in 2011. Complete your leg of the race.

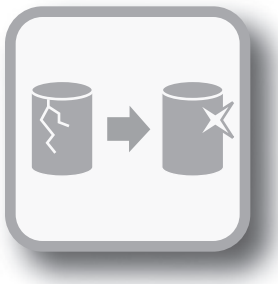
3. Archivists: Modernize Your Metadata

Further research, test, and agree upon metadata and documentation standards that we can all use. Standards help us by prompting us to ask the right questions, and they help us to share the answers. The Media Art Notation System (MANS) is one early attempt to articulate what is required from a metadata standard specifically for new media art and then to see how those requirements would play out as a real-world standard.

a. Feel free to copy the MANS elements when you are adding a few new fields to your collection management database.
b. Use MANS as a sounding board to develop your own documentation standard.
c. Or, instead, consider adopting an existing metadata standard to describe your new media art collection. Keep in mind the special requirements of new media art. Your standard should make explicit the parameters not only for how the work was manifested in the past, but for how it should be manifested in the future. Your standard should allow, even prompt, multiple memories of the work. More detailed requirements were outlined in chapter 5.
d. Don't get hung up on the bells and whistles of metadata that enable features that no one is using; be practical. It's more important to document and preserve the art now than to work on a standard for ten years. Look around at how your potential standard is actually being used and adapt the standard appropriately. Share your adaptation and your results.

4. Collection Managers: Renovate Your Database

Purchase, build, or find for free software tools that will allow you to gather together everything you'll need to preserve new media collections: the artist



interview, alternate memories, original source files, other documentation such as video or artist emails, and descriptive notes about each component of the work. (The author, programmer, or legal rights might be different for each component of the work; don't assume that one blanket "copyright" or "artist" field in a database will always cover the entire artwork.)

a. Don't become daunted by the complexity of some museum tools. If need be, this back-end tool could just be a simple FileMaker database with fields that look like MANS elements or Variable Media Questionnaire questions.
b. If you build a tool, share it.
c. Look for tools that have already been developed. The Forging the Future project[5] hosted at the University of Maine has a suite of free databases waiting for you.
d. Commercial developers of collection management tools for cultural heritage, take note. Be the first on your block to say that your system can fully accommodate new media art.

5. Institutions: Start Collecting New Media

Build repositories of digital culture. Once you have one new media artwork in your care, you have a collection. Build it a home. There are detailed guidelines for creating digital repositories in the Open Archives Information Standard documentation.[6]

a. Again, don't get hung up on details while your bits die. Prototype and iterate; you'll get better each time and you'll have saved an artwork by starting early.
b. Create digital repositories that are attached to curatorial programs (such as the Walker Art Center's Digital Art Study Collection), or repositories that stand apart (such as Rhizome's ArtBase), or repositories that act as production sites (like Still Water's The Pool).
c. Look for tools made specifically for this purpose such as ccHost, an open-source tool used to create the open-source music repository ccMixter.
d. Open your system to allow memory to seep through its pores both ways, so that official, institutional memory is shared with viewers and at the same

time they contribute alternate memories of the work. Maybe viewers will contribute their remixes or entirely new works to the archive.

6. Programmers: Connect Data across Institutions

Link these repositories of digital culture together to create a global network of digital primary evidence that exists at the tips of the world's fingers. Make this distributed database scalable and inclusive to leverage the wisdom of the crowd, expose and share undiscovered cultural artifacts, and ensure the maximum chance of these artifacts surviving.

a. Help flesh out the idea for an Interarchive, discussed earlier.

b. Consider registering or integrating your own repository with Forging the Future's Metaserver or contributing to a union database of digital assets like OAISter[7] as a way of sharing your content and maximizing knowledge.

c. Consider allowing your own digital repository, or parts of it, to be cloned by others to maximize its chances of survival through redundancy and shared responsibility.

d. Make participation in this distributed database very easy, even for small institutions. Consider how an archive would participate if it had a staff of four, no dedicated IT specialist, and no funds for specialized tools. How would an individual artist or scholar participate directly?

e. Build this distributed database so that it uses widespread existing Internet tools and knowledge; it should be as easy to contribute to the database as it is to build a blog or a webpage. Consider the Open Library as an example.[8]

7. Lawyers: Help the Arts Find Progressive Approaches to Copyright

The Canadian Heritage Information Network commissioned a white paper, *Nailing Down Bits: Digital Art and Intellectual Property*, that reported findings on research and professional interviews related to digital art and the law.[9] This paper concluded with a research agenda that could serve as a useful starting point for others. In addition to opining, surveying, and

theorizing, *Nailing Down Bits* argued that we need to test how new media art and the law interact in the real world. When asked for advice on the best strategy to do this, staff of the Creative Commons answered that the arts community should build repositories of new media art in order to play through the legal issues (see numbers 1–6 above). Experimentation and precedent are more useful than preemptive guesses. Jump in. Some other steps might include:

a. Arts organizations that build repositories of new media art can partner with a law school program, professor, or legal clinic. The repository provides interesting new legal research opportunities for the students, while they provide much-needed legal analysis.
b. Artists working in new media are encouraged to consider the legal disposition of their artworks. Artists may consider licensing their work through Creative Commons or the Open Art License mentioned in chapters 7 and 10. Artists can also consider and then articulate in written guidelines who is allowed to remix their works now and who will be allowed to reinterpret and reconstitute them in the future. If you are an artist, don't wait for a collector to interview you. Just include your instructions with the artwork, wherever it goes.[10]
c. Institutions such as museums are often caught in the middle of copyright issues, between the artist/creator and the public/user. But institutions also originate valuable knowledge themselves, such as records, video and photographic documentation, and educational texts or scholarly essays. These institutions can release their own content through open licenses to maximize the benefit to the public.[11]
d. Law is often about interpretation; this is especially true in the arena of digital copyright, which lacks a long history of case law. Lacking precedent, courts may judge a case based on established community practice. That means that in an unclear case, defendants who are merely following the practice of their peers, in good faith, would be judged with more leniency. Since cultural community practice is still emerging, it would be of mutual benefit to establish liberal rather than restrictive common copyright practices. This means that whenever artists or museums make liberal copyright decisions, they help shield themselves and others in the future. This is illustrated in a recent Canadian Supreme Court decision which found that the consistent application of a written fair-dealing policy was *prima facie* evidence of the practice of fair dealing and that the burden of proof was placed upon the plaintiff publishers to dissuade the courts otherwise.[12]

8. Creators: Save in as Open a Format as Possible

Protect your content. Back up your culture. Aim for long life if not immortality.

a. Whenever possible, save your work as uncompiled (ASCII) text or code. If you must use compiled code, save the original source file as well as the compiled one.
b. Be selective in what you preserve. You are most likely to preserve what you have a good reason to look at again.
c. Back up in multiple locations, both local and online.
d. Post/back up your work to open archives (Internet Archive) rather than proprietary ones (YouTube).
e. Avoid compression if possible.
f. Avoid proprietary formats, especially ones with any form of digital rights management, in favor of free and open standards. (Our best guesses on format longevity appear in table 13.1.)

9. Dealers: Invent New Economic Models

Research, model, and test how new media art interacts with the art market and other economic environments. Due to the legal, social, and technical complexities that attend new media art, collectors are sometimes understandably hesitant to buy this work. That forces new media artists to experiment with alternate economic models, but it also removes a time-tested source of support for individual new media artists and indeed for a whole genre of creators. Some brave models exist. For instance, the Catherine Clark Gallery in San Francisco and the Bitforms Gallery in New York have successfully sold new media art and have developed methods for continuing to do so. Caitlin Jones pioneered the use of variable media questionnaires in new media acquisitions for the Bryce Wolkowitz gallery.

a. Gallerists and private collectors need to be part of the conversation around preserving new media art. Private collecting not only provides one form of tangible support for artists, it also constitutes an additional sphere

Table 13.1
Comparative Longevity of Various Formats as of 2013

Format	Short-term	Medium-term	Long-term	Indefinite future
Text file	MS Word (.doc)	PDF,[1] Open Document Format (.odt), Office Open XML (.docx)[2]	TXT, HTML, RTF (Rich Text Format)	Nothing
Web application	Flash, Director (Shockwave)	Java	HTML, CSS, JavaScript	Nothing
Database	Filemaker, Access, Oracle	MySQL, PostGresQL, NoSQL	XML (Extensible Markup Language), RDML (Relational Database Markup Language)	Nothing
Server script	A.I.R, .NET/C#	Java (servlets), Ruby	PHP, JavaScript, Python	Nothing
Spreadsheet	Excel (.xls)	Open Document Format (.ods), Office Open XML (.xlsx)[3]	Comma-separated values (.csv)	Nothing
Vector image	Illustrator (.ai), Flash (.swf)	PDF,[1] CGM (Computer Graphic Metafile)	SVG (Scalable Vector Graphics), EPS (Encapsulated Postscript)	Nothing
Raster image	Photoshop (.psd), GIF	JPEG	Bitmap, TIFF, PNG, JPEG 2000	Nothing
Audio file	Copy-protected CD	Windows Media Audio, MP3, AAC	Ogg Vorbis,[4] FLAC, PCM (Pulse Code Modulation), DTS-HD, WAV	Nothing
Video file	Copy-protected DVD, BluRay	QuickTime (.mov), Windows Media Video, MPEG4,[5] AVI	Ogg Theora,[4] WebM/VP9, Motion JPEG 2000, MXF (Material Exchange Format) JPEG 2000[6]	Nothing

Note: A chart like this is more weather forecast than scientific measurement, and we're printing it not to serve as a tablet of biblical commandments but to illustrate how lifespan increases when formats are free, open, and uncompressed. We're grateful to John Bell and Richard Hollinger of the University of Maine Digital Curation program for our running debate about file formats, which has shaped the opinions expressed in this chart.

Table 13.1
(continued)

[1] As of this writing, I (Jon) don't believe PDF will have the longevity that many preservationists ascribe to it. Although released as an open standard in 2008 (PDF/A being a format designed for archives), PDF has had a troubled history of capturing interactivity (leading to JavaScript vulnerabilities) and still presents no easy way to access or modify the source code that determines its formatting.

[2] As of this writing, there is controversy over which of these two "open" formats is most open or will endure longest.

[3] Ditto.

[4] The Ogg Vorbis and Ogg Theora formats have the benefit of being open standards, unencumbered by patents or copyright. As of this writing, however, more widely adopted standards like MPEG-4/H.264 and WebM/VP9 have begun to shed their intellectual property restrictions as well. Having pressured proprietary formats to become more open, the Oggs may have served a purpose John Bell describes as "more political than technological." John Bell, private correspondence with Jon Ippolito, October 27, 2013.

[5] Despite the patents that hang over it, MPEG-4 is as of this writing one of the most popular cross-platform, Web-friendly video formats, especially when compressed with the H.264 codec. In 2013 Cisco agreed to open-source the H.264 spec and pay related patent costs; unfortunately that doesn't make the codec free—just out on bail.

[6] Motion JPEG 2000 and MXF JPEG 2000 both permit lossless capture of individual frames and no compression from one to the next, which relieves future preservators from having to reconstruct those layers of software. Another example of an uncompressed video format was applied to the emulation of *The Erl King*, as described in chapter 8. See note 23 of that chapter.

Frame-based film preservation has an impressive pedigree. In a rare example of the law contributing to the longevity of an art form, copyright law before 1912 required creators to deposit paper copies of their work with Library of Congress, and for pioneering filmmakers there was little alternative but to develop contact prints of their movies frame-by-frame. Now that much of the original film stock has deteriorated, these paper sequences are the only extant record of the original films. "The Paper Print Film Collection at the Library of Congress," *Library of Congress*, http://memory.loc.gov/ammem/edhtml/edppr.html, accessed November 12, 2013.

Ironically, this "preservation via copyright" has also spurred examples of proliferative preservation, as in Ken Jacobs's *tom tom the piper's son* (1962), which he created by reshooting paper copies of a vintage film and reanimating it frame by frame:

> Ken Jacobs's avant-garde landmark . . . begins with a 1905 short of the same title, in which a large crowd of people tumble through a doorway, leap from a loft, and climb out of a chimney

Table 13.1
(continued)

in pursuit of the eponymous pig thief. Jacobs then rephotographs the film—slowing it down, freezing frames, introducing flicker effects, and isolating portions of the frame, some so tiny that we see mostly the grain. As he varies the rhythm the film becomes a series of carefully constructed riffs on particular characters or actions, or on pure shape; new meanings emerge from the little dramas between alternating shadows, or from background elements of the original. . . . Thus Jacobs teaches us how to resee almost any film, by mentally reframing its images or changing the speed of its action.

Fred Camper, "Tom, Tom, the Piper's Son," *The Chicago Reader*, http://www.chicagoreader.com/chicago/tom-tom-the-pipers-son/Film?oid=1049974, accessed November 12, 2013.

for preservation. We can come together in professional forums and individual partnerships to develop equitable models for how private collecting can coexist with public service and even open-source practices. (For example, no more self-destructing DVDs.)
b. Limiting the edition for a duplicable work to three or five instances may help you jack up its price, but remember how poorly digital rights management has served the entertainment industry. You're more nimble than Sony or Time Warner—invent a creative financing scheme that doesn't restrict future access to the work. Otherwise, artificial scarcity in the short term will lead to innate scarcity in the long term.
c. For their part, creators should continue to explore additional economic models such as art subscriptions. Some models can succeed independently of the art market; artists like Scott Snibbe have sold inexpensive works in high volume for mobile devices through commercial music and software channels.[13]

10. Sponsors: Fund the Preservation of Born-Digital Culture

The NEA, NEH, and others have generously funded projects, including many of those mentioned in this book. Still, much funding continues to be devoted to building giant online databases of scanned paper documents and pictures of paintings. These are invaluable for research, but while we're researching our past using new media, our contemporary culture, created using those same media, lies dying. How much of the original $99 million dollar

Congressional allocation for the preservation of digital culture (NDIPP) is going toward the problem of preserving digital art, or any born-digital culture for that matter?

a. Large funders like foundations and government agencies could create programs, no matter how small to begin with, that deal with the preservation of born-digital material.
b. Funders could help everyone by funding risk and new approaches. It's safer of course to fund time-honored methods, but, as this book has tried to make clear, if we continue our old practices, our new culture is doomed. Again, even failure can produce new knowledge.
c. Not just large funders but small ones on the level of individual galleries, museums, and sponsors can help as well. When you next commission a work of new media art, consider how your investment will serve the public in the long term as well as for the short-term exhibition or program. You might consider incorporating elements into your agreements that stipulate that the commission be available for remix, if only on a local level. (The V2_ organization in Rotterdam included a requirement that work produced in their lab on one of their fellowships be kept in the lab and made available to future fellowship artists for remix.) A university museum could require a similar stipulation that served just their campus (if not the world). It's a start.

11. Academics: Educate, Engage, Debate

This book is one small attempt to further our shared conversation around new media, preservation, and social memory. We need many more.

a. If you are at a university, consider sponsoring a program or department like NYU's innovative Moving Image Archiving and Preservation Program, Avignon's Laboratoire des Médias Variables,[14] or the Digital Curation online program at the University of Maine.[15] There aren't enough around, and it's a chance to claim a niche while serving a need.
b. We need programs like the one above, but which focus on or include a significant component oriented specifically at new media art.
c. If you are at a museum, train your next preservator with a fellowship like the Guggenheim's Variable Media Fellowship. Or consider a public forum on the topic, like the Berkeley Art Museum's "New Media and Social

Memory" conference. Use this as an opportunity to engage with private collectors or law schools, as mentioned above.
d. In addition to individual schools and universities, larger umbrella organizations such as the American Alliance of Museums, the Museum Computer Network, and College Art Association can serve as clearinghouses for information and professional development around new media preservation.
e. Beyond the world of art and museums, create new conversations and new partnerships with others who also struggle with new media preservation: government agencies, libraries, industry, and entertainment.

12. Historians: Challenge Conventional Wisdom about Social Memory

As we said at the beginning of this book, new media have created a crisis in remembering that provides both an impetus and an opportunity to revisit the models and practices of social memory. This crisis is not limited to the art world. We need to foster and reward research on the theoretical, artistic, and social implications of the interplay of new media and social memory. We cannot significantly alter entrenched institutional practices without tackling the historical attitudes and discourse behind them, so both the practical and the theoretical are important here. Review the museological model for preservation. Put people—creators and collectors of artifacts—at the center. Question the current configuration of institutions (do the three primary types of cultural heritage institutions—museums, libraries, archives—remain the primary types we need today?).[16] Don't fall back on old-school art museum/media preservation discourse—come up with new paradigms so we can see what we're dealing with and make the necessary changes.

Conclusion

This book has argued that new media's challenges to time-tested practices can inspire us to reexamine and improve the ways social memory serves contemporary and future societies. We've tried to show that digital media impact both the subject and the tools of archival practice. The proliferative potential of these new media also suggest that social memory may be served by a reintegration of both formal and informal practices. Museums can, for instance, learn from indigenous cultures how to preserve living culture.

Digital media further confound the preservation, and even the concept, of the "original" in artistic, legal, and technical senses. This may not be a problem; maybe we are finished with notions of master copies and masterpieces. It is clear that in the not so distant future, when curators exhibit works of new media art, it will not be the familiar case of bringing the painting up out of the basement fully intact, looking just as it did 400 years ago, oozing authorial intent and integrity. Rather, new media works are going to need to be managed and migrated on a continual basis, and any future presentation will be, to some extent, an act of reinterpretation, reperformance, and remix.

In *Collecting the New*, Howard Fox wrote: "Anticipation of the future, rather than codification of the past, is a necessary attribute of the contemporary curator's function."[17] Curators and archivists must be able to dust themselves off and become futurists and reenactors. They must be able to describe the behaviors of an artwork with the same rigor, authority, and even linguistic specificity that they now use to describe its form. If they are to remain relevant, especially in collecting and preserving our digital culture, cultural heritage institutions like museums may need to become expert at embracing and managing change in addition to fixity. Cultural heritage institutions are themselves not locked into a fixed form but, like new media art, they need to be periodically reinvented. Perhaps the cultural heritage institutions that succeed in preserving our digital heritage will not look like entomology cases, where the butterflies of culture are pinned to the walls, fixed and motionless in their one true form for eternity. Instead, they may look like butterfly huts at the zoo, where they will breed successive generations of living culture that float about, flutter, and delight us.

Of course, in the fifty- to hundred-year view, calamities like climate change, energy descent, and economic collapse may make challenges like digital rights management and delamination seem like a walk in the park. Some say art can survive such cataclysms if we dump enough of it in a climate-controlled vault, along the lines of the great seed bank being built in Norway.[18] But here again the impulse to centralize does not necessarily serve the cause of preservation, as global disasters are more of a threat to capital-intensive systems such as governments, banks, and museums than to a dispersed populace of eccentrics making art in trailers and garrets. Perhaps the best way for art to survive the end of civilization is to go back to precivilized ways of preserving it.[19] The preservationists of the post-apocalypse won't wear white gloves. They'll be unreliable archivists—and that will be OK.

Notes

Chapter 1

1. "[A journalist] went to interview Jean Cocteau. His house was piled high with bibelots, paintings, drawings by famous artists, books, Cocteau kept everything, and felt a deep love for all those things. So anyway, during the interview, I decided to ask him: 'if the house caught fire right now, and you could only take one thing with you, what would you choose?' . . . 'I'd take the fire.'" Paulo Coelho, *Warrior of the Light*, no. 19, warriorofthelight.com/engl/edi19_frag.shtml, accessed January 6, 2012.

2. The close relationship between Hesse and LeWitt is well documented. See for example Gary Garrels, *Sol LeWitt: A Retrospective* (San Francisco: San Francisco Museum of Modern Art; New Haven: Yale University Press, 2000), p. 47.

3. Historians such as John G. Hanhardt question the claim that minimal and conceptual artists were progenitors of new media art, arguing rather that film, video, and performance influenced conceptual art practices. John G. Hanhardt, private correspondence with Jon Ippolito, July 5, 2013.

4. Some scholars pooh-pooh use of the term "new media" to describe the social networks woven by expressive technologies and network communication at the turn of the twentieth and twenty-first centuries, suggesting it be replaced by mouthfuls like "information and communication technologies" or synecdoches like "digital media." While they are meant to be more future-proof than the apparently relative term "new media," I believe these phrases throw the baby out with the bathwater by focusing on the gadgets instead of their revolutionary implications.

This book will cover hardware, software, wetware, and lots in between, so we'll stick with the vernacular term "new media," and, as introduced in the next chapter, the similarly inclusive "new media art." That said, the "new" in "new media" refers not to the latest gizmos available now but to expressive technologies of any period that outpace their culture's ability to control them. The aesthetic application of optics in the fifteenth century destabilized the church's stranglehold on orthodox representation, just as the creative use of packet switching in the twentieth subverted

a network originally intended for command and control. By contrast, television was never "new media" because its rollout was carefully controlled by the reigning media monopolies.

It makes no more sense to reduce new media to "information and communication technologies" than it does to reduce the Renaissance to "optical and painterly technologies." Unfortunately, however, the same slipperiness that makes new media revolutionary also makes them prone to obsolescence, as they slip through the traditional cultural institutions like water through a sieve.

For more on this definition, see the forthcoming article by Michael Grillo and myself entitled "From Support to Subversion: New Media as Catalysts of Change in the Fourteenth and Twentieth Centuries."

5. Doug Johns in a presentation at the San Francisco Museum of Art, spring 2002. For background, see Michelle Barger, "Thoughts on Replication and the Work of Eva Hesse," *Tate Papers*, no. 8 (Autumn 2007), http://www.tate.org.uk/research/publications, accessed July 24, 2008.

6. *Expanded Expansion* has been the object of meticulous study by conservators who have explored numerous approaches to and perspectives on the work. None has been a more vigorous and informed champion than Guggenheim chief conservator Carol Stringari, who argues that leaving the work in its decaying state is most respectful of the artist's intent and reflects a kind of ruined beauty. See "The Object in Transition," conference, Getty Conservation Institute, January 26, 2008, video documentation at http://www.getty.edu/conservation/publications_resources/videos/object_in_transition_day2.html#3, accessed January 5, 2012. See also Kate Taylor, "An Empress without Clothes (So to Speak): How a Conservator Looks inside a Painting," *Sun* (New York), May 28, 2008, http://www.nysun.com/arts/art-restoration-if-its-done-well-you-dont-see-it/78694/, accessed January 5, 2012.

7. *Wall Drawing 146*, documented in Susanna E. Singer, *Sol LeWitt: Wall Drawings 1984–1988* (Bern: Kunsthalle Bern, 1989).

8. *Wall Drawing 86*, documented at http://www.massmoca.org/lewitt/walldrawing.php?id=86, accessed June 17, 2012.

9. Personal conversation with the artist during a studio visit organized by Richard Lytle of the Yale School of Art, ca. 1990.

10. These four strategies have been used in one form or another for decades; to my knowledge, they were first described as a quartet of options in the Variable Media Questionnaire described in note 21 below. Since then, numerous individuals and institutions have explored and created variations on this theoretical framework.

11. While many professional conservators recognize that materials inevitably change over time, the presumption that their job is to arrest or slow this process pervades the rhetoric of cultural preservation outside the conservation lab. For example, the Wikipedia entry on conservation-restoration as of this writing reads:

The traditional definition of the role of the conservator involves the examination, conservation, and preservation of cultural heritage using "any methods that prove effective in keeping that property in as close to its original condition as possible for as long as possible."

The reference is to S. Walston, "The Preservation and Conservation of Aboriginal and Pacific Cultural Material in Australian Museums," *AICCM Bulletin* (Australian Institute for the Conservation of Cultural Materials) 4, no. 1 (December 1978): 9, http://en.wikipedia.org/w/index.php?title=Conservation-restoration, accessed June 17, 2012.

12. Bruce Sterling, "Digital Decay," in Alain Depocas, Jon Ippolito, and Caitlin Jones, eds., *Permanence through Change: The Variable Media Approach* (Montreal: Daniel Langlois Foundation; New York: Solomon R. Guggenheim Foundation, 2003), 12.

13. Matthew Kirschenbaum makes a compelling case that bits can hide away in material substrates much longer than one would expect, as in the forensic recovery of data from hard drives buried under rubble at the bottom of the World Trade Center after 9/11. (How much money it takes to recover those bits and how long they will still make sense after software protocols have changed are different questions.) See Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2008).

14. "Over 7723.398210 megabytes (and growing) of free storage so you will never need to delete another message": see https://mail.google.com/mail/help/intl/en/about.html, accessed June 17, 2012. (The number of megabytes on Google's page automatically updates several times a second. Note that in the year between the writing and editing of this article this figure doubled from 7-plus to 15 gigabytes—illustrating the rapid change of digital technology.)

15. These industrially manufactured products are the signature materials of the artist Felix Gonzalez-Torres, whose work Rick discusses in the next chapter.

16. Carol Stringari, "Meg Webster, Stick Spiral, 1986," in Depocas, Ippolito, and Jones, *Permanence through Change*, 79.

17. Jason Victor Serinus, "Director Peter Sellars on Art, Music, and Politics," *Home Theater High Fidelity* (Redwood City, CA), December 20, 2011, http://www.hometheaterhifi.com/interviews-musicians-artists/1442-director-peter-sellars-on-art-music-and-politics.html, accessed January 6, 2012.

18. Paul Taylor, "Way out of Line," *Independent* (London), March 18, 1994, http://www.independent.co.uk/arts-entertainment/theatre-way-out-of-line-samuel-beckett-was-notoriously-fastidious-about-his-stage-directions-drilling-his-actors-on-intonation-obsessively-concerned-with-gradations-of-lighting-and-rhythm-since-his-death-the-beckett-estate-has-monitored-productions-of-his-work-so-when-deborah-warner-reassigned-some-lines-and-sent-fiona-shaw-on-walkabout-in-footfalls-at-the-garrick-she-was-asking-for-trouble-1429888.html, accessed October 20, 2013.

19. Jon Ippolito, "Mark Napier, net.flag, 2002," in Depocas, Ippolito, and Jones, *Permanence through Change*, 113–114. A more systematic example of reinterpretation that harnesses the crowdsourcing strategy described in chapter 10 is the ReCode Project, a community that preserves computer art by translating from obsolete languages like FORTRAN into modern ones like Processing.

> Every translated work will be available to the public to learn from, share, and build on. . . . "Computer Graphics and Art" was a quarterly magazine published between 1976 and 1978. We are using PDF copies of the entire run of the magazine as our starting point for the project. On the 17th of November, coders from around the world will gather to translate these works. The majority of them have no code published alongside the original result. There will be opportunity for a variety of interpretations and approaches, all of which can become the starting point for a new work. (http://recodeproject.com)

> We will make all attempts to contact the author first and get their approval before making changes to their translations. In the event we are unable to reach them or they do not want their code changed, we can add the notes elsewhere on the page. . . . This is a community effort and we want to make the project as good as it can be. Carry on. (http://recodeproject.com/guide)

Both sites accessed November 5, 2013.

20. Blending the responsibilities of curators and conservators will require the former to be more aware of the effects of their choices on the future of an artwork and the latter to be more aware of the aesthetic process. John G. Hanhardt recounts a certain conservator asking a curator to send an artwork proposed for acquisition back to the artist with instructions to fabricate it from more easily preserved material. John G. Hanhardt, private correspondence with Jon Ippolito, July 5, 2013.

21. A thumbnail sketch of the history of the concept of variable media will suggest the many contributors to the idea. In the late 1990s, Keith Frank, Janet Cohen, and I began to question the media-centric interpretation that critics brought to our artistic collaborations. At the same time, my curatorial work with conservators like Carol Stringari and technicians like Paul Kuranko to ingest the Panza Collection at the Guggenheim inspired a similar interrogation of sculpture and installations. In 1998, when the preeminent art website *ada•web* succumbed to the vicissitudes of dot-com fever, conversations that Frank and I had with curators Steve Dietz and Benjamin Weil helped chart a more resilient path for vulnerable media. This developed into the Variable Media Initiative at the Guggenheim, as described in Jon Ippolito, "The Museum of the Future: A Contradiction in Terms?," *Artbyte* (New York) 1, no. 2 (June-July 1998): 18–19. Cohen, Frank, and I exhibited a proof-of-concept exhibition entitled "Variable Media: This Is Only a Test" at FourWalls in San Francisco, February 13–March 13, 1999. The Variable Media Questionnaire debuted at the "Digital Object" conference organized by Carl Goodman, American Museum of the Moving Image, New York, October 5–6, 2000. Meanwhile, Rick Rinehart had been working on a parallel initiative called CIAO (Conceptual & Intermedia Arts Online). In 2002 the Variable Media Network was launched, and included Rick and many other contributors, notably Alain Depocas of the Daniel C.

Langlois Foundation for Art, Science, and Technology. Since then numerous organizations and individuals worldwide have contributed to this approach; its adoption can be measured by the many contemporary collections that have incorporated interviews with creators about preservation into their acquisition process.

Chapter 2

1. Jacob Climo and Maria Cattell, eds., *Social Memory and History: Anthropological Perspectives* (Walnut Creek, CA: Altamira Press, 2002), 4.

2. Maurice Halbwachs, *The Collective Memory* (1950; New York: Harper and Row, 1980).

3. Paul Connerton, *How Societies Remember* (Cambridge: Cambridge University Press, 1989).

4. Thomas Laqueur et al., *Grounds for Remembering*, conference proceedings (Berkeley: Townsend Center for the Humanities, 1995).

5. Kevin Kelly, *The Technium*, December 11, 2008, http://www.kk.org/thetechnium/archives/2008/12/movage.php, accessed September 10, 2009.

6. The Stephen M. Cabrinety Collection in the History of Microcomputing: Video Games, http://www-sul.stanford.edu/depts/hasrg/histsci/index.htm, accessed August 8, 2009.

7. Laura Millar, "Evidence, Memory, and Knowledge: The Process of Archival Reasoning and the Extension of Social Thought," presented at the fifteenth International Congress on Archives, Vienna, August 23–27, 2004, 5.

8. Stewart Brand, *The Clock of the Long Now* (New York: Basic Books, 1999), 4.

9. Gary Kliewer, "The 10,000-Year Warning: Alerting Future Civilizations about Our Nuclear Waste," *Futurist* 26 (September-October 1992): 17.

10. Attila Marton, "Forgotten as Data—Remembered through Information. Social Memory Institutions in the Digital Age: The Case of the Europeana Initiative," PhD thesis, London School of Economics and Political Science (LSE), http://etheses.lse.ac.uk/190/, accessed May 25, 2012. From the abstract: "Supported by evidence from a case study on the Europeana initiative (a digitization project of European libraries, archives and museums), the dissertation reveals a fundamental shift in the field of memory institutions. The case study demonstrates the disintegration of 1) the cultural heritage artifact, 2) its standard modes of description and 3) the catalog as such into a steadily accruing assemblage of data and metadata."

11. National Digital Information Infrastructure and Preservation Program, "Digital Preservation," *U.S. Library of Congress*, http://www.digitalpreservation.gov/index.php, accessed June 1, 2012.

12. Connerton, *How Societies Remember*, 1.

13. Richard Rinehart, "One of Us! On the Coupling of New Media Art and Art Institutions," in Christiane Paul, ed., *A Companion to Digital Art* (Hoboken, NJ: Wiley-Blackwell, forthcoming).

14. Interview with Marisa Olson, *We Make Money Not Art*, http://we-make-money-not-art.com/archives/2008/03/how-does-one-become-marisa.php, accessed December 17, 2009.

15. Rachel Wolff, "Keeping New Media New: Conserving High-Tech Art," *ArtNews*, October 2013, http://www.artnews.com/2013/10/23/keeping-new-media-new/, accessed November 6, 2013.

16. It is important to note that the traditional "master" copy has the closest indexical relationship to the creation of the work; it is not necessarily the copy that "looks the best," since remastered derivatives may look cleaner than the master. This archival standard stands, but the priority of indexicality is debated, for instance, in Tom Gunning, "What's the Point of an Index? or, Faking Photographs," in Karen Beckman and Jean Ma, eds., *Still Moving: Between Cinema and Photography* (Durham: Duke University Press, 2008).

17. Read the lengthy discussion on this topic in the proceedings of "Preserving the Immaterial: A Conference on Variable Media," held at the Solomon R. Guggenheim Museum, March 30–31, 2001, http://www.variablemedia.net/e/preserving/html/var_pre_index.html, accessed June 1, 2012.

18. This is so much the case that a "school" of art practice, institutional critique (IC), grew up around these questions, though this practice is hardly the only forum in which museums, galleries, and exhibitions have been critiqued and theorized. Some IC artists, such as Fred Wilson, have also problematized museums' permanent collections, but most IC focuses on exhibitions and the museum as a social institution. For an overview of IC, see Alexander Alberro and Blake Stimson, eds., *Institutional Critique: An Anthology of Artists' Writings* (Cambridge, MA: MIT Press, 2009).

Chapter 3

1. For a revisionist view of the history of industrially fabricated art, see Michelle Kuo, "Industrial Revolution: Michelle Kuo on the History of Fabrication," *Artforum* 46, no. 2 (October 2007).

2. Private conversation between Mary Beth Smalley and Jon Ippolito, New York, 1992. Smalley worked extensively with Flavin as exhibition coordinator for the 1992 reopening exhibition of the Solomon R. Guggenheim Museum, which featured an extensive installation by the artist in the otherwise empty rotunda.

3. For one director's story, see Mike Figgis, *Digital Filmmaking* (New York: Faber and Faber, 2007).

4. While the pixel is at the time of writing the visual display unit of choice, some researchers claim it may be superseded in the future by vector-based imagery. "Is the Pixel About to Die?" *University of Bath News*, December 11, 2012, http://www.bath.ac.uk/news/2012/12/11/pixel-die/, accessed January 22, 2013.

5. For more on avant-garde film in New York during this period, see John G. Hanhardt and Jon Ippolito, *The Worlds of Nam June Paik* (New York: Guggenheim Museum, 2000), 90.

6. For more on the mechanics of Jacobs's film performances, see Jon Gartenberg, "Ken Jacobs, 'Bitemporal Vision: The Sea,' 1994," in Alain Depocas, Jon Ippolito, and Caitlin Jones, eds., *Permanence through Change: The Variable Media Approach* (Montreal: Daniel Langlois Foundation; New York: Solomon R. Guggenheim Foundation, 2003), 86–91. In this interview, Jacobs hints that a digital translation, as in his work *Flo Rounds a Corner*, may be a more appropriate way to capture the dynamic of his projections than conventional film conservation.

7. For more on *ada•web*'s vulnerabilities, see Steve Dietz, "Perspectives: Walker Art Center," in Depocas, Ippolito, and Jones, *Permanence through Change*, 43–45.

8. In ironic commemoration of this near-instantaneous obsolescence, Group Z's protagonist Michaël Samyn replaced the link to its work *Virgin/Sucker* with a single nonclickable page and added this caption at bottom: "This was the only page of *Virgin/Sucker* that makes some sense in browsers other than Netscape 1.1." From the standpoint of emulation, here it is not just the browser version, but the chip speed that would have to be emulated: any page that included the body animation hack now would run too quickly to be perceived.

Perhaps playing off the morbid associations between the word "body" and dead media, Samyn later created an online homage to the "cult" of the multiple body tag. Private conversation between Michaël Samyn and Jon Ippolito, May 18, 2007.

9. Joline Blais and Jon Ippolito, *At the Edge of Art* (London: Thames and Hudson, 2006), 219.

10. Ibid., 205, 207.

11. Ibid., 222.

12. Ironically, the new shark was installed in the original 1991 vitrine. Hirst seems to come down on the side of re-creation: "It's a big dilemma. Artists and conservators have different opinions about what's important: the original artwork or the original intention. I come from a conceptual art background, so I think it should be the intention. It's the same piece. But the jury will be out for a long time to come." Quoted in Carol Vogel, "Swimming with Famous Dead Sharks," *New York Times*,

October 1, 2006, http://www.nytimes.com/2006/10/01/arts/design/01voge.html, accessed January 6, 2012.

13. Cynthia Esworthy, "A Guide to the Visual Artists Rights Act," NEA Office of General Council, J.D., Washington and Lee University School of Law, 1997, *Harvard Law School*, http://www.law.harvard.edu/faculty/martin/art_law/esworthy.htm, accessed January 6, 2012.

14. The video tour's site-specific dependency was already implicit before the renovation. When SFMOMA conservator Jill Sterrett asked what issues might be raised by bringing a Cardiff video tour into the museum collection, I asked whether it would be possible to loan the work to another venue—and if so, whether a new video would have to be recorded. The same conundrum pertains to Meg Webster's installations created with local flora. Carol Stringari, "Meg Webster, Stick Spiral, 1986," in Depocas, Ippolito, and Jones, *Permanence through Change*, 84.

15. http://geogoo.net/, accessed 4 November 2013. Ben Fino-Radin discusses the preservation challenges of a related work by jodi, *globalMove.us*, in "Digital Preservation Practices and the Rhizome ArtBase," 2011, *Rhizome*, http://media.rhizome.org/blog/8332/rhizome-digital-preservation-practices.pdf, accessed January 6, 2012.

16. We'll return to the strategy of denial in chapter 10.

17. "Eva Hesse, *Expanded Expansion*" panel, in the conference "The Object in Transition," Getty Conservation Institute, January 26, 2008, video documentation at http://www.getty.edu/conservation/publications_resources/videos/object_in_transition_day2.html, accessed January 5, 2012.

18. Yve-Alain Bois and Rosalind Krauss, "A User's Guide to Entropy," *October* 78 (Autumn 1996): 5.

19. "Seeing Double: Emulation in Theory and Practice" *Variable Media Network*, http://variablemedia.net/e/seeingdouble, accessed June 17, 2012. Chapter 8 treats this exhibition in more detail.

20. I was present at this conversation, held in the fall of 1999 during preparations for the exhibition.

21. Paik scholar Gregory Zinman understands that conservators would prevent viewers from adjusting *Crown TV* to prevent damage to fragile vintage oscillators and CRT circuits, yet he laments the skewed version of history this implies for visitors who see the work as a noninteractive "museum piece":

> *TV Crown*, in particular, presents a complex example of how experimental media in the gallery and museum is now shaping the history and memory of experimental moving images more broadly. In its various manifestations, *TV Crown* presents art as a networked system—an idea that flourished in the early '60s under the influence of cybernetics, again in the late '90s with the increased prevalence of email and the internet, and now in 2013 with the unavoidable interconnectedness of actual and virtual life. Curiously, in the current Paik exhibition at SAAM

[the Smithsonian American Art Museum], interactive touch kiosks have been installed to show information about the various objects on display, but visitors cannot touch the objects themselves—the same objects, one might note, that helped bring to prominence the touch-screen technology employed.

Nevertheless Zinman sees a future for *Crown TV* that resembles the vision Rick and I portray in chapters 7 and 10:

It's not unthinkable, however, to conceive of a computerized, digital version of *TV Crown* that maintained its interactive capabilities. Paik was never particularly precious about his media objects, preferring to think of them as mutable and portable, existing in different containers and in different versions, and being continually re-imagined. Furthermore, Paik repeatedly expressed a desire to democratize both access to and the production of art. If *TV Crown* demonstrates a primary delight in shaping technological abstractions in time, that ability is increasingly in the hands of any computer or mobile phone user. Brian Eno and Peter Chilvers' "generative visual music" iPhone apps *Bloom* and *Trope*, for example, appear today as a fulfillment of Paik's dream of "creating an electronic canvas," one that would engender a media environment in which children would "grow up with video synthesizer [sic] every home." They demonstrate how art need not be static or merely received, but taken up, toyed with, and reworked to produce new images, new sounds, and new ideas.

Gregory Zinman, "Nam June Paik's *TV Crown* and Interventionist, Participatory Media Art," manuscript for forthcoming article in the 35th anniversary issue of *Millennium Film Journal*, quoted with permission of the author. I'm indebted to John G. Hanhardt for bringing Zinman's manuscript to my attention.

22. Bruce Sterling et al., "Dead Media Project," accessed via *Internet Archive*'s Wayback Machine, http://web.archive.org/web/20070111150513/www.deadmedia.org/notes/index-cat.html, accessed January 6, 2012.

23. The website for *Embrace the Decay* includes a JavaScript that checks for Flash player 9, which was the "up-to-date" Flash plugin when the work was created. Unfortunately, at the time of writing, the up-to-date Flash player is version 11, which makes the project inaccessible to anyone with current browsing technologies. The fact that the Flash player is proprietary also helped rationalize Apple's decision to prevent it from functioning on its mobile iOS platform; we'll return to the vulnerability of proprietary technologies in our conclusion.

24. In a curious historical convergence, Robert Smithson also planted upside-down trees, though with a completely different context and purpose.

25. See the artists' interview, "Christiane Paul, Whitney Museum, 2008," *Variable Media Questionnaire*, http://variablemediaquestionnaire.net/app/#a=17, accessed January 7, 2012.

26. For more information on Layar, see http://www.layar.com, accessed January 6, 2012.

27. To be sure, Manifest.AR's artists have different perspectives on the matter. Sander Veenhof seems to argue for reinterpretation when he says, "I like artworks

that connect and reflect to their time and space, which does imply that when time and context changes, the artwork becomes a different piece too. . . . I think AR is more like a 'performance type' art form." Sander Veenhof, private correspondence with Jon Ippolito, July 4, 2011.

28. Manifest.AR's Tamiko Thiel writes that her augmented reality works in Venice "infiltrate a closed curatorial space without permission—and can stay there infinitely long, as they are beyond the control of any part of the Venice Biennial apparatus. And yet, they can [be] seen at any time by anyone who knows they are there (and has the technical means to view them). Here, the visual background is not stunning by itself, but only within the context of knowledge that the Giardini is the Sacred Grove of the Venice Biennial and it is forbidden to place artworks there without permission." Tamiko Thiel, private correspondence with Jon Ippolito, July 4, 2011. Thiel also claimed that the director of the Berlin-based festival Transmediale called augmented reality art "offensive." See "NetBehaviour" thread, Site/Cite, *Furtherfield*, February 4, 2012, http://www.furtherfield.org/netbehaviour/fwd-augmented-reality-art-termed-offensive-transmediale-director-0.

29. "Not Here" press release, Samek Art Gallery (Lewisburg, PA), June 4–November 27, 2011, http://www.bucknell.edu/x70622.xml, accessed January 6, 2012.

30. Some artists of the mid-twentieth century, including Hesse as well as Frank Stella and Robert Ryman, began to treat the spatial limits of a painting—its frame—as a parameter to manipulate. At the beginning of the twenty-first century, it would appear the temporal limits of a work—how it decays or transforms over time—has become a fertile material for artistic manipulation.

31. Leo Marx, "Technology: The Emergence of a Hazardous Concept," *Technology and Culture* 51, no. 3 (2010): 561–577.

32. While Apple seems to be openly cavalier about backward-compatibility—having been the first major computer manufacturer to drop the floppy drive—Microsoft's approach can be more covert. In an apparent ploy to inspire users to upgrade to its Vista operating system, Microsoft rigged its 2006 antivirus software to make it appear incompatible with older operating systems such as Windows 2000. "Microsoft Squeezes Win2000 Users," *Slashdot*, December 17, 2006, http://tech.slashdot.org/story/06/12/17/0259259/microsoft-squeezes-win2000-users, accessed February 18, 2012.

33. Bruce Sterling, "The Life and Death of Media," in Paul D. Miller, ed., *Sound Unbound: Sampling Digital Music and Culture* (Cambridge, MA: MIT Press, 2008), 81. Even commercial industrial products are affected by the acceleration of culture in general, as in the example of Felix Gonzalez-Torres's candies mentioned in chapter 2. The general cultural trend is sufficiently recognized to warrant numerous books with near-identical titles, including Danny Goodman's *Living at Light Speed: Your Survival Guide to Life on the Information Superhighway* (1995), William Gray Olsson's *Living at the Speed of Light: The Unlimited Power of the Present* (2000), Mark Dery's *Escape Velocity: Cyberculture at the End of the Century* (1997), and Geoffrey A. Moore's

Escape Velocity: Free Your Company's Future from the Pull of the Past (2011). Also notable is James Gleick's *Faster: The Acceleration of Just About Everything* (New York: Vintage Books, 2000).

Chapter 4

1. Alan Turing, "Computing Machinery and Intelligence," in *The Essential Turing*, ed. J. Copeland (Oxford: Clarendon Press, 1950), 446.

2. Conversation in Jon Ippolito, "Mark Napier, *net.flag*," in Alain Depocas, Jon Ippolito, and Caitlin Jones, eds., *Permanence through Change: The Variable Media Approach* (Montreal: Daniel Langlois Foundation; New York: Solomon R. Guggenheim Foundation, 2003), 110–111.

3. Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," in Charles Harrison and Paul Wood, eds., *Art in Theory 1900–1990* (Oxford: Blackwell, 1992), 513.

4. Ibid.

5. Ibid., 515.

6. For example, in *The Language of New Media* (Cambridge, MA: MIT Press, 2002), Lev Manovich extrapolates in detail the implications of Benjamin's writings for new media and, further, positions variability as one of the five principles of new media.

7. Benjamin, "The Work of Art in the Age of Mechanical Reproduction," 000.

8. Michael Fried, "Art and Objecthood," in Fried, *Art and Objecthood: Essays and Reviews* (Chicago: University of Chicago Press, 1998).

9. This debate is covered in James Meyer, *Minimalism: Art and Polemics in the Sixties* (New Haven: Yale University Press, 2004).

10. Fried, "Art and Objecthood," 167.

11. To see Shawn Brixey's proposal for *Epicycle*, go to the Center for Digital Arts and Experimental Media website, *DX Arts*, http://www.dxarts.washington.edu/shawnx/profile_research.php%3Fwho=brixey&project=epicycle, accessed August 2, 2009.

12. The article's teaser reads: "Major museums sometimes display facsimiles of original artworks. The truth about 'exhibition copies' and artists' intentions." Jen Graves, "Better Than the Real Thing?," *Newsweek*, June 4, 2008, http://www.thedailybeast.com/newsweek/2008/06/04/better-than-the-real-thing.html, accessed June 8, 2008.

13. Jon Thomson, email to author, New-Media-Curating Archives, *JISC Email Archive*, https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=NEW-MEDIA-CURATING;d77cbfce.1003, posted March 18, 2010.

14. Ibid., March 20, 2010.

Chapter 5

1. For a thorough overview of metadata, see National Information Standards Organization, *Understanding Metadata*, http://www.niso.org/publications/press/UnderstandingMetadata.pdf, accessed June 1, 2012.

2. Technically, "data" and "metadata" are the plurals of "datum" and "metadatum"; however, such strict usage can lead to awkward grammar and is thus often not adhered to in the professional literature, nor in this book. Generally, I will use "metadata" in the singular since it refers as much to a field of practice or a category of applied technology as to a collection of data elements. However, I will use "metadatum" for the singular or "metadata" for the plural when I am referring to specific data elements. In addition, some professional literature makes the distinction between data about an object, and metadata about that data. Such a conceit proves problematic when referring to digital artworks that are themselves "data," and any artwork is open to semiotic reading. Rather than cleave those ontological hairs, I simply mean "metadata" to refer to all levels of information about an artwork that are not part of the artwork itself.

3. Tim Berners-Lee, *Weaving the Web* (San Francisco: Harper, 1999), chapter 1.

4. At its most hyperbolic, the semantic web has been characterized as a self-assembling global intelligence engine and has been rightly critiqued (see Clay Shirky, "The Semantic Web, Syllogism, and Worldview," November 7, 2003, *Shirky.com*, http://www.shirky.com/writings/semantic_syllogism.html, accessed June 1, 2012). At its most humble, the semantic web is characterized as a practical way to get more use out of existing data systems and has been quietly in use in libraries across the world for decades.

5. Rhizome ArtBase, *Rhizome*, http://rhizome.org/artbase/, accessed May 1, 2010.

6. For instance, the following paper explains how the Getty's *Art and Architecture Thesaurus* and the *Library of Congress Thesaurus for Graphic Materials*—both widely accepted standards for describing visual materials—each frames those materials differently, thus representing different worldviews and serving different audiences. Jane Greenberg, "Intellectual Control of Visual Archives: A Comparison between the *Art and Architecture Thesaurus* and *Library of Congress Thesaurus for Graphic Materials*," *Cataloging and Classification Quarterly* 16, no. 1 (2003): 85.

7. Kevin McCoy, private conversation with the author, April 12, 2009.

8. Princeton Library, "What Is Primary Evidence?," http://www.princeton.edu/~refdesk/primary2.html, accessed June 12, 2012.

9. This is one reason that the Open Archives Information Standard recommends that every digital artifact that is a target for preservation be mirrored in the real world by a physical record. See Open Archives Information Standard Reference

Model, *Consultative Committee for Space Data Systems*, http://public.ccsds.org/publications/archive/650x0m2.pdf, accessed November 5, 2013.

10. Committee on Cataloging: Description and Access, Task Force on Metadata, Final Report, *American Library Association*, http://downloads.alcts.ala.org/ccda/tf-meta6.html, accessed November 5, 2013.

11. Jeanette Ingberman, in round table on "Unwritten Histories and the Digital Divide: On Critics, Archives and Networks," *Kabul: Reconstructions*, http://www.kabul-reconstructions.net/mariam/texts/UnwrittenHistories.pdf, accessed April 8, 2009.

12. University of Maine, *The Pool*, http://pool.newmedia.umaine.edu/, accessed September 1, 2010. Online software tool for collaboration visualization.

13. Jon Ippolito, "Death by Wall Label," in Christiane Paul, ed., *New Media in the White Cube and Beyond* (Berkeley: University of California Press, 2009).

14. For more information, see Matters in Media Art, *Tate*, http://www.tate.org.uk/about/projects/matters-media-art, accessed July 30, 2013.

15. Jane Hunter, University of Queensland, http://itee.uq.edu.au/~jane/, accessed March 11, 2010. For information on PANIC, see "PANIC Overview," *University of Queensland*, http://www.itee.uq.edu.au/eresearch/projects/panic, accessed July 30, 2103.

16. "Capturing Unstable Media Conceptual Model," *V2_: Institute for the Unstable Media*, http://www.v2.nl/archive/works/capturing-unstable-media-conceptual-model-cmcm, accessed September 11, 2009.

17. "IU Digital Music Library Data Model Specification V2," *Indiana University*, September 18, 2003, http://dml.indiana.edu/pdf/DML-DataModel-V2.pdf, accessed September 30, 2010.

18. Variable Media Questionnaire, http://variablemediaquestionnaire.net/, accessed September 30, 2010.

19. Richard Rinehart, "The Media Art Notation System: Documenting and Preserving Digital/Media Art," *Leonardo* 40, no. 2 (April 2007): 181–187.

20. *Forging the Future: New Tools for Variable Media Preservation*, http://forging-the-future.net/, accessed December 11, 2011.

21. For example, see Ben Fino-Radin, "Digital Preservation Practices and the Rhizome ArtBase," 2011, *Rhizome*, http://media.rhizome.org/blog/8332/rhizome-digital-preservation-practices.pdf, accessed January 6, 2012.

22. Stephen Gray, "Documenting Performance Art for the Archive," University of Bristol project case study, 2011, *Kultur II Group*, http://vads.ac.uk/kultur2group/casestudies/Bristol2011.pdf, accessed September 21, 2011.

Chapter 6

1. Holmes's archenemy Moriarty is basically an ingenious mafioso, while Holmes's two closest collaborators are Watson, a respected doctor, and his brother Mycroft, who has a lofty government position.

2. Ben Fino-Radin, "Digital Preservation Practices and the Rhizome ArtBase," 2011, *Rhizome*, http://media.rhizome.org/blog/8332/rhizome-digital-preservation-practices.pdf, accessed January 6, 2012.

3. Jon Ippolito, "Death by Wall Label," in Christiane Paul, ed., *New Media in the White Cube and Beyond* (Berkeley: University of California Press, 2009).

4. Richard Rinehart and Layna White, "Challenges to Museum Collaboration: The MOAC Case Study," in Paul F. Marty and Katherine Burton Jones, eds., *Museum Informatics: People, Information, and Technology in Museums* (New York: Routledge, 2008).

5. Among the countless cultural references is W. B. Yeats's poem "Easter 1916" (Kindle Edition by Shamrock Eden Publishing, 2010), which equates unwavering devotion with an immobile stone; ironically, the poem is a eulogy for those with stonelike hearts who were executed in the Easter Rising:

Hearts with one purpose alone
Through summer and winter seem
Enchanted to a stone
To trouble the living stream.
The horse that comes from the road,
The rider, the birds that range
From cloud to tumbling cloud,
Minute by minute they change;
A shadow of cloud on the stream
Changes minute by minute;
. . .
The stone's in the midst of all.

Lao Tzu's *Tao Te Ching* provides one of the few prominent countermetaphors to stone as strength: "In the world there is nothing more submissive and weak than water. Yet for attacking that which is hard and strong nothing can surpass it." Translation by D. C. Lau, *Center Tao*, http://www.centertao.org/tao-te-ching/dc-lau/, accessed January 22, 2012.

6. See *The Long Now Foundation*, http://longnow.org/, accessed June 17, 2012.

7. In the older neighborhoods of Japan, streets do not have names, and city blocks are numbered based on the order in which they were registered, to the consternation of foreign visitors trying to find an address.

8. Alexander Rose, "The Mormon Vaults," April 9, 2007, *The Long Now Foundation*, http://blog.longnow.org/02007/04/09/the-granite-vaults-of-geneology/, accessed August 5, 2013.

9. The works belonged to the mint company Altoids; Mirapaul told me this story about the collection because it included a work by Janet Cohen, Keith Frank, and me. "*Altoids Curiously Strong Collection* was established in 1998. . . . With its distinctive and adventurous philosophy of visual arts patronage, the Collection has grown to become a valuable overview of the art of our time. . . . In 2000, Altoids donated the entire *Curiously Strong Collection*, as well as all works subsequently acquired by the Collection, to the New Museum of Contemporary Art. Now including 155 original works, the scale and open-ended nature of this unique gift is unprecedented in the Museum's history, and embodies the New Museum's mission to present new art and new ideas." http://archive.newmuseum.org/index.php/Detail/Occurrence/Show/occurrence_id/430, accessed October 22, 2013.

10. Matthew Mirapaul, private correspondence with Jon Ippolito, 2000.

11. *Daniel Langlois Foundation for Art, Science, and Technology*, http://www.fondation-langlois.org/html/e/; *MedienKunstNetz*, http://www.medienkunstnetz.de/; and *Archive of Digital Art*, http://www.digitalartarchive.at, all accessed January 22, 2014.

12. As of this writing, the Langlois, Media Art Net, and Archive of Digital Art databases all still exist, though in cases like the Langlois Foundation the physical archive may have closed or been transferred. For more on the vulnerability of institutional collections of new media and solutions based on a distributed approach, see Caitlin Jones, "Do It Yourself: Distributing Responsibility for Media Arts Preservation and Documentation," in Annet Dekker, ed., *Sustainable Archiving of Born-Digital Cultural Content* (Amsterdam: Virtueel Platform, 2010), 4.5.

13. The Guggenheim's own press office puts the figure closer to 900,000; see "Thomas Krens to Step Down as Director of the Solomon R. Guggenheim Foundation," February 28, 2008, *Solomon R. Guggenheim Foundation*, http://www.guggenheim.org/guggenheim-foundation/foundation-press/1908-thomas-krens-to-step-down-as-director-of-guggenheim-foundation, accessed June 17, 2012. However, in Rick's and my experience, the attendance reported by museums is substantially higher than the visitors who actually spend any time in the galleries.

14. See Margot Wallace, "Building Museum Brands for the Next Generation: Web Sites that Reach and Keep Young People," paper presented at the conference "Museums and the Web," 2001, http://www.museumsandtheweb.com/mw2001/papers/wallace/wallace.html, accessed June 17, 2012. Wallace's paper ends with a recommendation that museums share one thing on their websites: swag.

Human beings love to acquire and have done so since the acquisition of the first apple. Ownership makes the intangible tangible. Purchases bring experiences home. To impress the brand image of a museum on a visitor, one need only place an object on his or her coffee table. Special consideration should be given to the gift and purchasing features of a museum Web site.

Wallace's invocation of the Fall from Grace may be unintentional, but her conflation of ownership, branding, and consumerism represents an ideology that has replaced the museum as public good with the museum as private product.

15. Joline Blais argues that the ability to execute an action—whether based on computer, legal, or social codes—is a defining characteristic of art in the Internet age. Blais, "Political Design," in Joline Blais and Jon Ippolito, *At the Edge of Art* (London: Thames and Hudson, 2006).

16. Morris expressed this to me during my tenure as exhibition coordinator of his 2004 Guggenheim retrospective. The sentiment is also conveyed by Elizabeth Buhe: "As we stood in front of *Untitled (Corner Piece)* (1964), [Jeffrey] Weiss brought up Morris's steadfast resistance to the oft-asked question about the specific shade of gray that one should use to paint a newly fabricated sculpture; the artist's answer is usually along the lines of 'whatever you think.'" *Contemporary Art Consortium at the IFA* (New York University), http://ifacontemporary.wordpress.com/2012/04/04/robert-morris-in-the-guggenheims-panza-collection/, accessed October 22, 2013.

17. Morris changed this artistic practice later in life, perhaps in reaction to the difficulty institutions demonstrated in dealing with variable works.

18. Owen Smith, private conversation with Jon Ippolito, September 23, 2013. Much of the history alluded to here is recounted in Owen F. Smith, *Fluxus: The History of an Attitude* (San Diego: San Diego State University Press, 1998).

19. In the 1990s, I performed a detailed assessment of The Museum System and Multimimsy, in conversation with the vendors, together with the Guggenheim's information technology department. I have not used the products themselves since then; however, the spec sheets released as of this writing do not indicate any means of toggling from one reporter's account to another's, nor do their conservation screens permit a more future-oriented description than a conservator's condition or restoration report. See *Multimimsy*, http://www.selagodesign.com/library/mxg-extended-overview.pdf and *The Museum System*, http://www.gallerysystems.com/sites/default/files/TMS_2010_R2%20_New_Features_List_COMPLETE_08_2010%20%282%29.pdf, both accessed June 18, 2012.

20. Our cultural bias toward conferring authority on print over speech was reinforced to me at the 2006 College Art Association conference. The moderator of one panel said there was time for two comments from the audience; when I made the first, a British scholar on the panel responded angrily that he "disagreed absolutely

a hundred percent" with everything I had said. When another audience member asked the second question, the same panelist immediately replied, "Well, Jon Ippolito has written about this, and he says . . ."

21. Michel Foucault argues in works such as *Discipline and Punish: The Birth of the Prison* (New York: Random House, 1975) that power in contemporary society is exercised in the most quotidian exchanges between ordinary people.

22. Now in evidence at "The Variable Media Initiative," *Solomon R. Guggenheim Foundation*, http://www.guggenheim.org/new-york/collections/conservation/conservation-projects/variable-media, accessed June 18, 2012.

23. See Wendy Chun, "The Enduring Ephemeral, or the Future Is a Memory," in Rachel Feuchtwang, ed., *Archive 2020* (Amsterdam: Virtueel Platform, 2011); and Gabriele Blome and Gaby Wijers, "Visibility, Distribution and Memory Through Networks and Collaboration," in Dekker, *Sustainable Archiving of Born-Digital Cultural Content*. Chun asserts: "Key to the digital as the new is an ideological conflation of memory and storage that undermines and underlines digital media's archival promise. Memory, with its constant degeneration, does not equal storage; although artificial memory has historically combined the transitory with the permanent, the passing with the stable, digital media complicates this relationship by making the permanent into an enduring ephemeral" (5.2). Blome and Wijers quote Aleida Assmann on the difference between *Speichergedächtnis* (storage) and *Funktionsgedächtnis* (remembering), which together make up cultural memory, and claim that Assmann describes *Speichergedächtnis* as the passive pole and *Funktionsgedächtnis* as the active pole of memory.

As mentioned in note 13 of chapter 1, Matthew Kirschenbaum argues for storage as a more permanent preservation strategy—at least for Wall Street banks willing to pay hundreds of thousands of dollars to resurrect hard drives crushed under the World Trade Center rubble after 9/11—in his compelling book *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2008).

24. In chapter 7, we'll see this dynamic most starkly in the example of Martha Maxwell, who killed animals in order to accession them. Shouldn't the museum serve the life it celebrates, rather than the other way around?

25. Ippolito, "Death by Wall Label," 127–130.

26. For examples of museums that have experimented with crowdsourcing the cataloguing or selecting of works, see our chapter 8. That said, this chapter asks whether museums might leverage the human dimension of memory as well as curation. A more germane, if radical, model might be a library that decided to loan out people along with books:

> Wouldn't it be easier to learn Chinese from a native speaker than from a book, or explore a religion from an actual practitioner rather than words on a page? A library in Surrey, B.C., thinks

so and has introduced a "human library" program. Visitors will be able to "check out" real people to learn about their experiences and specific knowledge.

"Canadian Library to Loan Out People," *Slashdot*, http://news.slashdot.org/story/11/08/19/1437249/Canadian-Library-to-Loan-Out-People, accessed September 1, 2011.

Chapter 7

1. Theodore Low, *The Museum as Social Instrument* (New York: Metropolitan Museum of Art, 1942), 15.

2. General histories: Edward Alexander and Mary Alexander, *Museums in Motion: An Introduction to the History and Function of Museums* (Plymouth, U.K.: Altamira Press, 2008); Matthew Battles, *Library: An Unquiet History* (New York: W. W. Norton, 2003). Overviews of digital media and cultural heritage: D. R. Harvey, *Preserving Digital Materials* (Berlin: Walter de Gruyter, 2012); Yehuda Kalay, ed., *New Heritage: New Media and Cultural Heritage* (Abingdon: Routledge, 2008).

3. Germain Bazin, *The Museum Age* (New York: Universe Books, 1967), 29.

4. Silvia Spitta, *Misplaced Objects: Migrating Collections and Recollections in Europe and the Americas* (Austin: University of Texas Press, 2009), 27–49.

5. Oliver Impey and Arthur MacGregor, *The Origins of Museums: The Cabinet of Curiosities in Sixteenth- and Seventeenth-Century Europe* (London: House of Stratus, 2001), 138.

6. *Museum of Jurassic Technology*, http://www.mjt.org/, accessed June 12, 2012.

7. Alice Tyler, *Freedom's Ferment: Phases of American Social History to 1860* (Minneapolis: University of Minnesota Press, 1944), 259–264.

8. For instance, a recent U.S. Supreme Court case on copyright extension pitted the ALA against Disney, among others. See the *Washington Post*'s summary, "Eldred v. Ashcroft: A Primer from the Washington Post online," http://www.washingtonpost.com/wp-srv/technology/articles/eldredprimer_100902.htm, accessed November 5, 2013.

9. Sheila Watson, *Museums and Their Communities* (London: Routledge, 2007), 329.

10. M. J. Heale, *American Anticommunism: Combating the Enemy Within, 1830–1970* (Baltimore: Johns Hopkins University Press, 1990), 18.

11. As exemplified by the "industrial drawing movement" and detailed in this contemporaneous publication: Isaac Edwards Clarke, *Art and Industry: Education in the Industrial and Fine Arts in the United States* (Washington, DC: Government Printing Office, 1885–1898), 497.

12. For instance, in response to the Digital Millennium Copyright Act, the American Library Association webpage asserts, "The doctrine of 'fair use' has never more been threatened than it is now." Meanwhile, the American Association of Museums' response to the DMCA contains a neutral sentiment: "As both owners and users of works protected by copyright, museums have a strong incentive to strike a balance between these interests." "Digital Millennium Copyright Act," *ALA*, http://www.ala.org/advocacy/copyright/dmca, accessed August 6, 2013. Letter from American Association of Museums (AAM) to General Counsel about DMCA, February 17, 2000, *AAM*, http://www.copyright.gov/1201/comments/184.pdf, accessed June 12, 2012.

13. This author was guilty of this in naming an NEA-funded preservation project "Archiving the Avant Garde." See "Archiving the Avant Garde," *University of California, Berkeley, Art Museum and Pacific Film Archive* (*BAM/PFA*), http://www.bampfa.berkeley.edu/about/avantgarde, accessed June 6, 2012.

14. Michel Foucault, "Of Other Spaces, Heterotopias," 1967, in *Architecture, Mouvement, Continuité*, vol. 5 (October 1984), downloaded from http://foucault.info/documents/heteroTopia/foucault.heteroTopia.en.html.

15. "Did She Kill 'Em All?," National Cowboy and Western Heritage Museum, http://www.nationalcowboymuseum.org/events/event.aspx?ID=79, accessed August 7, 2013.

16. Marina Abramović, *Seven Easy Pieces*, Guggenheim Museum, http://pastexhibitions.guggenheim.org/abramovic/, accessed June 1, 2012.

17. See "Nyquist-Shannon Sampling Theorem," *Wikipedia*, http://en.wikipedia.org/wiki/Nyquist-Shannon_sampling_theorem, accessed June 1, 2012.

18. "The AIDS Memorial Quilt," *NAMES Project Foundation*, http://www.aidsquilt.org/about/the-aids-memorial-quilt, accessed September 20, 2011.

19. Gary Kliewer, "The 10,000-Year Warning: Alerting Future Civilizations about Our Nuclear Waste," *Futurist* 26 (September-October 1992): 17.

20. Geoffrey C. Bowker, *Memory Practices in the Sciences* (Cambridge, MA: MIT Press, 2005), 8.

21. Moya K. Mason, "Copy Cataloguing: Our Quest for the Perfect Copy," *MKM Research*, http://www.moyak.com/papers/cataloguing-library-congress.html, accessed June 1, 2012.

22. "Number of Libraries in the United States," *American Library Association*, http://www.ala.org/tools/libfactsheets/alalibraryfactsheet01, accessed November 5, 2013. "Museum Facts," *American Alliance of Museums*, http://www.aam-us.org/about-museums/museum-facts, accessed November 5, 2013.

23. Sometimes context can take as simple a form as attaching a human memory to an object record, as demonstrated in this exchange of comments on a webpage of the Brooklyn Museum about an object from their collection:

> Recent Comments
> 23:32 01/30/2010
> Brilliant. The carver was my father. He actually lived in Ijebu IKORODU and he belonged to the Ruling Mosene clan. I am one of his 5 children still alive. Will like to meet some one to discuss his work. His full name is Thomas Onajeje Odulate, alias Jeje Thomas. Died NOV. 1952
> By William Ayodele Odulate
> 02:47 02/24/2010
> William—thank you for your comment and that information. I will follow up with you through email. —Kevin Dumouchelle (Assistant Curator, Interim, Arts of Africa & the Pacific Islands)
> By AfrArt
>
> Arts of Africa: Figure of a Clergyman, *Brooklyn Museum*, http://www.brooklynmuseum.org/opencollection/objects/147096/Figure_of_a_Clergyman/right-tab/talk/, accessed June 10, 2012.

24. "Companies with global footprints would be required to deal with multiple vendors in order to protect data across their enterprise." "How to Compare Server Online Backup and Recovery Service Providers" (white paper), Iron Mountain, http://i.zdnet.com/whitepapers/Iron_Mountain_WP_How_to_Categorize_PC_Online_Backup_and_Recovery_Providers_for_Better_Decision_Making.pdf, accessed November 5, 2013.

25. Kristina Mucinskas, "Moral Rights and Digital Art: Revitalizing the Visual Artists' Rights Act?," *University of Illinois Journal of Law, Technology, and Policy* 2005, no. 2 (Fall 2005): 295.

26. Electronic Arts Intermix (EAI) is a New York-based organization lauded for making available copies of video art for loan and exhibition, but increasingly artists have needed to restrict the number of copies of their work that EAI may distribute in order to maintain higher market prices for the work at the galleries that represents them.

27. Art auction figures from services such as ArtNet are closed to everyone but subscribers and so make for hard-to-verify sources, but publicly available FindArtInfo.com lists Bill Viola's video installation *Surrender* selling for $532,934. Art auction result for Bill Viola, *FindArtInfo.com*, http://www.findartinfo.com/search/listprices.asp?keyword=170177&name=Bill-Viola, accessed November 5, 2013.

28. André Malraux, *Museum without Walls* (New York: Doubleday, 1967).

29. Steve Dietz, "Collecting New Media Art: Just Like Anything Else, Only Different," in *Collecting the New* (Princeton: Princeton University Press, 2005), 88.

30. Charles Leadbeater, "The Art of With: An Original Essay for Cornerhouse, Manchester," March 2009, http://www.cornerhouse.org/wp-content/uploads/old_site/media/Learn/The%20Art%20of%20With.pdf, accessed December 5, 2011.

31. Jon will explore this idea in chapter 10.

32. *Forging the Future: New Tools for Variable Media Preservation*, http://forging-the-future.net/, accessed July 1, 2011.

33. "About the Licenses," *Creative Commons*, http://creativecommons.org/licenses/, accessed April 5, 2011.

34. "Open Art License," *Open Art Network*, http://three.org/openart/license/, accessed May 12, 2011.

35. Branden W. Joseph, *Random Order: Robert Rauschenberg and the Neo-Avant-Garde* (Cambridge, MA: MIT Press, 2007), 91.

36. *Open Library*, http://openlibrary.org/, accessed May 12, 2011.

37. Roger Malina, contribution to Crumb Discussion List, *JISC Email Archive*, https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=NEW-MEDIA-CURATING;d77cbfce.1003, posted March 13, 2010.

38. The Berkeley Art Museum's NetArtchive is just one limited example, at http://openmuseum.berkeley.edu. Rhizome's The Download is a more recent example at http://rhizome.org/the-download/.

39. For instance, the Rhizome ArtBase at http://rhizome.org/artbase, Media Art Net at http://www.mediaartnet.org, and the Archive of Digital Art (former Database of Virtual Art) at https://www.digitalartarchive.at/nc/home.html.

40. With a nod toward the 2002 book of the same name by Beatrice von Bismarck, Hans-Peter Feldmann, and Hans-Ulrich Obrist.

41. cc Search, *Creative Commons*, http://search.creativecommons.org/, accessed September 30, 2011.

42. The original discussions about creating an Interarchive proposed to use this Creative Commons–like model using only text metadata and Google's search engine. However, if an Interarchive were to make use of a more sophisticated tool such as the aforementioned Metaserver, Jon Ippolito explains that it would still be a different model from current Library projects:

> The Metaserver aims to achieve similar goals as harvester-based services such as OAI-PMH (the Open Archives Initiative Protocol for Metadata Harvesting). That said, the Metaserver diverges from the OAI paradigm in several ways. First, because the Metaserver requires only a minimal number of metadata fields, it can interlink collections that aren't organized according to a single standard such as OCLC. This model of sharing while respecting differences encourages links among institutions of different technical strength and disciplinary focus; given nothing more than a common "keyword" or "creator" tag, the Metaserver can associate records in the Django-based Rhizome ArtBase to records in the Franklin Furnace archive's FileMaker database, and vice versa.
>
> Second, the Metaserver follows a peer-to-peer architecture more than a client-server one; anyone who searches for data can also share data. Because the data are not harvested but pulled

dynamically as needed, the Metaserver requires no caretaker to update references to the various collections.

As a crude analogy, consider residents of a small town who want to share books but have no library. A harvester-based model would require residents to put photocopies of any new books they have bought in their mailboxes; a harvester would then pick up the copies each week and deposit them in a central library. Residents who want to read another person's book would have to go to the library to find it. A peer-to-peer model, on the other hand, requires only that residents place Catalog Cards for each of their new books in their mailboxes. The Metaserver then redistributes copies of all the cards to all the residents. Then when one resident wants to read another person's book, she walks to the other person's house and finds it in that person's collection.

"Into the Loop: Access through Cross-Promotion," application for a Digital Humanities Start-Up Level II grant, submitted by Jon Ippolito, project director, 2011.

43. Bronac Ferran, Crumb Discussion List, *JISC Email Archive*, https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=NEW-MEDIA-CURATING;85537828.1003, posted March 14, 2010.

Chapter 8

1. Sebastian Chan, "Releasing the Collection on GitHub," *Cooper-Hewitt Labs*, February 25, 2012, http://labs.cooperhewitt.org/2012/releasing-collection-github/, accessed January 27, 2013.

2. In describing their approach to open-sourcing *Planetary*, Sebastian Chan and Aaron Cope used a metaphor that happens to evoke the biological preservation discussed in chapter 11.

We liken this situation to that of a specimen in a zoo. In fact, given that the Smithsonian also runs the National Zoo, consider Planetary as akin to a panda. Planetary and other software like it are living objects. Their acquisition by the museum, does not and should not seal them in carbonite like Han Solo. Instead, their acquisition simply transfers them to a new home environment where they can be cared for out of the wild, and where their continued genetic preservation requires an active breeding program and community engagement and interest. Open sourcing the code is akin to a panda breeding program. If there is enough interest then we believe that Planetary's DNA will live on in other skin on other platforms. Of course we will preserve the original, but it will be "experienced" through its offspring.

Sebastian Chan and Aaron Cope, "Planetary: Collecting and Preserving Code as a Living Object," *Smithsonian Cooper-Hewitt National Design Museum*, August 26, 2013, https://www.cooperhewitt.org/object-of-the-day/2013/08/26/planetary-collecting-and-preserving-code-living-object, accessed November 7, 2013.

3. Examples include steve.museum, a multi-institution effort enabling visitors to add descriptive "tags" to works in an online collection, as well as exhibitions at the Museum of Modern Art in New York ("The Residents: Re-Viewed," 2006), the Brooklyn Museum ("Click! A Crowd-Curated Exhibition," 2008), and the Guggenheim

("YouTube Play," 2010), in which online visitors helped select the works on view. For similar initiatives, see Andrew Lavallee, "Museums Try YouTube, Flickr to Find New Works for the Walls," *Wall Street Journal*, October 13, 2006, http://online.wsj.com/article/SB116040543414086891.html, accessed October 13, 2006.

4. Literary critic Harold Bloom offers a more organic, if just as exclusionary, metaphor of the barricade as "the hedge around the Torah" in "At Home with Harold Bloom: (2) On the Humanities," *Radio Open Source*, December 28, 2007, http://www.radioopensource.org/at-home-with-harold-bloom-2-on-the-humanities/, accessed January 26, 2012.

5. I'm grateful to Tilman Baumgärtal and Christiane Paul for drawing my attention to the importance of the gaming fan base for preservation, at the conference "Echoes of Art: Emulation as Preservation Strategy," Guggenheim Museum, New York, May 8, 2004. Information at http://variablemedia.net/e/seeingdouble, accessed January 28, 2012.

6. I have great respect for conservators fighting to keep works alive in museums, but of course that is their job. The devotion of preservation amateurs, meanwhile, is unconnected to career aspirations, and sometimes opposed to them. Consider this note on the "Tech Help" page from one of the best-known and best-documented sites for game emulators, *HOTU* (*Home of the Underdogs*): "This is the 2002 year's update ;o). I'm sorry. I've been overhelmed with my exams (that, btw, aren't going very well:o( ), and I haven't had time to update the site. I have one last exam, but I wanted you to know that I'm still around here." HOTU Technical Help Page, *HOTU*, http://www.homeoftheunderdogs.net/tech/techelp_indx.html, accessed January 25, 2012.

7. Internet Relay Chat (IRC) is one of the oldest communication forms of the Internet—a global instant-messaging service whose use by ordinary netizens has lately been usurped by commercial applications such as Skype and iChat, but which is still as of this writing used by technically savvy programmers and hackers.

8. "Seeing Double" was co-curated by Caitlin Jones, Carol Stringari, and myself, with sponsorship from the Langlois Foundation for Art, Science, and Technology. While it focused less on the tangled issues of emulating artworks than on the history of games, a predecessor that employed emulation extensively was curator Carl Goodman's exhibition "Computer Space: A Digital Game Arcade" at the American Museum of the Moving Image in 1995.

9. Rothenberg made this point repeatedly during our collaboration on *The Erl King*, profiled later in this chapter. For more background on emulation, see Jeff Rothenberg, "Avoiding Technological Quicksand: Finding a Viable Technical Foundation for Digital Preservation," January 1998, *Council on Library and Information Resources*, http://www.clir.org/pubs/reports/rothenberg/contents.html, accessed January 26, 2012.

10. "Service packs" and "patches" are updates to operating systems popular as of this writing that squash bugs, patch vulnerabilities, and sometimes add new features. Microsoft issues Windows service packs every year or so; the Linux communities issue a new patch every couple days.

11. "List of Video Game Emulators," *Wikipedia*, http://en.wikipedia.org/wiki/List_of_video_game_console_emulators#Nintendo_Entertainment_System, accessed June 18, 2012.

12. FCEUX can trace its genealogy back to an early emulator called Family Computer Emulator, or FCE, so called because Nintendo released the NES in Asia as "Family Computer." In the manner of many open source projects, no company controlled the source code for this emulator; instead the programmer, known by the name Bero, released his abashedly titled "dirty code" online for other gaming fans to tinker with and extend (http://www.geocities.co.jp/Playtown/2004/fce.htm). One such fan, known as Xodnizel, released an improvement called FCE Ultra that became so popular in the early 2000s that it spawned a half-dozen "forks," or versions modified by other users. By the late 2000s, NES fans merged four of the forks to produce FCEUX, a cross-platform and cross-standard emulator released under the GPL open-source license; see http://www.emulator-zone.com/doc.php/nes/fceultra.html. Both sites accessed December 12, 2009.

13. Jon Ippolito, "The Art of Misuse," in *Telematic Connections: The Virtual Embrace*, exh. cat., CD-ROM and website copublished by Independent Curators International and the Walker Art Center. The exhibition traveled to San Francisco Art Institute, February 7–March 24, 2001; Alyce de Roulet Williamson Gallery, Art Center College of Design, Pasedena, May 13–July 1; Austin Museum of Art, July 20–September 18; and other venues through 2002. See *Telematic Connections*, http://telematic.walkerart.org/overview/overview_ippolito.html, accessed January 26, 2012.

14. A hex editor is an application that enables a user to view and edit the raw data of a file directly—usually represented as hexadecimal numbers, such as 6C 78 1F 2A and so forth—thus changing its contents at an elemental level.

15. At the 2004 "Echoes of Art" conference, Heemskerk recalled a quirky distribution network that was the radio equivalent of freeware distribution on the Internet: "In the 80s when these programs existed, there were even radio programs broadcasting the code and people at home with tape recorders recording the data . . . and then finding out after the program what the hell was on the tape."

16. As of January 25, 2012, Wikipedia included this curious anecdote: "Arcangel was forced to remove the installation when Warhol's estate put up an outcry, threatening to distribute copies of the game at gun shows with Arcangel's face replacing Warhol's." (Formerly at http://en.wikipedia.org/wiki/Hogan%27s_Alley_%28video_game%29.) While emulators are prey to copyright lawsuits, Arcangel replied to my investigative email to the effect that this was an inaccurate fabrication, so I deleted the anecdote from Wikipedia.

17. The emulated version of jodi's *JET SET WILLY Variations* also failed to capture important aspects of the original hardware, as we'll see below.

18. "Echoes of Art."

19. Ibid.

20. Francis Hwang advocated using the emulated CRT screen for the game *Tempest* in his presentation for "Echoes of Art." Curiously, pixel-based screens may someday be replaced by their vector-based ancestors; see note 4 of chapter 3.

21. Whether a hardware constraint is important historically can be a matter of disagreement, as evidenced by this exchange between Weinbren and preservationist Howard Besser at "Echoes of Art" about a delay added to the new system:

HOWARD BESSER: Grahame, you've said that the piece *The Erl King* is really about nonlinear cinema, and that you would hide the wires, or get rid of them, and that these things are not important. But it appears to be a contradiction, as [conservator] Pip [Laurenson] said, when you insert pauses that were related to the technology at the time . . . that's part one. And then part two is . . . might you change your mind twenty years from now, when nonlinear cinema is ubiquitous? And might the piece be more important for the technology that it used, because it used that technology for this nonlinear cinema?

WEINBREN: No and no. (laughter) . . . We use the pauses positively. I mean when you work in film, what you think about is the rhythm and the timing and the way the images are presenting themselves. . . . So no, we didn't want to put the pauses back in for authentic reasons; we wanted to put the pauses back in because they contributed very basically to the meaning of the piece. . . . We used the fact that there was a pause to signal to the viewer that there was a change. . . . I hope the piece is better than, you know, just an example of the technology. Maybe I'm wrong. You know, but I'd hate to think that in twenty years, all that will matter about it is the technology that it ran on. But you know, you're asking the artist about that; you should ask somebody else, right? (laughter)

See http://www.variablemedia.net/e/echoes/morn_text.htm#audience, accessed January 28, 2012.

22. Apart from Weinbren, Rothenberg, and Dimitrovsky, the team included Paul Kuranko, Caitlin Jones, Carol Stringari, Alain Depocas, and me, and the entire effort was funded by the Langlois Foundation. For more information on the process, see Jeff Rothenberg, "Renewing *The Erl King*" (Langlois Foundation), January 2006.

23. Because the codec—the standard of data compression and decompression—is one of the aspects of video most prone to obsolescence, Dimitrovsky proposed to eliminate a codec altogether and simply save the video as a series of uncompressed images labeled something like frame0001.bmp, frame0002.bmp, and so on. He then wrote a trivial Java program consisting of a loop that loads frame0001, waits one-thirtieth of a second, then loads the next frame, and so on. In a single stroke, this

protocol reduced the knotty challenge of preserving video to the easy problem of preserving bitmapped images, which are simply an array of pixel values.

When I first heard this suggestion, I said there was no way the image could be painted from a hard drive onto a video monitor in time, especially with the spontaneous cuts determined by the user touching the screen. I was spectacularly wrong: even by 2003, the technology had progressed to the point that Weinbren had to add an artificial *wait time* to simulate the delay caused by searching the original laser disc—because otherwise users wouldn't realize that the contact of their finger was what caused the video transition. (See note 21 for the aesthetic implications of this intervention.)

Weinbren and Dimitrovsky have since packaged a video authoring system for artists based on this approach called LimoHD. JPEG2000-MXF, an open version of this format, has been used to archive video by museums such as the Smithsonian American Art Museum. American Art associate curator Michael Mansfield, private conversation with Jon Ippolito, February 7, 2013.

24. At "Echoes of Art," Flanagan recounted an embarrassing moment when *[phage]* brought up an old email that stirred up memories that the user had buried.

25. Artists such as Olia Lialiana and curators such as Steve Dietz have expressed ambivalence or frustration about the way showing net art in a gallery diminishes its potential for participation and connection. Auriea Harvey refused an invitation to the 2000 Whitney Biennial, where her website would have been projected in a manner that discouraged simultaneous interaction, while the collective ®™Mark took its Biennial invitation as a chance to open its website to pages built by other artists. Matt Mirapaul, "For Museums, Internet Art Is a Tricky Fit," *New York Times*, March 30, 2000, http://theater.nytimes.com/library/tech/00/03/cyber/artsatlarge/30artsatlarge.html, accessed January 26, 2012.

26. Curator Christiane Paul has made this point in numerous public presentations.

27. *Shredder 1.0*, on *Potatoland.org*, http://www.potatoland.org/shredder/shredder.html, accessed June 18, 2012.

28. The Internet Archive has done a remarkable job of *storing* the entire Internet, and in a sense its WayBack Machine allows a user to glimpse an "emulation" of a previous version of the Internet. Such pools of outdated websites serve more than historians (and the lawyers of chapter 9). Napier's *Shredder* is only capable of remixing HTML; should the prevailing web standard change from HTML to something else, then *Shredder* could be demonstrated on an emulated pool of websites from the HTML era.

29. As noted earlier, the "Echoes of Art" transcript can be found at http://variablemedia.net/e/seeingdouble, accessed January 26, 2012.

30. Anecdotal conversations with gallerygoers would seem to corroborate this difference, but a more thorough study would be needed to confirm this conclusion.

31. Jerome McDonough et al., "Preserving Virtual Worlds Final Report" (2010), 46–47, 88, https://www.ideals.illinois.edu/handle/2142/17097, accessed February 20, 2012.

32. "Play—Machinima—Law," Center for Internet and Society, Stanford Law School, and the How They Got Game Project, Stanford University, April 24–25, 2009. See http://www.stanford.edu/group/htgg/cgi-bin/drupal/?q=node/973.

33. Those familiar with jodi's iconoclastic work recognize that the copyright symbol is likely an ironic gesture.

34. "Seeing Double" featured a movie directed by Babette Mangolte of the 1993 performances featuring Andrew Ludke and Sarah Tomlinson. These restagings intentionally emulated the original 1964 live performance of *Site* with Robert Morris and Carolee Schneemann, down to the position of props and the appearance of the performers. As mentioned in chapter 6, in his later years Morris more frequently chose a form for his works that was fixed rather than fluid.

35. "Echoes of Art."

36. Ibid.

37. Leslie Johnston, "What Are We Going To Do about Hardware?," *The Signal* (Washington, DC), May 24, 2013, http://blogs.loc.gov/digitalpreservation/2013/05/what-are-we-going-to-do-about-hardware/, accessed November 7, 2013 (emphasis in original).

38. Olive is a project of Carnegie Mellon University (https://olivearchive.org/). bwFLA is an emulation-as-service work-in-progress sponsored by the German state of Baden-Württemberg (http://www.fpc.cdpa.org.uk/index.php/citech-projects/ahrc-gamespres/visor-partners-aluf). While the Internet Archive supports Jason Scott in his efforts to coordinate JSMESS (http://jsmess.textfiles.com/), it does not directly fund this open-source community project. Jason Scott, private conversation with Jon Ippolito, November 7, 2013. (All sites accessed November 7, 2013.)

39. Jason Scott, private conversation with Jon Ippolito, November 7, 2013.

Chapter 9

1. John Bingham, "Woman Who Plays Classical Music to Soothe Horses Told to Get Licence," *The Telegraph* (London), March 27, 2009, http://www.telegraph.co.uk/news/newstopics/howaboutthat/5061004/Woman-who-plays-classical-music-to-soothe-horses-told-to-get-licence.html; "Singer in Grocery Store Ordered to Pay Royalties," *Slashdot*, October 22, 2009, http://entertainment.slashdot.org/story/09/10/21/2319200/Singer-In-Grocery-Store-Ordered-To-Pay-Royalties; "No New Tricks for Robot Dog," *Chilling Effects*, no date, http://chillingeffects.org/anticircumvention/notice.cgi?NoticeID=24; "Please Use as Directed, Pretty Please?," *Branded*

Newb, July 6, 2006, http://brandednewb.blogspot.com/2006/07/please-use-as-directed-pretty-please.html; all accessed January 29, 2012.

2. One might argue that it is legislators, rather than lawyers, who decide the lifespans of contemporary media, since they make the inane laws that lawyers and judges enforce. Unfortunately, many intellectual property laws in the United States reflect the private influence of lawyers and lobbyists more than public opinion. As of this writing, the public has only just begun to intervene to overturn such unpopular legislation: witness the Stop Online Piracy Act/Protect IP Act (SOPA/PIPA) protests of January 18, 2012. Herman Blignaut, "Democracy the Winner in Sopa, Pipa Battle," *TechCentral*, January 30, 2012, http://www.techcentral.co.za/democracy-the-winner-in-sopa-pipa-battle/28860/, accessed November 1, 2013.

3. Robert A. Gorman, *Copyright Law*, 2d ed. (Washington, DC: Federal Judicial Center, 2006), 87. http://www.fjc.gov/public/pdf.nsf/lookup/copyright.pdf/$file/copyright.pdf, accessed 1 November 2013.

4. Adam Clark Estes, "The Great Martin Luther King Copyright Conundrum," *The Atlantic Wire*, January 16, 2012, http://news.yahoo.com/great-martin-luther-king-copyright-conundrum-170521665.html, accessed January 29, 2012.

5. Valerie Strauss, "King's Fiery Speech Rarely Heard," *Washington Post*, January 15, 2006, http://www.washingtonpost.com/wp-dyn/content/article/2006/01/14/AR2006011400980.html, accessed June 18, 2012.

6. Ironically, the King speech was *less* restrained by copyright than culture produced after 1976, as summarized well by Wikipedia:

> The case is analyzed under the previous copyright law, the Copyright Act of 1909 ("1909 Act"), rather than the Copyright Act of 1976 ("1976 Act") as the previous act was in force when the facts arose. Under the 1909 statute common law copyright subsisted until a work was published. As the 1909 Act did not comply with the automatic protection of the Berne Convention, statutory copyright could only be obtained by completing the necessary formalities, i.e. by registering the work with the Registrar of Copyrights in Washington, D.C. CBS argued that Dr. King had not complied with the statute, and thus, by performing the work, he essentially granted it to the public domain. His estate argued to the contrary that the work had never been published at the time of its initial performance by Dr. King and thus retained common law copyright.

"Estate of Martin Luther King, Jr., Inc. v. CBS, Inc.," *Wikipedia*, http://en.wikipedia.org/wiki/Estate_of_Martin_Luther_King,_Jr.,_Inc._v._CBS,_Inc.#Legal_analysis, accessed January 29, 2012.

7. Mark Tribe, private correspondence with Jon Ippolito, July 21, 2011.

8. Quoted in Matthew Rimmer, "The Grey Album: Copyright Law and Digital Sampling," February 2005, http://works.bepress.com/matthew_rimmer/16, accessed January 29, 2012.

9. Ibid.

10. Later, "Ramon and Pedro" was revealed as the nom de guerre of Swiss directors Laurent Fauchère and Antoine Tinguely.

11. Ironically, MTV featured an interview with Burton. Corey Moss, "Grey Album Producer Danger Mouse Explains How He Did It," *MTV*, March 11, 2004, http://www.mtv.com/news/articles/1485693/grey-album-producer-explains-how-did-it.jhtml, accessed November 7, 2013.

12. At 7 p.m. EST on Febuary 4, 2008, NASA broadcast the Beatles' song "Across the Universe" into deep space. The Beatles thus became more accessible to aliens in the Crab Nebula than to paying customers on the planet Earth, due to the reluctance of the Beatles' label to release their songs digitally—an irony not lost on Gizmodo wag Wilson Rothman:

> [A] message to the Crab people: Don't trust these downloads. You'll see the file streaming into your antenna array and you'll be like, "Sweet! Free music!" But then you open the file, and you get this message on your Crab Nebula equivalent of Windows Media Player 11, saying that in order to enjoy this track, you need to get authorization from a central server. You click okay, and the message has to travel back to earth, taking another 50,000 years or so. Which may seem worth the wait, only the track itself expires in 30 days.

Wilson Rothman, "Space Aliens First to Get DRM-Free Beatles Music?," *Gizmodo*, Febuary 1, 2008, http://gizmodo.com/351542/space-aliens-first-to-get-drm+free-beatles-music, accessed January 29, 2012.

13. Debord's first thesis in *Society of the Spectacle* claims that "Everything that was directly lived has receded into a representation." Guy Debord, *Society of the Spectacle* (Detroit: Black & Red, 1973), at http://www.marxists.org/reference/archive/debord/society.htm, accessed June 18, 2012. See also Ben McGrath, "War Games," *New Yorker*, May 5, 2008, http://www.newyorker.com/talk/2008/05/05/080505ta_talk_mcgrath, accessed January 29, 2012.

14. McGrath, "War Games."

15. Matthew Kirschenbaum's informative analysis of this kind of Kriegspiel occasioned a bevy of critics debating details of the pedigree of Debord's game and RSG's rendition. Regardless of who came first or created the most authentic rendition, it is only by such reinterpretations that we currently know many artifacts of history, and it is only by encouraging responsible reinterpretations that we may have any sense of a broad swath of culture from this digital century. Matthew Kirschenbaum, "On Debord's Kriegspiel and Board Wargames," *Zone of Influence*, April 13, 2008, http://www.zoi.wordherders.net/?p=103, accessed January 29, 2012.

16. Stephen Ryan, "The Old School Meets the New," *CNN*, April 12, 2004, http://www.cnn.com/2004/TECH/04/07/emulators/index.html, accessed June 18, 2012.

17. John Klima, *EARTH* (2001), *ecosystm* (2002), and *glasbead* (2000). Documentation at John Klima, *Cityarts.com*, www.cityarts.com, accessed January 29, 2012.

18. Michael Rush, "Virtual Reality Art: Beyond Technology," *New York Times*, January 6, 2006, http://www.nytimes.com/2006/01/06/arts/06iht-rush.html?pagewanted=all&_r=0, accessed January 29, 2012.

19. Private conversation between John Klima and Jon Ippolito, October 9, 2004.

20. The analogy of opening the car's hood suggests a freedom inherent in the ownership of physical gadgets and often associated with American innovation—one at odds with licenses that restrict such tinkering. (See, for example, https://freedom-to-tinker.com, accessed January 29, 2012.)

That said, the analogy also highlights a divergence in the free culture community about which form of openness is more free. For example, Blender is released under the GPL copyleft license, which means it is free to anyone willing to share derivatives made with it according to the same freedoms. Some argue that Blender would be more free if it were given away to the public domain without restrictions; others point out this would "leave the door open" for profiteers to take the code and repackage it under a restrictive license.

A loose analogy would be to the difference between a door that is left unlocked but could be locked by a later user (public domain) versus a door that is locked in the open position (copyleft).

A more accurate, if forced, analogy would be to a series of doors connecting sections of a long corridor. Public domain would lock the first door in an open position, but allow subsequent doors to be locked by those who pass through the first. Copyleft would lock all the corridor's doors in an open position.

21. Randy Kennedy, "The Artists in the Hazmat Suits," *New York Times*, July 3, 2005, http://www.nytimes.com/2005/07/03/arts/design/03kenn.html, accessed June 18, 2012.

22. One example is Joe Davis, a biotech artist who has argued for responsible use of genetically modified materials; Davis bred his recombinant bacteria in scientific labs rather than smuggling them home to the kitchen. Joe Davis, private correspondence with Jon Ippolito, February 26, 2008.

23. King argued that Steve Kurtz and the Critical Art Ensemble "recreate [scientific] ideas using their own way of imaging, and then say, 'Maybe you'd like to look at it this way.' To me, that's teaching. It does not seem to me to threaten homeland security. In fact, I would be threatened to live in a homeland in which that was perceived to be a threat." In FAQ, *Critical Art Ensemble Defense Fund*, http://www.caedefensefund.org/faq.html#scientists, accessed July 30, 2009.

24. Denise Grady, "Scientists to Pause Research on Deadly Strain of Bird Flu," *New York Times*, January 20, 2012, http://www.nytimes.com/2012/01/21/science/scientists-to-pause-research-on-deadly-strain-of-bird-flu.html, accessed January 29, 2012.

25. According to a definition proposed by art historian Michael Grillo and Jon Ippolito in the forthcoming article "From Support to Subversion: New Media as

Catalysts of Change in the Fourteenth and Twentieth Centuries," new media are characterized by the inability of established interests to control them. See note 4 of chapter 1.

26. "The Internet Archive is not interested in preserving or offering access to Web sites or other Internet documents of persons who do not want their materials in the collection." "How can I remove my site's pages from the Wayback Machine?," *Internet Archive*, http://www.archive.org/about/faqs.php accessed January 29, 2012.

27. "Internet Archive," *Wikipedia*, http://en.wikipedia.org/wiki/Internet_archive #Healthcare_Advocates.2C_Inc., accessed June 18, 2012.

28. This is the conclusion of a survey of new media professionals that Rick conducted in 2006. Richard Rinehart, "Nailing Down Bits: Digital Art and Intellectual Property" (Canadian Heritage Information Network, 2006), p. 38. The PDF is available at http://www.coyoteyip.com/rinehart/papers_files/Nailing_down_bits.pdf.

29. The Sony adhesive tape fiasco is only a single example of DRM's many shortcomings. Wikipedia notes nine categories of reasons DRM fails at http://en.wikipedia .org/wiki/Digital_rights_management#Shortcomings, accessed June 18, 2012.

30. Take it from the inventor of the spreadsheet: "I believe that copy protection [as sanctioned by the DMCA] will break the chain necessary to preserve creative works. It will make them readable for a limited period of time and not be able to be moved ahead as media deteriorates or technologies change." Dan Bricklin, "Copy Protection Robs the Future," *bricklin.com*, February 23, 2004, http://www.bricklin.com/robfu ture.htm, accessed January 29, 2012.

31. "DVD Jon's code in Sony Rootkit?," *Slashdot,* http://news.slashdot.org/ story/05/11/17/1350209/dvd-jons-code-in-sony-rootkit, accessed August 12, 2013.

32. Darren Todd writes:

> The copyright rich often try to compete with piracy using the same old tools: repackaging their products instead of reimagining them. Such tactics still cling to the notion that beating piracy means lowering prices and increasing convenience, but introducing new limits as well. That piracy needs to be beaten at all, as reflected in such models, shows a gap in understanding.
>
> Beginning in 2003, petrol stations, airports, and other transitional places began selling EZ D disks of popular films. They performed as any other DVD, but with a catch. After 48 hours of inexorable exposure to oxygen on opening, the disk changed color and became unreadable by the DVD laser. In effect, Flexplay Technologies, Inc., had created a self-destructing DVD, so they could sell popular films anywhere without the concern of returning the DVDs, therefore allowing much lower prices. Plus, since the disk was little more than a shiny object after 48 hours, the viewer would have to rent or buy the film again to rewatch it.

Darren Todd, *Pirate Nation: How Digital Piracy Is Transforming Business, Society and Culture* (Creative Commons, 2011), 198–199, http://digital-rights.net/wp-content/ uploads/books/Piratenation.pdf, accessed June 18, 2012.

Despite a chilly initial reception, the industry tried self-destructing DVDs again five years later; see also Darren Murph, "Staples to Stock Flexplay Self-Destructing DVDs," *Engadget*, June 2, 2008, http://www.engadget.com/2008/06/02/staples-to-stock-flexplay-self-destructing-dvds/, accessed June 18, 2012.

33. "RIAA Says Don't Expect DRMed Music to Work Forever," July 30, 2009, *Slashdot,* http://yro.slashdot.org/story/09/07/30/1736209/RIAA-Says-Dont-Expect-DRMed-Music-To-Work-Forever, accessed July 30, 2009.

34. Quoted in "Sony Pictures CEO Thinks the Net Wasn't Worth It," *Slashdot,* May 16, 2009, http://news.slashdot.org/story/09/05/16/1825244/sony-pictures-ceo-thinks-the-net-wasnt-worth-it, accessed July 30, 2009.

35. Bruce Sterling, "Dead Media Beat: Dark Authentication Servers," *Wired,* July 30, 2009, http://www.wired.com/beyond_the_beyond/2009/07/dead-media-beat-dark-authentication-servers/, accessed July 30, 2009.

Chapter 10

1. https://popcorn.webmaker.org/, accessed 1 November 2013.

2. To be fair, some indigenous communities have specialized roles for those who sustain culture, such as the griots of West Africa, entrusted with passing on news and histories via song and story. What's more germane to this chapter is the way many native rituals of cultural preservation focus more on drawing a wide spectrum of participants into the process than on fidelity to a particular slab of wood or series of dance moves. For example, Joline Blais argues that "the production of Malanggan cloth in Papua New Guinea follows a logic of ownership that entangles rather than detaching its object from the context of its making." Joline Blais, "Indigenous Domain: Pilgrims, Permaculture, and Perl," *Intelligent Agent* (New York) 6, no. 2 (2006), http://www.intelligentagent.com/archive/Vol6_No2_community_domain_blais.htm, accessed November 1, 2013.

3. Michael Kimmelman, "After a Much-Debated Cleaning, a Richly Hued Sistine Emerges," *New York Times*, May 14, 1990, http://www.nytimes.com/1990/05/14/arts/review-art-after-a-much-debated-cleaning-a-richly-hued-sistine-emerges.html, accessed June 18, 2012.

4. When I asked a fellow curator at the Guggenheim who worked on web projects in the 1990s how he intended to preserve them, he told me that they should just be allowed to exist in their present form or die a natural death.

5. Most professional conservators have a more realistic understanding of the changes artifacts inevitably undergo, a tradeoff suggested by the title of the 1999 Getty conference "Mortality/Immortality." See Miguel Angel Corzo, ed., *Mortality Immortality? The Legacy of Twentieth-Century Art* (Los Angeles: Getty Conservation Institute,

1999). For more on the difference between the lay perception of conservation and its actual practice, see note 11 of chapter 1.

6. The Variable Media Questionnaire, a preservation tool mentioned earlier in this book and discussed later in this chapter, is often described as an instrument that encourages creators to imagine ways their work can survive the translation to other media once its current medium expires. The Questionnaire also happens to be the only systematic means at present for creators to declare that they *don't* want their work to be translated into another medium. Like a living will, such declarations assert that the cure could be worse than the disease.

7. Sterling describes laptops as "colorful, buzzing cuddly things with the lifespan of hamsters" in Paul D. Miller, ed., *Sound Unbound: Sampling Digital Music and Culture* (Cambridge, MA: MIT Press, 2008), 73.

8. Tjebbe van Tijen, *nettime* email list, March 1, 1999, http://www.nettime.org/Lists-Archives/nettime-l-9903/msg00005.html, accessed February 9, 2012.

9. Although the original 1998 version of *The Impermanence Agent* no longer functions, as of this writing, documentation and a reinterpreted version from 2003 can be found at http://www.noahwf.com/agent, accessed February 9, 2012.

10. The artists chose to shutter *The Impermanence Agent* after a third party used the work's open proxy to attack another site—underscoring the volatility of network-based memory. Noah Wardrip-Fruin, private correspondence with Jon Ippolito, February 12, 2012.

11. Mark Napier, *Digital Landfill*, http://www.potatoland.org/landfill/, accessed February 9, 2012.

12. Garrett Lynch, *Things to Forget* (2002), on *Rhizome ArtBase*, http://rhizome.org/artbase/artwork/9844/, accessed February 9, 2012.

13. William Pope.L, *The Black Factory*, http://www.theblackfactory.com. Curt Cloninger explains that "The Black Factory . . . intentionally self-sabotages its own eventual/inevitable recontextualization as an archived art object. The project is basically a mobile performance factory that takes "black" objects submitted by people and physically converts them into other objects." Curt Cloninger, *New Media Curating* email list, September 11, 2009.

Pope.L himself makes the connection to indigenous culture explicit: "Like the African shaman who chews his pepper seeds and spits seven times into the air, I believe art re-ritualizes the everyday to reveal something fresh about our lives. This revelation is a vitality and it is a power to change the world." http://www.foundationforcontemporaryarts.org/grant_recipients/popel.html, accessed February 9, 2012.

14. Recent technological advances have made memory more manipulable than ever, raising epistemological and ethical issues. Microsoft developed a camera necklace for

Alzheimer patients to help them recall where they have been; see kdawson, "MS's 'Lifeblogging' Camera Enters Mass Production," *Slashdot,* http://hardware.slashdot.org/story/09/10/17/178249/MSs-Lifeblogging-Camera-Enters-Mass-Production, October 17, 2009. For the rest of us, there's Microsoft researcher Gordon Bell's MyLifeBits project (see Sharon Gaudin, "Total Recall: Storing Every Life Memory in a Surrogate Brain," *Computerworld*, April 2, 2008, http://www.computerworld.com/s/article/9074439/Total_Recall_Storing_every_life_memory_in_a_surrogate_brain) and IBM's Pensieve for handhelds (timothy, "Software Backs Up Human Memory," *Slashdot*, August 1, 2008, http://tech.slashdot.org/story/08/08/01/025259/software-backs-up-human-memory). Meanwhile, researchers at Harvard and McGill University have been using propranolol, a drug used in the treatment of amnesia, to accomplish the reverse, by blocking or removing bad memories on a selective basis (see Tony Long, "Thanks for the Memories . . . Whatever They Were," *Wired*, July 19, 2007, http://www.wired.com/culture/lifestyle/commentary/theluddite/2007/07/luddite_0719). Israeli researchers have created artificial memories for the first time in neurons growing in a lab (see Zonk, "Data Stored in Live Neurons," *Slashdot*, June 9, 2007, http://hardware.slashdot.org/story/07/06/09/0528247/data-stored-in-live-neurons), while scientists at Oxford have written memories into flies by flashing a laser at their brains while they smelled a particular odor, provoking a negative reaction to that odor in the future (see Soulskill, "Scientists Write Memories Directly into Fly Brains," *Slashdot*, October 16, 2009, http://science.slashdot.org/story/09/10/16/2345204/Scientists-Write-Memories-Directly-Into-Fly-Brains). All sites accessed November 2, 2013.

15. Igor Štromajer, in *Digital Art Conservation: Practical Approaches* (Strasbourg: École supériore des arts décoratifs, 2011), 27.

16. "One more thing: the words on the plaque [*Beam me up Scotty. I'm done here.*] really do capture one of the last things he ever said. Of course as kids we watched the show [*Star Trek*] in its first run." "A Geek Funeral," *Slashdot*, September 29, 2009, http://news.slashdot.org/story/09/09/29/193234/A-Geek-Funeral. Compare Olivia Solon, "Company Presses Your Ashes into Vinyl When You Die," *Wired*, August 27, 2010, http://www.wired.co.uk/news/archive/2010-08/27/and-vinyly. Both sites accessed February 9, 2012.

17. buswolley, "Re:Smart move!," October 27, 2009, comment no. 29884875 on samzenpus, "Facebook to Preserve Accounts of the Dead," *Slashdot*, October 27, 2009, http://tech.slashdot.org/comments.pl?sid=1420235&cid=29884875, accessed November 2, 2013.

18. While the practice of hoarding may reassure the elderly, it can leave their heirs with an enormous logistic and financial burden, something I know from personal experience.

19. Jeffrey Rosen, "The Web Means the End of Forgetting," *New York Times*, July 21, 2010, http://www.nytimes.com/2010/07/25/magazine/25privacy-t2. html. The unintended persistence of data on social networks has inspired data-erasing software

like Vanish; see http://it.slashdot.org/story/09/07/21/1522255/Vanish-Makes-Sensitive-Data-Self-Destruct. Both sites accessed February 9, 2012.

20. "You know, just business, banks, will not let this information dissipate. No matter what kind of changes take place in platforms or programs, a kind of universal, almost cryptography code will have to be created, that will incidentally also salvage these artworks, as well as the economy." Ken Jacobs, "Preserving the Immaterial" conference, March 31, 2001, on *Variable Media Network*, http://www.variablemedia.net/e/preserving/html/var_pre_session_two.html, accessed February 9, 2012.

21. For example, backers of a proposed storage system consisting of iron particles floating in carbon nanotubes "estimated that information stored within it would be essentially impervious to degradation." Lee Billings, "Immortal Information," *Seed Magazine*, June 15, 2009, http://seedmagazine.com/content/article/immortal_information/, accessed February 18, 2012.

22. Todd Bishop, "E-mail from the Grave? Microsoft Seeks Patent on 'Immortal Computing,'" *Seattle PI*, January 21, 2007, http://www.seattlepi.com/business/article/E-mail-from-the-grave-Microsoft-seeks-patent-on-1226027.php, accessed February 9, 2012.

23. The Rosetta Project (http://rosettaproject.org), by the Long Now Foundation mentioned in chapter 2, aims to create a durable archive of human languages by microetching the same text in 1,500 languages into a stainless steel disk—a strategy that was copied in 2011 by a commercial startup offering to etch its customers' movies into a "stone-like" disc that can be read by a DVD player (http://hardware.slashdot.org/story/11/08/08/2222208/Start-Up-Claims-Immortality-For-Data-With-Stone-Like-Disc). Both sites accessed February 9, 2012.

24. Similar proposals to encode historical data into gravesites include Memory Medallions, QR Memories, and RosettaStone™, as well as their digital cousins Entrustet and Legacy Locker. (Despite its familiar-sounding name, the social media-archiving app Recollect was released after this book was already titled.) See Rob Walker, "Cyberspace When You're Dead," *New York Times,* January 5, 2011, http://www.nytimes.com/2011/01/09/magazine/09Immortality-t.html, accessed August 16, 2013, and Alex Denham, "QR Codes for Memorials," *I Programmer*, September 8, 2012, http://www.i-programmer.info/news/81-web-general/4766-qr-codes-for-memorials.html, accessed November 2, 2013. Of course, many of these will have a lifespan shorter than the people they are meant to memorialize.

25. Bruce Sterling, "Dogfooding the Cloud, or, Adventures in Mixed Metaphor," *Wired*, October 17, 2009, http://www.wired.com/beyond_the_beyond/2009/10/dogfooding-the-cloud-or-adventures-in-mixed-metaphor/, accessed February 9, 2012.

26. Eliot Van Buskirk, "Screwed for Sure," *Wired,* August 21, 2006, http://www.wired.com/entertainment/music/commentary/listeningpost/2006/08/71621, accessed February 9, 2012.

27. Roni Caryn Rabin, "Religious Belief Linked to Desire for Aggressive Treatment in Terminal Patients," *New York Times*, March 17, 2009, http://www.nytimes.com/2009/03/18/health/research/18faith.html, accessed February 9, 2012.

28. That LP of Arturo Toscani performing Beethoven, or that VHS tape of our son's first steps that we so cherish, offers a surrogate for a lost experience. In a curious parallel, recent psychiatric research has focused on the potential role of recordings in overcoming loss of a loved one or one's own memories: "A crucial phase of the treatment, borrowed from the cognitive behavioral therapy used to treat victims of post-traumatic stress disorder, requires the patient to recall the death in detail while the therapist records the session. The patient must replay the tape at home, daily. The goal is to show that grief, like the tape, can be picked up or put away." Fran Schumer, "After a Death, the Pain That Doesn't Go Away," *New York Times,* September 28, 2009, http://www.nytimes.com/2009/09/29/health/29grief.html, accessed February 9, 2012. In an unsettling, if more mainstream, practice of surrogacy, the U.S. military offered families of troops sent to the second Iraq War a life-size cardboard cutout of their father; military spokespeople encouraged soldiers' loved ones to take these "flat daddies" for a ride in the family car and stand them next to a chair at the dinner table. Katie Zezima, "When Soldiers Go to War, Flat Daddies Hold Their Place at Home," *New York Times*, September 30, 2006, http://www.nytimes.com/2006/09/30/us/30daddy.html, accessed November 2, 2013.

29. Ironically, the actual attempt to do this not only left a hole but damaged the work in the attempt to safeguard it. Venetian Admiral Francesco Morosini tried to remove the western pediment following a destructive military victory over the Ottomans in 1687, but ended up shattering the sculptures he intended to rescue. "Before evacuating Athens, [Morosini] endeavoured to take down the horses of the central group, and the Poseidon. But the workmen had hardly begun to raise the great overhanging stones of the cornice, when the whole of the group fell to the ground." *A Guide to the Sculptures of the Parthenon in the British Museum* (British Museum, Department of Greek and Roman Antiquities, 1908), http://www.archive.org/stream/guidetosculpture00britiala/guidetosculpture00britiala_djvu.txt, accessed November 2, 2013.

30. "One version is the frozen original, with broken code, pages of oddly formatted, garbled text and instructions for users who wanted to fax in their contributions (including the number for the Lehman College gallery, which first showed the piece). Links were redirected, through the archiving site the Wayback Machine, to their 1990s counterparts. 'The idea is that it's sort of a time capsule,' said Ben Fino-Radin, a digital archivist who helped rebuild the work. The new version, which the Whitney calls the live version, looks similar but has some new links. Users can't contribute to the historical site, but they can add to the live one—albeit not by fax." Melena Ryzik, "When Artworks Crash: Restorers Face Digital Test," *New York Times*, June 9, 2013, http://www.nytimes.com/2013/06/10/arts/design/whitney-saves-douglas-daviss-first-collaborative-sentence.html, accessed November 7, 2013.

31. http://myboyfriendcamebackfromth.ewar.ru, accessed November 8, 2013.

32. Entry for "archive," *Edenics*, http://www.edenics.net/english-word-origins.aspx?word=ARCHIVE, accessed June 18, 2012.

33. See Robert C. Bird and Lucille M. Ponte, "Protecting Moral Rights in the United States and the United Kingdom: Challenges and Opportunities under the U.K.'s New Performances Regulations," *Boston University International Law Journal* 24, no. 213 (2006), 278; and Nicholas Forrest, "Picasso Gets the Chop!!," *Art Market Blog* (Sydney), April 17, 2008, http://www.artmarketblog.com/2008/04/17/picasso-gets-the-chop-artmarketblogcom/, accessed November 2, 2013.

34. As flippant as this statement might sound, U.S. law has historically put little responsibility in the hands of owners to care for their property. To some extent, the ability to destroy even extends to animate property; colonial courts cautioned the plantation owner that he could not arbitrarily kill a slave "as he could an ox." Charles P. M. Outwin, "Securing the Leg Irons: Restriction of Legal Rights for Slaves in Virginia and Maryland, 1625–1791," *Early America Review* (Winter 1996), http://www.earlyamerica.com/review/winter96/slavery.html, accessed February 9, 2012.

Contrast such cavalier treatment of property with the stewardship demonstrated among the Australian Pintupi, whose words for "owned" and "not owned" translate more accurately as "cared for" and "orphaned," respectively. Blais, "Indigenous Domain."

35. See the appendix of Jon Ippolito, "Death by Wall Label," in Christiane Paul, ed., *New Media in the White Cube and Beyond* (Berkeley: University of California Press, 2009).

36. See Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2007).

37. Neal Stephenson, quoted in John Maxwell, "Software Preservation and the Special Problem of Unix?," *Simon Fraser University Commentary*, May 29, 2013, http://www.ccsp.sfu.ca/2013/05/software-preservation-and-the-special-problem-of-unix, accessed November 7, 2013.

38. Jon Ippolito, "Got a Camera? You Can Print Your 'Photos' in 3d," *NMDnet*, September 5, 2011, http://www.nmdnet.org/2011/09/05/got-a-camera-you-can-print-your-photos-in-3d/, accessed February 20, 2012.

39. Joseph Flaherty, "Harvard's 3D-Printing Archaeologists Fix Ancient Artifacts," *Wired*, December 10, 2012, http://www.readability.com/read?url=http%3A//www.wired.com/design/2012/12/harvard-3d-printing-archaelogy/, accessed January 26, 2013.

40. Randall Newton, "Bentley Pointools Reveals Prehistoric Artwork on Stonehenge," *Graphic Speak*, March 12, 2013, http://gfxspeak.com/2013/03/12/bentley-pointools-reveals-prehistoric-artwork-on-stonehenge/, accessed November 7, 2013.

41. Nathan Hurst, "3D-Print Your Own Ancient Art at Museum Scanathon," *Wired*, October 2, 2012, http://www.wired.com/design/2012/10/scanathon/, accessed November 1, 2013.

42. The Smithsonian's Günter Waibel described an Alaskan tribal leader who needed to pass on the ritual duties associated with an orca-shaped hat, but whose health was failing too quickly to wait for the full repatriation process. In response, a replica of the killer whale hat was scanned from the original, milled, and repainted by an artist, and sent to the tribe to be used in the ceremony. Since then, Waibel reported, the Smithsonian has heard from native communities who would prefer to use the replica and keep the original in a museum. Günter Waibel, presentation at Digital Curation Summit, Washington, DC, January 8, 2013, organized by Johns Hopkins University, University of Arizona, and Simmons College.

While it confuses traditional Euro-American understandings of authenticity, this choice resonates with traditions such as Malanggan; see Blais, "Indigenous Domain."

43. Matthew Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2008), 213–248. The Maryland Institute for Technology in the Humanities and the Digital Forensics Lab at University of Maryland produced an emulated run of the poem based on a bit-level copy of an original diskette at http://agrippa.english.ucsb.edu/category/the-book-subcategories/the-poem-running-in-emulation.

44. "Let's Solve the File Format Problem!," http://fileformats.archiveteam.org/, accessed January 26, 2013. Compare "Crowd Sourced Representation Information for Supporting Preservation (cRIsp)," http://wiki.opf-labs.org/display/SPR/Crowd+sourced+Representation+Information+for+Supporting+Preservation+%28cRIsp%29, accessed November 7, 2013.

45. Pamela Wright, presentation at Digital Curation Summit. In response to a question about the quality of crowdsourced projects like this, Wright described one of her students "correcting" a misspelling in one of the documents, only to be admonished by the crowd that the correct archival practice is to leave the misspelling in place. See also Rebecca J. Rosen, "World: We Have Lost the First Webpage; Professor: Oh, I Have a Copy of It Right Here," *Atlantic*, May 30, 2013.

46. Zach Schonfeld, "Inside the New Museum's Vast, Beautiful, and Totally Insane Digitization Project," *Atlantic*, July 26, 2013.

47. Larry Rohter, "A Huge Amazon Monster Is Only a Myth. Or Is It?," *New York Times*, July 8, 2007, http://www.nytimes.com/2007/07/08/world/americas/08amazon.html?_r=0, accessed February 9, 2012.

48. "Maori Legend of Man-Eating Birds Is True," *Slashdot*, September 14, 2009, http://science.slashdot.org/story/09/09/14/1718211/Maori-Legend-of-Man-Eating-Birds-is-True, accessed February 9, 2012.

49. David Kestenbaum, "Atomic Tune-Up: How the Body Rejuvenates Itself," *National Public Radio,* July 14, 2007, http://www.npr.org/templates/story/story.php?storyId=11893583, accessed November 2, 2013.

50. Ben Coxworth, "Researchers May Have Discovered How Memories Are Encoded in the Brain," *Gizmag*, March 21, 2012, http://www.gizmag.com/memory-storage-theory/21900/, accessed January 22, 2013.

51. Quoted in Diana Taylor, *The Archive and the Repertoire: Performing Cultural Memory in the Americas* (Durham: Duke University Press, 2003), 5.

52. Ibid., 18–19.

53. Shortly before his death, choreographer Merce Cunningham said of his dance, "I hope that in its own way it can go on. . . . I'm under no illusions about things not changing. I would like it mostly if the ideas we explored were continued, not only with the present people but with other companies." Daniel J. Wakin, "Merce Cunningham Sets Plan for His Dance Legacy," *New York Times*, June 9, 2009, http://www.nytimes.com/2009/06/10/arts/dance/10merc.html, accessed February 9, 2012.

While the word "repertoire" is familiar from theater and dance contexts, it suggests new possibilities for museums and archives. Artist Tino Sehgal doesn't allow any form of documentation of his installations (a word he prefers to "performances"); his work can be listed as collection record, but otherwise nothing about it can be written down. When New York's Museum of Modern Art acquired his work *Kiss*, he trained its conservators the way a choreographer would teach his repertoire to apprentice dancers. S. T., "The Fine Art of Human Interaction," *Economist*, July 12, 2012, http://www.economist.com/blogs/prospero/2012/07/tino-sehgal, accessed November 2, 2013. I'm indebted to Tate conservator Pip Laurenson for first bringing Sehgal's preservation conundrums to my attention.

54. Taylor, *The Archive and the Repertoire*, 20.

55. The King James Bible is one of countless "authoritative" documents that conceals a rich variety of preexisting sources. As one example, its authors translated fourteen different Hebrew words into the single English word "prince" (http://en.wikipedia.org/wiki/King_James_Edition, accessed February 9, 2012). Such divergences can be re-revealed by the literary form known as the variorum, which collates all known variants of a text.

56. While under the watchful eye of foreign occupiers, Okinawan martial artists crafted their katas—choreographed sequences of strikes, blocks, and kicks—in a manner that misled the uninitiated while containing a secret language of self-defense.

57. As one example, the Guggenheim earmarked about 15 percent of the acquisition budget for its 2002 Internet art commissions for an endowment meant to fund future re-creations of the works.

58. At the 2006 College Art Association conference, new media historian Edward Shanken responded to a similar statement by saying, "Now Jon, I'm sure you don't want to put professionals out of business." That is true, but I believe professionals have enough work already on their hands, and that amateurs can help.

59. Reuters, "Smoking Cuts for Classic Cartoons," *tv.com*, August 21, 2006, http://www.tv.com/news/smoking-cuts-for-classic-cartoons-5948/, accessed February 9, 2012.

60. Dennis McLellan, "Sheik Goaded Neighbors with Gaudy Decor," *Los Angeles Times*, January 5, 2003, http://community.seattletimes.nwsource.com/archive/?date=20030105&slug=alfassiobit05, accessed June 18, 2012.

61. Lucas's stance is notoriously contradictory, according to the website *Save Star Wars*:

> "In the future it will become even easier for old negatives to become lost and be 'replaced' by new altered negatives. This would be a great loss to our society. Our cultural history must not be allowed to be rewritten." (Lucas, 1988)
>
> "The other versions will disappear. . . . Even the 35 million [video] tapes out there won't last more than 30 or 40 years. A hundred years from now, the only version of the movie that anyone will remember will be the [Special Edition] version." (Lucas, 1997)

Will Gompertz, "Why Star Wars Should Be Left to the Fans," *British Broadcasting Corporation*, September 16, 2011, http://www.bbc.co.uk/news/entertainment-arts-14944240.

The website *Gizmodo* reported a rumor that George Lucas has bought the rights to old movies in order to digitally insert dead actors in his films, "so you'd have Orson Welles and Barbara Stanwyck alongside today's stars." See Jesus Diaz, "George Lucas Plans to Resurrect Dead Movie Stars," *Gizmodo*, December 6, 2010, http://gizmodo.com/5707079/george-lucas-plans-to-resuscitate-dead-movie-stars. In the meantime, Marilyn Monroe, Grace Kelly, and Marlene Dietrich have already been resurrected for a Dior commercial. Lauren Kirchner, "No RIP for VIPs: Dead Stars Rise to Make Sales Pitches," *Wired*, November 29, 2011. Yamaha now claims to be able to resurrect any singer's voice simply by sampling existing songs. Bruce Sterling, "Dead Media Beat: Synthetic Voices of the Dead," *Wired,* December 27, 2011. All accessed February 9, 2012.

62. *Variable Media Questionnaire*, http://variablemediaquestionnaire.net/.

63. At the 2001 conference "Preserving the Immaterial," Bill Brand contrasted the "public use" of artworks and other cultural artifacts with their original intent. See "Session on Performative Artworks: Review of Questionnaire," March 31, 2001, http://variablemedia.net/e/preserving/html/var_pre_session_two.html, accessed February 12, 2012.

64. Writer Kevin Kelly contends that new media enable us to save everything, and we can figure out what's worth paying attention to later. While cheap digital storage

and ever-better search algorithms lend this provocative vision credibility in the short term, in the long term the accumulated patchwork of quickly evolving, conflicting standards would make it hard to access all those saved bits.

65. Surprisingly, new media art has not made significant inroads in this community. Joline Blais and I argue this is because new media artists have ghettoized themselves inside the art world. See our "Out of the Hothouse and into the World," http://at-the-edge-of-art.com/out_of_the_hothouse/#leavingboth, accessed February 12, 2012.

66. "On the sixth word (sun), he cracked the note. It was, as recalled by author William Manchester, 'like a catch in your voice, or a swiftly stifled sob.' The broken note was considered the only conspicuous slip in the otherwise ornate and grandiose ceremony. Some thought it to be a deliberate effect. It was not." Jari Villanueva, "A Bugle Call Remembered: Taps at the Funeral of President John F. Kennedy," http://tapsbugler.com/a-bugle-call-remembered, accessed August 27, 2013.

67. For the record, many observers do not believe Armstrong's claim that he said "a man," claiming instead that he flubbed the line (Eric M. Jones, "One Small Step," *NASA.gov*, http://www.hq.nasa.gov/alsj/a11/a11.step.html), even though his brother confirms the singular ("Origin of Neil Armstrong's 'One Small Step' Line Revealed," *Slashdot,* http://science.slashdot.org/story/12/12/31/0421229/origin-of-neil-armstrongs-one-small-step-line-revealed, both accessed February 12, 2012). As a listener who grew up in Armstrong's home state of Ohio, where speech is often clipped, I have always heard that "a" *sotto voce* in the official broadcast from the moon.

68. For an explanation of a "long tail," see the Wikipedia entry, http://en.wikipedia.org/wiki/Long_Tail, accessed June 18, 2012.

69. Serra claimed that "a site-specific sculpture is one which is conceived and created in relation to the particular conditions of a specific site and only to those conditions. To remove *Tilted Arc*, therefore, is to destroy it." Sherrill Jordan ed., *Public Art, Public Controversy: The Tilted Arc on Trial* (New York: ACA Books, 1987), 149; quoted in Keith Charles Culver, "Ethical Issues Surrounding the Censorship of Public Site Art," master's thesis, McMaster University, 1992, http://digitalcommons.mcmaster.ca/cgi/viewcontent.cgi?article=7176&context=opendissertations, accessed June 18, 2012.

70. The word "JoyWar" is an allusion to "ToyWar," an intellectual property battle that pitted online activists against a litigious toy company. See Jon Ippolito, "Whatever Happened to the Gift Economy?" *Artbyte* (New York) 3, no. 1 (May-June 2000): 22–23, archived at http://three.org/ippolito/writing/wri_cross_gift.html, accessed February 12, 2012.

71. Joy Garnett and Susan Meiselas, "Portfolio: On the Rights of Molotov Man—Appropriation and the Art of Context," *Harper's* (February 2007), 53–58.

72. The Cross-Cultural Partnership, a legal template created by the Connected Knowledge Working Group, skirts the battle between copyright lockdown and the idea that "information wants to be free" to propose a third path in which culture can be shared responsibly. See "The Cross-Cultural Partnership," http://connected-knowledge.net/, accessed February 12, 2012.

73. See *ada•web* archive, http://www.adaweb.com. As a quirky attempt to capture *ada•web*'s context as well as its individual works, *The Unreliable Archivist* was in part a reaction to early collection initiatives such as the San Francisco Museum of Modern Art's web acquisitions in the late 1990s, which stripped formerly interactive websites of their context. Matthew Mirapaul, "Head of San Francisco Museum Embraces Digital Art," *New York Times*, November 5, 1998, http://theater.nytimes.com/library/tech/98/11/cyber/artsatlarge/05artsatlarge.html. True to its name, the original version of *The Unreliable Archivist*, optimized for Netscape 4, became obsolete by the early 2000s; however, a 2010 migration can be viewed at http://three.org/unreliablearchivist. All accessed February 12, 2012.

74. Dominique Quaranta, *Curating New Media* email list, June 2009.

75. Dan Visel, "Art and Technology, 1971," *if:book*, October 29, 2008, http://www.futureofthebook.org/blog/archives/2008/10/art_and_technology_1970.html, accessed February 12, 2012.

76. Such new contexts can subvert the author's expectations as well, as shown earlier in this chapter by Matthew Kirschenbaum's ironic example of William Gibson and Dennis Ashbaugh's *Agrippa*, which—though it was supposed to be a lesson in ephemerality, a poem that erased itself when read—has been preserved online to this day. Kirschenbaum, *Mechanisms*, 213–248.

77. Jon Ippolito, "The Museum of the Future: A Contradiction in Terms?," *Artbyte* (New York) 1, no. 2 (June-July 1998): 18–19, archived at http://three.org/ippolito/writing/wri_cross_museum.html, accessed February 12, 2012.

78. I believe this is an unattainable goal for any art form, even so-called "conceptual art." See Jon Ippolito, "Where Did All the Uncertainty Go?," *Flash Art International* 29, no. 189 (July-August 1996): 83, 85–87.

79. For a solid biography of John Cage, see David Revill, *The Roaring Silence: John Cage* (London: Bloomsbury Publishing, 1992).

80. Ibid., passim.

81. Janine Antoni wrote, "I was thinking of Mierle Ukeles' *Hartford Wash: Washing, Tracks, Maintenance: Inside* (1973). . . . It was only after I made *Loving Care* that I became aware of Paik's *Zen for Head*. Nam June was instrumental in bringing the 1993 biennial to Korea, and when meeting him I acknowledged the relationship between my work and his. He laughed it off, and very modestly said, "Oh, that was

just something I did for fun. Your piece is entirely different." Janine Antoni, email to Jon Ippolito, October 12, 2012.

82. The Pool is an online environment created by faculty and students at the University of Maine for sharing creative works and tracking their reuse. See *The Pool*, http://pool.newmedia.umaine.edu/, accessed January 27, 2013.

83. Unlike Creative Commons licenses, the Open Art License is crafted to help expose artistic genealogies. See http://three.org/openart/license, accessed February 12, 2012.

84. Music labels have typically lionized celebrity frontmen at the expense of their many collaborators—though some in the industry have begun to question whether remix culture offers a creative way out of this star system. Faced with a collection of "almost completed" songs, Sony and the estate of Michael Jackson have two paths:

> They can serve up Jackson's outtakes and archives as he left them, if indeed the songs are complete enough to release. Or . . . treating Jackson's work . . . as source material for recordings that work outside chronology and authenticity. Instead of pretending to divine his intentions, they could bring in the many producers and songwriters Jackson influenced—Ne-Yo, Justin Timberlake, Kanye West, R. Kelly, Usher, Britney Spears, OutKast, Janelle Monae, Prince, Madonna, Will.i.am, truly an endless list—and give them a chance to meet Jackson artist to artist, working with songs still unheard. . . . The real Michael Jackson died in 2009. R.I.P. His musical artifacts can still be resurrected.

Jon Pareles, "After Death, the Remix," *New York Times,* December 9, 2010, http://www.nytimes.com/2010/12/12/arts/music/12jackson.html.

Pareles's dichotomy is a bit misleading, as Michael Jackson's music already reflects the influences of artists such as James Brown, whether they were direct collaborators or not.

For one standard for such expanded credit, see Ippolito, "Death by Wall Label."

Chapter 11

1. Stephen Harrod Buhner, *The Secret Teachings of Plants: The Intelligence of the Heart in the Direct Perception of Nature* (Rochester, VT: Bear and Co., 2004), 263.

2. Mike Olson, "Appetite for Art: Restoring Ancient Works with Hungry Bacteria," *Wired*, November 1, 2011, http://www.wired.com/magazine/2011/11/st_artrestore micro, accessed February 15, 2012.

3. L. D. Adleman, "Molecular Computation of Solutions to Combinatorial Problems," *Science* 266, no. 5187 (November 1994): 1021–1024, http://www.usc.edu/dept/molecular-science/papers/fp-sci94.pdf, accessed June 18, 2012.

4. For more, see Jon Ippolito, "Whatever Happened to the Scary Cyborg?," *ArtByte* 2, no. 3 (September-October 1999): 28–29, archived at http://three.org/ippolito/writing/wri_cross_scary.html, accessed February 17, 2012.

5. Alan Leo, "Writing the Book in DNA," *Harvard Medical School News*, August 16, 2012, http://hms.harvard.edu/news/writing-book-dna-8-16-12. See also "Scientists Store Entire Textbook in DNA," *Slashdot*, August 16, 2012, http://science.slashdot.org/story/12/08/16/1923243/scientists-store-entire-textbook-in-dna, both accessed January 28, 2013.

6. "Scientists Create Computing Building Blocks from Bacteria and DNA," *PhysOrg*, October 18, 2011, http://www.phys.org.com/news/2011-10-scientists-blocks-bacteria-dna.html, accessed February 17, 2012.

7. "Data Stored in Live Neurons," *Slashdot*, June 9, 2007, http://hardware.slashdot.org/story/07/06/09/0528247/data-stored-in-live-neurons, accessed February 17, 2012.

8. "Scripps Research and Technion Scientists Develop Biological Computer to Encrypt and Decipher Images," Scripps Research Institute, February 2012, http://www.scripps.edu/news/press/2012/20120207keinan.html, accessed February 17, 2012.

9. Andrew Myers, "Microbe Computers—Built from the Stuff of Life," *Stanford Medicine Magazine*, Fall 2013, http://stanmed.stanford.edu/2013fall/article10.html, accessed November 8, 2013.

10. "Easily 'Re-programmable Cells' Could Be Key in Creation of New Life Forms," *UK Campus*, November 7, 2011, http://www.nottingham.ac.uk/news/pressreleases/2011/november/easily-re-programmable-cells-could-be-key-in-creation-of-new-life-forms.aspx, accessed February 17, 2012.

11. Steve Lohr, "I.B.M. Announces Brainy Computer Chip," *New York Times*, August 18, 2011, http://bits.blogs.nytimes.com/2011/08/18/ibm-announces-brainy-computer-chip, accessed February 17, 2012.

12. "MIT Creates Chip to Model Synapses," *Slashdot*, November 16, 2011, http://hardware.slashdot.org/story/11/11/16/0424246/mit-creates-chip-to-model-synapses, accessed February 17, 2012.

13. "Artificial Life Forms Evolve Basic Memory, Strategy," *Slashdot*, August 8, 2010, accessed February 17, 2012.

14. Bruce Sterling, "Digital Decay," in Alain Depocas, Jon Ippolito, and Caitlin Jones, eds., *Permanence through Change: The Variable Media Approach* (Montreal: Daniel Langlois Foundation; New York: Solomon R. Guggenheim Foundation, 2003), 12.

15. Ibid., 11.

16. Private conversation between Jon Ippolito and Vanessa Vobis, program manager, Public Programs at the Los Angeles Museum of Natural History, February 20, 2012. More at Rudabeh Shahbazi, "Natural History Museum to Open the North Campus

Nature Exhibit," *KABC-TV*, April 19, 2012, http://abclocal.go.com/kabc/story?section=news/local/los_angeles&id=8628888, accessed January 22, 2013.

17. Stewart Brand, email summary of Jim Richardson talk at Long Now Foundation, February 23, 2012. Sadly, Brand notes that for the last 100 years we've been throwing away this genetic reservoir by ramping up the scale and homogeneity of agribusiness: "95% is gone. In the US in 1903 there were 497 varieties of lettuce; by 1983 there were only 36 varieties. (Also changed from 1903 to 1983: sweet corn from 307 varieties to 13; peas from 408 to 25; tomatoes from 408 to 79; cabbage from 544 to 28.)"

18. Ibid.

19. Hippocrates' aphorism has held up well over the years, to judge from recent titles like Gary A. Braunbeck's *Flesh Is Fleeting . . . Art Is Forever!* (Metairie, LA: Creeping Hemlock Press, 2008). Of course, Braunbeck's book is . . . what else? A zombie thriller.

20. Sebastian Anthony, "Harvard Cracks DNA Storage, Crams 700 Terabytes of Data into a Single Gram," *Extreme Tech*, August 17, 2012, http://www.extremetech.com/extreme/134672-harvard-cracks-dna-storage-crams-700-terabytes-of-data-into-a-single-gram, accessed January 28, 2013.

21. Zoos are the obvious exception, where staff have titles like Curator of Large Reptiles. I was reminded of the linguistic parallels between the custodians of animals and those of art when as a curator at the Guggenheim I received a letter addressed to "The Keeper of Modern Art."

22. "Suzanne Briet's *What Is Documentation?*," trans. and ed. Ronald E. Day and Laurent Martinet with Hermina G. B. Anghelescu, http://ella.slis.indiana.edu/~roday/what%20is%20documentation.pdf, p. 10, accessed December 11, 2009.

23. The Blue Screen of Death is the colloquial name for a screen indicating that Microsoft Windows has crashed. http://en.wikipedia.org/wiki/Blue_screen_of_death, accessed February 20, 2012.

24. Joline Blais and Jon Ippolito, *At the Edge of Art* (London: Thames & Hudson, 2006), 229.

25. "In Church and Kosuri's case, they have successfully stored around 700 kilobytes of data in DNA—Church's latest book, in fact—and proceeded to make 70 billion copies (which they claim, jokingly, makes it the best-selling book of all time!) totaling 44 petabytes of data stored." Anthony, "Harvard Cracks DNA Storage." To be fair, Church and his coauthors acknowledged that Davis first demonstrated the scientific technique, in a refreshing example of scientists crediting an artist for a discovery. George M. Church, Yuan Gao, and Sriram Kosuri, "Next Generation Digital Storage in DNA," *Science Express*, http://www.sciencemag.org/content/337/6102/1628.abstract, accessed January 28, 2013.

26. http://numeral.com/appletsoftware/combo.html, accessed February 18, 2012.

27. Jorge Luis Borges, "The Library of Babel," in Borges, *Ficciones*, trans. Anthony Kerrigan (New York: Grove Press, 1962), 84.

28. As long as the items to be archived can be broken down into discrete building blocks, such as the twenty-odd letters and punctuation marks that make up the alphabet or the 256 pixel colors that make up an 8-bit digital image, there is a way to list all the possible combinations of these building blocks, though the list may not be finished in your lifetime (or anyone else's). Even if the number of combinations is infinite, you can devise a procedure that will eventually generate any given item in the set, as long as the fundamental variables are discrete. If, however, the variables are continuous—such as pixels that can vary across a continuous spectrum of color—then the list cannot be begun even in principle.

29. http://numeral.com/appletsoftware/eicon.html, accessed February 18, 2012.

30. Anderson implied that his demonstration proved the "infinite monkey theorem," which claims that a monkey hitting random keys would eventually type out the works of Shakespeare. As pointed out by *Slashdot* commenters, however, his code was less random than evolutionary, in that it applied a fitness function to shape the evolution of results—a technique discussed later in this chapter. Jesse Anderson, "A Few Million Monkeys Randomly Recreate Every Work of Shakespeare," *Jesse Anderson Online*, October 6, 2011, http://www.jesse-anderson.com/2011/10/a-few-million-monkeys-randomly-recreate-every-work-of-shakespeare; "A Few Million Monkeys Finish Recreating Shakespeare's Works," *Slashdot*, October 9, 2011, http://entertainment.slashdot.org/story/11/10/09/2252225/A-Few-Million-Monkeys-Finish-Recreating-Shakespeares-Works; both accessed February 17, 2012.

31. Marcel Duchamp's original *Boîte-en-valise [Box in a Suitcase]* (1935–1940) is an edition of twenty boxes containing sixty-nine reproductions of the artist's own work, often with slight variations from one box to another. Creating such reproductions in 1935 took considerable effort and expense, but today a suite of digital images can be produced at practically zero effort or cost thanks to software programs, or "bots."

32. Technically speaking, anything can be produced by a formula given enough variables; practically speaking, any complex work would take too long to produce by formula, as noted above with regard to *Every Icon*.

33. If the 3D printing economy takes off, a black market in pirated designs will surely grow up around it, prompting manufacturers to attempt to control proliferation just as the music and movie industries have. Future design buffs may be able to download and print an Aeron chair at Staples.com, but if it's got digital rights management like the self-destructing DVDs currently sold by Staples, it might crumble to dust after your 30-day trial is over. "The One-Use, Self-Destructing DVD Returns," *Slashdot*, June 4, 2008, http://news.slashdot.org/story/08/06/03/2237203/the-one-use-self-destructing-dvd-returns, accessed February 20, 2012.

34. "Artificial Life and Natural Death," discussion with Stewart Brand and Kevin Kelly, "New Media and Social Memory" conference, University of California, Berkeley, January 18, 2007.

35. John Timmer, "Synthetic Biologists Use DNA to Calculate Square Roots," *Wired*, June 3, 2011, http://www.wired.com/wiredscience/2011/06/dna-mathematics, accessed February 20, 2012.

36. "Genetic Drift," *Wikipedia*,http://en.wikipedia.org/wiki/Genetic_drift, accessed November 8, 2013.

37. http://life.ou.edu/, accessed February 18, 2012.

38. http://www.karlsims.com/evolved-virtual-creatures.html, accessed February 18, 2012.

39. "Reality Check: The Future of Software," *Wired* 3.06 (June 1995), http://www.wired.com/wired/archive/3.06/reality_check.html, accessed February 18, 2012.

40. "Excel 2010 includes a new version of the Solver add-in, which you can use to find optimal solutions in what-if analysis. Solver has an improved user interface, a new Evolutionary Solver, based on genetic algorithms, that handles models with any Excel functions." "What's New in Excel 2010," http://office.microsoft.com/en-us/excel-help/what-s-new-in-excel-2010-HA010369709.aspx, accessed January 28, 2013.

41. The term was coined by the embryologist Conrad Waddington in the 1950s. A good description for the layperson is found in Jack Cohen and Ian Stewart, *The Collapse of Chaos* (New York: Penguin, 1994), 93.

42. "Extinct Ibex Resurrected by Cloning," *Slashdot*, http://science.slashdot.org/story/09/12/28/1641208/Extinct-Ibex-Resurrected-By-Cloning, accessed June 18, 2012.

43. "Pharming (Genetics)," Wikipedia, http://en.wikipedia.org/wiki/Pharming_(genetics)#Pharming_in_mammals, accessed June 18, 2012.

44. Richard Black, "GM Plants 'Established in the Wild,'" *BBC*, August 6, 2010, http://www.bbc.co.uk/news/science-environment-10859264, accessed February 18, 2012.

45. "In the early 1900s, a shrub known as tamarisk was introduced to Utah to control river-bank erosion. Today it has taken over the habitats for native plants, overgrown acres and acres of beaches, and, with its deep root systems, is threatening the water supply of an already dry region." Rebecca J. Rosen, "Assuming We Develop the Capability, Should We Bring Back Extinct Species?," *Atlantic*, August 30, 2012, http://www.theatlantic.com/technology/archive/2012/08/assuming-we-develop-the-capability-should-we-bring-back-extinct-species/261796/, accessed January 22, 2013. Some conservation biologists have proposed to turn this problem on its head, by back-breeding an extinct species specifically to recuperate an ecosystem. They are

hoping to reintroduce *Aurochs*, the extinct ancestor of all domestic cattle, to clear closed-canopy forests to introduce biodiverse meadows—a process dubbed "re-wilding." Stewart Brand, "The Dawn of De-extinction. Are You Ready?," March 2013, http://www.ted.com/talks/stewart_brand_the_dawn_of_de_extinction_are_you_ready.html, accessed March 13, 2013. As impressive as it may sound to bioengineer an entire ecosystem, I can't shake the suspicion that these scientists would be propagating a new breed of unintended consequences along with an old breed of ox.

46. Ryan Phelan, quoted in Rosen, "Assuming We Develop the Capability, Should We Bring Back Extinct Species?"

47. "If Extinct Species Can Be Brought Back . . . Should We?," *Slashdot*, August 31, 2012, http://news.slashdot.org/story/12/08/31/029228/if-extinct-species-can-be-brought-back-should-we?, accessed January 22, 2013.

48. Raiford Guins, *Game After: A Cultural Study of Video Game Afterlife* (Cambridge: MIT Press, 2014).

49. Blais and Ippolito, *At the Edge of Art*.

50. Tom Ray, "Network Tierra FAQ," http://life.ou.edu/tierra/netfaq.html, accessed November 8, 2013.

51. Black, "GM Plants."

Chapter 12

1. Guggenheim Museum chief conservator Carol Stringari has pointed out that, in reality, even traditional artworks very over time. The conservator's challenge remains not so much how to stop inevitable change as how to guide it. "The studied and thoughtful discussion of alteration and artistic meaning is not a new phenomenon. Conservators have discussed the natural ravages of time and the consequences of conservation intervention throughout history. . . . Artworks have been constantly reinterpreted throughout history, i.e., changing an original frame, repatination or application of a surface coating, adapting a site-specific sculpture to a new space, eliminating lost elements or broken mechanical components." Carol Stringari, "Beyond 'Conservative': The Conservator's Role in Variable Media Preservation," in Alain Depocas, Jon Ippolito, and Caitlin Jones, eds., *Permanence through Change: The Variable Media Approach* (Montreal: Daniel Langlois Foundation; New York: Solomon R. Guggenheim Foundation, 2003), 57–58.

2. Pip Laurenson, head of collection care research at the Tate Gallery, has been an articulate advocate of this concern. "[When original works are recreated with new technologies] I lose something in terms of somebody going to a museum and really being able to understand how radical these pieces were *because* they were made at a certain time, and because they were made with the limits of the technology that

was available. . . . And I think that's an important part of the museum and the art historical aspect of the collections, . . . to have a sense of just what artists were doing at that at a historical point." Pip Laurenson, "Magic Bullet or Shot in the Dark: Emulation as Preservation Strategy," in "Echoes of Art: Emulation as a Preservation Strategy," Solomon R. Guggenheim Museum, May 8, 2004, archived at http://www.variablemedia.net/e/echoes/morn_text.htm#laurenson, accessed June 4, 2012.

3. Tim Druckrey argues that some artists use purposely outdated or retro technology in order to critique the capital-driven tech culture of constant upgrade. Works such as the VinylVideo "records" he cites would naturally resist preservation-through-reinterpretation; again, the artist's intent must be considered when considering any sort of preservation intervention. Timothy Druckrey, http://www.vinylvideo.com/press/03_reviews/01_print/1999-09_eikon_magazine.html, accessed June 10, 2012.

4. Curator Rudolf Frieling provides two examples of how performance artists are keeping their art form alive. Note that in neither case is video documentation conflated with preservation, despite decades of museum practice.

The debate that was generated by two performative museum shows in New York earlier this year, Marina Abramović's retrospective at MoMA and Tino Sehgal at the Guggenheim, underlined a fascinating conflict: in order to distinguish itself from the performing arts, "performance" needs to introduce a difference to the theatrical script or musical score. Sehgal thus detaches himself from the body-centered tradition of performance developing situative "interpretations," whereas Marina Abramović insists on the possibility of a remake, now called "reperformance."

Rudolf Frieling, "Between Remake and Reperformance: Emerging Narratives in Media Art," in "Still Accessible? Rethinking the Preservation of Media Art I," http://www.isea2010ruhr.org/files/redaktion/pdf/isea2010_proceedings_p13.pdf, accessed June 10, 2012.

5. Lizzie Muller is to be credited with proposing methods for capturing multiple levels of memory associated with an artwork, from public audience members to museum attendants to curators and artists. Lizzie Muller, "Toward an Oral History of New Media Art," Daniel Langlois Foundation for Art, Science, and Technology, http://www.fondation-langlois.org/pdf/e/towards-an-oral-history.pdf, accessed June 10, 2012.

Chapter 13

1. Variable Media Questionnaire, http://variablemediaquestionnaire.net/, accessed February 20, 2012.

2. The Guggenheim did this for its 2002 Internet art commissions.

3. http://www.docam.ca/, accessed February 20, 2012.

4. See *Digital Art Conservation: Practical Approaches* (Strasbourg: École supérieure des arts décoratifs de Strasbourg, 2011). The exhibition at ZKM / Center for Art and Media Karlsruhe was held from November 24 to 26, 2011.

5. http://forging-the-future.net, accessed February 20, 2012.

6. Open Archives Information Standard Reference Model, http://public.ccsds.org/publications/archive/650x0b1.pdf, accessed January 8, 2009.

7. OAIster, OCLC, http://www.oclc.org/oaister.en.html?urlm=168646, accessed November 2, 2013.

8. Open Library, http://openlibrary.org/, accessed January 10, 2012.

9. Richard Rinehart, *Nailing Down Bits: Digital Art and Intellectual Property* (Quebec: Canadian Heritage Information Network, 2006).

10. The Variable Media Questionnaire allows anyone to add their interpretations of how works should be preserved—and artists are encouraged to include works in their own collections.

11. In 2013 the Getty Research Institute released all of the thousands of digital images it owns into the public domain, making them freely downloadable at reproduction quality. James Cuno, "Open Content, an Idea Whose Time Has Come," *Getty Iris*, August 12, 2013, http://blogs.getty.edu/iris/open-content-an-idea-whose-time-has-come/, accessed November 8, 2013.

12. CCH Canadian Ltd. v. Law Society of Upper Canada, [2004] 1 S.C.R. 339, 2004 SCC 13, http://scc.lexum.org/decisia-scc-csc/scc-csc/scc-csc/en/item/2125/index.do, accessed December 1, 2011.

13. Scott Snibbe, "Art Wants to Be Ninety-Nine Cents," http://www.snibbe.com/blog/2010/05/19/art99/, accessed November 30, 2011. Snibbe's iPad apps have been downloaded by 500,000 viewers (Snibbe, private correspondence with Jon Ippolito, February 19, 2012). In 2013, artist Erik Loyer's *Strange Rain* became the top free iPhone app in entertainment in Europe and number 8 in free iPad entertainment in the United States.

14. Part of the Department of Conservation and Restoration of Cultural Heritage of the École Supérieure d'Art d'Avignon.

15. http://DigitalCuration.UMaine.edu, accessed January 29, 2013.

16. In a related analysis, Anne Collins Goodyear asked whether the analog division among museum departments—exhibition, publication, and education—still makes sense when almost all content is delivered over the web. Anne Collins Goodyear, "Putting the 'Public' Back in Publication," *Digital Humanities Week*, University of Maine, October 9, 2013, archived at http://www.youtube.com/watch?v=Mr4hIwijzSg, accessed November 8, 2013.

17. Howard Fox, "The Right to Be Wrong," in Bruce Altshuler, ed., *Collecting the New: Museums and Contemporary Art* (Princeton: Princeton University Press, 2007), 26.

18. "Inside Norway's 'Doomsday Vault'," *Fox News*, March 11, 2010, http://www.foxnews.com/scitech/2010/03/11/inside-norways-doomsday-vault, accessed February 20, 2012.

19. Through songs, dances, and adaptation, key aspects of Native American culture have somehow survived 500 years of invasion from a continent bent on genocide and armed with muskets and smallpox.

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