Trusting Amateurs with Our Future

By Jon Ippolito [v2.1]

(Forthcoming in Christiane Paul, ed., *A Companion to Digital Art* (Hoboken: Wiley Blackwell) This essay focuses on "unofficial" preservation practices and why they are sometimes more effective than professional enterprises.¹ After challenging the prevailing expectations about durability as the touchstone of long-term cultural memory, this chapter looks at the rise of preservation by so-called amateurs in writing emulators and crowdsourcing the replication of 3D artifacts. The essay concludes with the challenges of such distributed preservation to conventional notions of cultural heritage.

The Oldest Human Record

Which of these is the oldest human record?









1. Gudea Cylinders2. Dead Sea Scrolls3. Rosetta Stone4. Mapinguary

The Megatherium Lives

This is the oldest human record I have found: the story of the mapinguary, passed down from generation to generation among the Indians of the Brazilian rainforest. Twenty feet tall, as strong as a dozen gorillas, adorned with matted hair covering a bony carapace — the giant ground sloth made such an impression on the tribes of the Amazon that nearly every one has a word for this creature, which most call the mapinguary.

The native accounts are detailed enough that scientists have been able to identify their protagonist as the giant ground sloth, *Megatherium*. In fact, when a native of Peru's Machiguenga people matter-of-factly described seeing a mapinguary at the natural history museum in Lima, ethnobiologist Glenn Shepard was



able to corroborate the mapinguary's pedigree: the museum has a diorama with a model of the *Megatherium*.²



How do I know these stories are older than the pyramids or Machu Picchu? Because the diorama in Lima depicted *prehistoric* mammals. The *Megatherium* is a creature that died out tens of thousands of years ago, yet survives in the stories of Indians of the Brazilian rainforest.

The legend of the mapinguary isn't just some stone tool or potshard from which we can infer a story about an experience long past. It is the story itself. Or rather, it is the persistence of key elements in the

story, as retold over at least two thousand generations, that has kept alive accounts of human encounters with this prehistoric animal. Indigenous storytellers even "remember" features of the mapinguary that paleontologists cannot read from the bones: it had reddish fur, avoided water, and moved silently through the thick jungle. Their stories even tell us how the *Megatherium* smelled: the name mapinguary means fetid beast.

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. ³

What Are Professional Archivists To Make of This?

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 theorists such as Peggy Phelan imply that performance cannot be stored.

Perhaps not. But storage isn't the only mode of safeguarding culture, and in this age of rapid obsolescence, storage is turning out to be the least reliable of them.

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. But while books can be burned and temples destroyed, stories such as the mapinguary survived even the conquistadors' deliberate attempt to obliterate them.

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 pre-historic is not. Euro-ethnic 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.

I'm going to make a radical claim: that the future of new media lurks in the Amazon rainforest. Well, not only in the Amazon, but really anywhere that so-called "amateurs" thrive, because it is only by their paradigm of proliferative preservation that we will keep the rich technological culture of the present alive.

I've already suggested how well distributed memory works in indigenous practices. For the rest of this essay, I'll try to explain why it works equally well in digital practices, with particular attention to emulation and crowdsourcing, and the preservation paradigm known as "variable media." I will end with some of the challenges to proliferative preservation, and the reasons I am confident we can overcome them.

First, however, we need to accept the ascendance of the amateur.

The Amateurs Arrive

The rise of amateur producers has been one of the defining features of the turn of the millennium. Theorist Bernard Stiegler calls this class the *amatorat*⁵; hardware and software manufacturers call them *prosumers*; start-up founders and venture capitalists call the phenomenon

Web 2.0. The introduction to the *Eternal September* exhibition curated by Valentina Tanni argues that "every system previously used to managing and controlling cultural production is now experiencing a deep crisis, which is also causing the inevitable collapse of all the related business models. The ultimate consequence of this scenario is also the most radical one: the questioning of 'professionalism.'⁷⁶

Rather than ascribe this trend to the Internet, we can trace the dawn of the phenomenon as far back as the mid-1960s. The legend of Nam June Paik picking up the first Sony Portapak to film the pope from a taxi in 1965 may be apocryphal,⁷ but there is no doubt that artists such as Frank Gillette, Ira Schneider, and Paik were among the earliest adopters of mobile camcorders. As Tanni reminds us, art critic Gene Youngblood foretold the death of the professional in the 1982 Siggraph catalogue:

A tool is 'mature' insofar as it's easy to use, accessible to everyone, offering high quality at low cost and characterized by a pluralistic rather than singular practice, serving a multitude of values. Professionalism is an archaic model that's fading in the twilight of the Industrial Age.⁸

As of this writing, amateurs connected via social networks and mobile apps continue to disrupt professions from taxi driver to hotel owner, as evidenced by sharing economies such as Uber and AirBnB. While the jury may still be out on whether these platforms empower or enslave their unpaid contributors, academic studies⁹ bear out what we already know from millions of Wikipedia articles and Facebook posts: amateurs can be remarkably effective at filling gaps previously occupied by paid middlemen.

The Amateurs Take Control

Notwithstanding what you read in a thesaurus, *nonspecialist* is no longer a trustworthy synonym for amateur. To many, the word *amateur* may conjure up cat videos on YouTube or coffee shop reviews on Yelp; yet much of the Internet's unpaid labor force wields specialized knowledge or skill. Amateurs in the Internet age can just as easily be experts as laypersons, especially when it comes to expertise in a narrow specialty like Klingon grammar or *My Little Pony* episodes--or retro-computing forensics.¹⁰

To prove this point, Stiegler turns to amateur astronomers to represent his *amatorat*, since in recent years nonprofessionals have made notable contributions to our knowledge of the skies. NASA's "clickworkers" peruse photos of Mars to identify craters with an accuracy equal to or better than astrophysics grad students.¹¹ Armed with little more than an English degree and a backyard telescope, amateur David Levy discovered no less than nine comets--and eleven more once professionals let him play with their equipment.¹²



Image: ISEE-3

One of the most extraordinary exploits of amateur stargazing--not to mention restoring a technological artifact--involved breathing new life into a crippled spacecraft. In 1978 NASA and the European Space Agency launched the satellite ISEE-3 into an orbit around the sun, after which it became the first spacecraft to visit a comet. Although ISEE-3 once again approached the Earth in 2014, it received no hero's welcome, for NASA had abandoned the satellite in 1997 and had neither the budget nor time to recover a connection based on outdated software protocols.

That gap of budget and time led Randall Monroe, creator of the XKCD comic, to suggest that amateur astronomers might be able to reverse-engineer the signal processor on their own and reestablish contact with the errant spacecraft. As if in response to Monroe's appeal to the crowd, on May 29, 2014, a team of unofficial astrophysicists sent one of the most astonishing tweets in the world of amateur science:

@agentGav: We Are Now In Command of the ISEE-3 Spacecraft

By July 2 the team announced they had successfully fired the thrusters for the first time since 1987. Digital conservators may take heart in the example of this unofficial team of space Samaritans, who crowdfunded time on dish antennas to reach across a million miles of emptiness and reanimate a 36year-old software protocol. Suddenly saving a Flash-based work of Internet art doesn't sound so hard.

Outperforming the Professionals: Emulation

Citizen science aside, how can amateurs contribute to the preservation of human creativity?

The most obvious example is emulation, the poster child for unofficial solutions to new media problems. Defined by RAND computer scientist Jeff Rothenberg as the ability of a new computer to impersonate an older one, emulation is a preservation practice that as of this writing is far more likely to be found in a teenager's bedroom than a conservator's lab. An emulator is a computer program that "fools" original code into assuming that it is running on the hardware for which it was designed, thus enabling software from an out-of-date computer like the Atari or Gameboy to run on a contemporary one like a Macintosh, Windows, or Linux PC. To be sure, a handful of professional institutions have experimented with emulation; a case study will show why they are falling behind in the race to save digital culture.

Professional Emulators: Falling Behind

Our best efforts to preserve the rich outpouring of the last few decades known as media art are being buried underneath an avalanche of obsolete floppy disks, restrictive End User License Agreements, and antisocial archival practices.¹³ Even when aware of promising strategies such as emulation, museums and other cultural institutions are having trouble adapting to them.

Let me illustrate this by starting with one of the few triumphs of the art world's preservation efforts: the renewal of Grahame Weinbren and Roberta Friedman's *Erl King* (1983-85), one of the first examples of interactive video. Loosely based on stories by Goethe and Freud, this kiosk-based installation allows users to control the direction of a narrative by touching the screen to trigger seamless cinematic transitions. The original hardware included a 1982 Sony SMC-70 computer, three analog laserdisks, and a touchscreen; the software was a PASCAL program custom-written by the artists and their collaborators, which ran on the CP/M operating system, a precursor to DOS.

This piece was on its last legs when the Variable Media Network,¹⁴ a partnership with the Guggenheim Museum and Daniel Langlois Foundation among others, chose it as a poster child for the exhibition *Seeing Double: Emulation in Theory and Practice* (2004).¹⁵ When the original and emulated version were exhibited side by side, a survey of visitors concluded that the two were practically indistinguishable. The technique of emulation, whereby a newer computer impersonates an older one, enabled preservationists to salvage the source code and user experience of the *Erl King* while replacing its body with up-to-date guts.



Image: Erl King

The successful emulation of the *Erl King* was only possible because of a "perfect storm" consisting of talented technicians, an eager and forthcoming artist, access to the original software and hardware, and organizations willing to fund. It is hard to imagine spending two years and tens of thousands of dollars to re-create every interactive video installation from the 1980s, much less every endangered example of media art.

So our shining example of a successful emulation is shining all the brighter because it is pretty much standing alone, surrounded by less fortunate works that are all going dark.

Amateur emulators: Going strong

If we professionals are falling behind, who's keeping up? Super Mario Brothers, that's who. When it comes to preservation, the Olympians of new media art are getting their butts kicked by an Italian plumber.



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 amateurs has safeguarded the lion's share of a different genre of early computational media: video games.

Image: FCEUX emulator running Super Mario Brothers



Take, for example, the FCEUX emulator, at the time of this writing the top-ranked emulator on the prominent site Emulator Zone for the enormously popular Nintendo Entertainment System (NES). 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. 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.



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, re-converging, and constantly improving without a single institution or copyright holder at the wheel.

Learning from the Amateurs: Crowdsourcing

The amateur preservationists responsible for the FCE emulator stream aren't laboring away in some government-funded think tank or corporate software lab. They are banging out code in an Internet café, or in a university computer club, or in their underwear in the basement of their mother's house. But some clever organizations have realized that in proliferative preservation, the benefits of crowdsourcing can easily offset any range of quality of amateur contributions.

Photosynth (2008),¹⁶ a project by Microsoft and the University of Washington, attaches the hundreds of amateur photographs tagged "Notre Dame" from the photo-sharing site Flickr to a preexisting CAD model of Paris' Notre Dame cathedral, which otherwise would show just the geometry, without any visual texture. 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 virtually any range of detail, from distant views of its skyline to detailed closeups of its façade.



Image: Photosynth applied to Notre Dame

Photosynth video: http://www.ted.com/talks/blaise_aguera_y_arcas_demos_photosynth.html

Rather than map crowdsourced images onto a shape, some applications perform the reverse reconstruction by deriving a shape from crowdsourced images of its surface. Like the replicators featured in *Star Trek*, 123D Catch (2009)¹⁷ 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 (the solid gold *Mask of Agamemnon*, 1500 B.C.) or of degradation (artist Matthew Barney's vaseline *DRILL TEAM* dumbbells, 1991). As hybrid examples of proliferative preservation, these applications employ software written by experts to collocate images taken by lay photographers.



Image: 123D Catch capturing a historical artifact.

123D Catch (formerly Photofly) tutorials (scroll down): http://www.123dapp.com/catch Some forward-thinking museums have already begun to incorporate this kind of curatorial crowdsourcing. 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.¹⁸ While the invited public could scan any sculpture that interested them, the curators selected five they believed to be of especially historical interest. All of the digital files from this "scanathon" were freely available for anyone to download and print on the online 3-D object repository Thingiverse.

The Brooklyn Museum has gone further, and enabled lay visitors to "curate" the collection themselves. Their 2008 exhibition *Click!* invited the public to submit photographs, which were evaluated by an online audience and finally displayed on the museum walls. The Brooklyn curators have been even more promiscuous with their collection data, creating an API that gives third parties the ability to curate their collection without permission. They have even allowed visitors to add metadata to collection records, so that the son of a Yoruba carver was able to discover his father's sculpture online and identify the maker's name, clan, and date of death. ¹⁹

Challenges of Proliferative Preservation

Of course there are downsides to trusting amateur preservationists to do the job of professionals. I am going to focus on three concerns here: the loss of artistic integrity, the loss of

material context, and the clash of amateur and professional cultures.

1. Loss of Artistic Integrity

version.

Image: Picasso's Trois Femmes

The most common complaint is the loss of artistic integrity through deviation from a work's original intent. Here are three examples:

- Art investors tried to cut up Picasso's *Trois Femmes* (1959) into one-inch squares to sell as "original Picassos."²⁰
- Ted Turner tried to make older movies more palatable to contemporary audiences by colorizing them or editing smoking scenes out of classic cartoons.²¹
- George Lucas added updated special effects to the first three Star Wars movies of the 1970s, so they would stand up technically alongside the prequels from the 2000s, as well as 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 hardcore *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." These examples are all pretty clearly deviations from the spirit of the original, even when perpetrated by the original creator (as in the case of George Lucas). That said, there is only a problem if we assume the "either/or" logic of analog media: either you have the original Picasso or you have a bunch of fragments in its place; either television shows the black-and-white *Asphalt Jungle* or the colorized





Image: Marilyn Monroe (colorized) Image: Marilyn Monroe in *Asphalt Jungle* (original)

Either/Or versus Both/And

But digital artifacts operate not by a logic of *either/or* but one of *both/and*. 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 Athen's smoggy skies might move it to the British Museum, but this has the unfortunate side effect of leaving a gaping hole in the Parthenon. Migrating an audio file from WAV



to MP3 or Ogg Vorbis, by contrast, does not require removing the original file.



Removing analog artifacts can hurt the artifacts as well as the context. In the 1600s, Venetians keen on "rescuing" the chariot horses of Athena and Poseidon from the Turk-controlled Parthenon succeeded only in shattering them when the pulleys slipped. In the 1800s, Lord Elgin's ship carrying his first shipment of marbles sank off the island of Cythera.

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. The original lingers, but is joined in the same space by other renditions.

Take the case of museum artifacts 3d-printed by museumgoers who have photographed them. The same company that makes 123D Catch, Autodesk, also makes MeshMixer, software that makes it easy to tweak, warp, and otherwise remix 3D designs. One of the participants in the Asian Art Scanathon used MeshMixer to create an iPhone case based on a stone relief of *Kumbhakarna battling the monkeys*, and contemplated building an Arduino-powered LED lamp from his 3D model of an 13thcentury *Seated Ganesha* sculpture. Phone cases and lamps hardly sound like the ideal vehicles for preserving Ramayana stone reliefs or elephant deities, but such proliferative preservation has been the norm rather than the exception for the tens of thousands of years that indigenous peoples kept culture alive through refashioning and retelling.²²

In a recent example of 3D scanning as preservation, anthropologists at the Smithsonian were in talks with an Alaskan tribal leader who needed to pass on the ritual duties associated with an orcashaped hat that had ended up in their collection. Unfortunately the leader's health was failing too quickly to wait for the full repatriation process. So the museum arranged for a 3D replica of the killer-whale hat to be scanned from the original. The stand-in was milled, repainted by an artist, and sent to the tribe to be used in the ceremony. Since then, elders have brought in other hats to be scanned, and have danced with originals and duplicates in the same ceremony. The Smithsonian reports hearing from some native communities that would prefer to use the replica and keep the original in a museum. ²³ [Note: the link from the footnote has some images of the hats, in case we wanted to use them.]

In fact, most digital artists inadvertently generate multiple versions of their works in the very act of creating them, simply because that is how new media work. 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.²⁴ Indeed, one of the main complaints that

Star Wars fans have with George Lucas is his attempt to squelch access to the original versions of the movies — a completely artificial erasure of history that isn't necessary given the both/and logic of digital video.

How then do preservationists accommodate the sometimes conflicting desires of creators and their audience? The opinions of artists as to how their work should be preserved form the kernel of the Variable Media Questionnaire,²⁵ a project begun at the Guggenheim in 1998 and currently maintained by the Forging the Future alliance, which tracks opinions about how artworks may change in the future when their current media expire. The Questionnaire asks creators to choose the most appropriate strategy for dealing with the inevitable slippage that results from translating to new mediums: storage (mothballing a PC), emulation (playing Pong on your laptop), migration (putting Super-8 on DVD), or reinterpretation (Hamlet in a chat room). It is not sociological survey, but an instrument for documenting the opinions of creators and others associated with a work as to how that work should be categorized, seen, and (if at all) re-created in the future. It is meant to be applied in a case-by-case fashion, one work at a time. This reflects a confidence that the ingenuity of artifact makers may supersede the ability of "media experts" to come up with a one-size-fits-all technical fix.

While the artist's own opinion formed the core of the first version of this questionnaire, 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. This is essential for preserving the aging work of dead artists such as Eva Hesse; rather than choosing either storage, recommended by her Estate, or emulation, favored by fellow artist Sol LeWitt, the Questionnaire offers both opinions and lets the future decide which is most appropriate.

Even living artists can benefit from crowdsourcing opinions about their work for future preservation. The project *Botaniq* (2011)²⁶ by media artist Gabriel Vanegas offers "diaries of an observer and interactor....to be able to look at the work of art more than in its materiality, as an artefact that narrates stories of a cultural moment, an unique journey, particular and unrepeatable." Botaniq appears to aim for a pre-taxonomic form of documentation:

The conquerors of America faced a similar problematics on having seen the impossibility of showing to Europe the new beautiful species that they were discovering since the trip by ship was very long, bringing only dissected bodies, without movement, smell, color or flavor. That is why the notations and the diaries of the members of the expeditions went from being just a documentation or a copy to become the reality itself.²⁷

Of course, natural history textbooks are fond to point out the cultural biases exhibited by eyewitness "botanists," as in Hendrick Goltzius's 1598 drawing of a beached whale sporting an ear where its pectoral fin should be. What they seldom point out is that some witnesses accounts, such as Jan Saenredam's 1602 engraving of an anatomically correct whale, are better than others.²⁸ For her oral history of *The Giver of Names*, Lizzie Muller and collaborator Caitlin Jones interviewed artist David Rokeby but also random audience participants and museum attendants, whose reactions portray a

side of the work that even the artist didn't anticipate.²⁹ With enough eyeballs, an accurate portrayal of the new species may emerge.

2. Loss of Material Context



Image: Marjetica Potrc, Caracas favela



Marjetica Potrc, Kagiso (Skeleton House), South Africa

Another common criticism leveled at emulation, migration, and other "variable media" preservation strategies is their detachment of a work from its original hardware; this detachment is all the more likely once you let amateurs in on the job of reinterpreting works in new media.

It is true that certain works, such as Nam June Paik's *TV Crown* (1965) or Cory Arcangel's *Hogan's Alley* (2002), resist translation into new mediums 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.

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 employs a new projector every time it travels to a new museum. The bricks purchased for a favela installed by Marjetica Potrc are different for a New York installation than for one in Johannesburg. Mark Morris' *Nutcracker* looks completely different from Mikhail Baryshnikov's, which looks different from George Balanchine's. A Java applet by John F. Simon, Jr. 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.

With this multiplicity in mind, the variable media paradigm starts not from an assumption 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.

3. The Clash of Cultures

The third concern sometimes raised about proliferative preservation is not about the work being preserved but about the folks doing the preserving. It's all very well to recognize that game fanatics have built an incredible stockpile of emulators to preserve their favorite passtime, but how do the diversions of a dispersed fanbase translate into preservation tactics that can be used immediately by professionals in libraries and conservation labs? Few of the genres collected by museums and archives command the rabid obsession that gamers devote to Mario or Minecraft. Museum conservators study resins and spectrometry, not ROMs and savefiles. And whereas the vast majority of games were designed for widespread commercial platforms from the Atari to the Xbox, many new media artworks are unorthodox assemblages of custom code, network connections, environmental inputs and outputs, and other nonstandard elements.

Fortunately, those new media works that don't depend on hardware idiosyncrasies can avail themselves of "emulation as a service," a model that emerged in the early twenty-teens. Initiatives such as bwFLA³⁰, JSMESS³¹, and the Olive project³² offer screen-based works a new browser-based habitat that's easily accessible and in same cases doesn't require specialized software to install. Even if most emulators to date have been developed by game-loving geeks, the collateral benefit of chip-level emulation means that they inadvertantly emulate non-gaming software as well. Visit the JSMESS emulation portal and you can run primordial accounting software for a Texas Instruments home computer alongside *E.T. the Extra-terrestrial* for the Atari game console; the JavaScript is agnostic as to whether the application is productive or frivolous. For its part, the bwFLA website lists use cases that include reproducing scientific experiments, accessing historic digital documents, re-enacting business processes to understand past decisions, and enabling "crowd curation."³³ If these easy-to-access environments prevail, digital art may enjoy an afterlife in the cloud.

What about works created for esoteric platforms that aren't available via emulation as a service? Even if museums and archives may not have the technical chops to build emulators themselves, they can band together to choose an extinct but historically important platform that would benefit various constituencies and then fund the development of an emulator for that platform. As one example, artists Char Davies, Golan Levin, and Karl Sims made important work that depended on hardware by the now-defunct company Silicon Graphics, so writing an emulator for those machines could rescue an entire class of endangered art. Or museums could help influence the development of an emulator to improve access to an entire collection. After collaborating on the bwFLA emulation

service, artist Dragan Espenschied took the post of digital conservator at the new media art platform Rhizome. He has since worked to integrate bwFLA directly into Rhizome's collection of software art, so that viewing and interacting with an obsolete work might be as easy playing a YouTube video.

Of course, few archives have a digital conservator on staff as of this writing, and not many conservators are as intimate as Espenschied with what's lurking beneath the hood of an emulation platform. So instead of trying to build a collaborator and emulator themselves, museums can crowdsource the problem by putting out calls for help from communities who get excited by working with art and creative culture. It isn't enough to start a random Kickstarter campaign, however. You need to research and build bridges to the communities you're targeting. Michael Dille, a member of the CMU Computer Club who helped resurrect the lost Andy Warhol Amiga artworks from the 1980s, says it's not enough for museums to ask for help on a blog read only by a close-knit community. Rather, an institution in need might seek out niche clubs online or in academia likely to have the requisite enthusiasm and free time, or announce a "fun little contest" with a small monetary bounty and the promise of some fame to resurrect their obscure artifact.³⁴

These communities are already out there, waiting for an enterprising museum to collaborate with them. Calling itself "an active archive of computer art," the ReCode project invites volunteer programmers to reverse-engineer the images illustrated in the magazine *Computer Graphics and Art* published from 1976-78, releasing them as Processing sketches released under the open MIT license.³⁵ The digital artists of Re-programmed Art, meanwhile, re-create with Arduinos and other contemporary technologies the sculptures and installations of Gruppo T, an Italian collective of artists that pioneered an algorithmic approach to artmaking in the 1960s.³⁶

Beyond emulation, collecting institutions should also recognize other preservation problems they share with the gaming community, with an eye toward teaming up or repurposing each other's solutions. How, for example, can preservators re-create the full participatory experience of a work whose content came, and presumably should continue to come, from its audience? As soon as artists got their hands on HTML in the mid-1990s, they began making projects that open the door for other users to participate. Alexei Shulgin invited his fellow netizens to contribute screenshots of their desktops. Martin Wattenberg invited gallerygoers to sit at a kiosk and build apartments out of words. Mark Napier created a *Digital Landfill* as a repository for other people's cast-aside emails, images, and other unwanted bits.

While the gaming community hasn't solved the problem of archiving user-generated content, it suffers even more keenly from the problem. Second Life contains thousands of custom dwellings created by its users; Minecraft contains millions. Were a game conservator merely to archive and replay the source code for one of these games – either on the original hardware or running under emulation – it would do nothing to preserve the rich history of virtual architecture, costumes, and props invented by its former inhabitants.

Another example of a common preservation conundrum is how to represent the timeline of a work that has been remixed. Art in the Internet age has a tendency to mutate as it propagates through and beyond its intended community. Sometimes this is intentional, as when Olia Lialina invited other artists to transform her most famous work and added their remixes to her *Last Real Net Art Museum*. Other times the metamorphosis is unauthorized, as when a photograph of a Sandinista hurling a Molotov cocktail inspired a painting by Joy Garnett, which triggered a copyright suit filed by the original photographer, which in turn inspired hundreds of additional derivative images produced by Internet artists in protest. We might think of these third-party variations on an original work the way game modders think about the scores of third-party mods for a popular game like *Civilization*. While of questionable authenticity in the traditional sense that they are not part of the original work's scope, mods like these are part of the social history of the work and in some cases become more important than the work itself.

While no one has yet found a silver bullet to archive the networks of remix culture in their full complexity, the gaming world has online forums like the Civilization Fanatics Center that nourish modding culture,³⁷ while some museum curators have explored version-tracking systems like CC-Mixter or The Pool.³⁸ Leaders from both domains should be comparing notes. A rare example of this is the consortium project Preserving Virtual Worlds, in which librarians from Stanford rubbed shoulders with computer scientists from Urbana-Champlaign to interview influential game designers and imagine how to keep the most important videogames and online environments from disappearing from history without a trace. The lessons learned from these game studies will benefit any parallel efforts to rescue other creative genres dependent on interactivity, participatory content, and remix.

Conclusion

I hope I have shown that some of the bugaboos of proliferative preservation seem a lot less scary once you realize that digital media are inherently multiple and variable. One bugaboo that won't be going away any time soon is the fact that proliferative preservation loosens the control of culture's traditional custodians over the future of the culture they are supposed to preserve.

Yet, as threatening as these amateurs may seem, the cultural elite would do well to find a way to live symbiotically with them, because the ingenuity they bring to the job of cultural perseverance can inject a much-needed vitality into the professional archive and its dusty shelves. As 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 21st century may never know the remarkable art created for the Sony SMC-70 or Silicon Graphics Onyx, but the future of the mapinguary and Mario is all but assured.

If the custodians of culture want to add artists such as Grahame Weinbren and Char Davies to that future, they will need to fund more than conservation labs and climate-controlled vaults. Artists' studios, online forums, 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 less of their budgets to renting storage space and more to funding the process of creating, and re-creating, art.

⁸ Eternal September curatorial statement.

¹ This essay expands on ideas developed in my chapter "Unreliable Archivists" from the book Re-Collection: Art, New Media, and Social Memory (Cambridge: MIT Press, 2014), co-written with Richard Rinehart. An earlier version of this essay was given as a keynote for The Fifth National Symposium of the Brazilian Association of Cyberculture Researchers, Universidade Federal de Santa Catarina, Brazil, November 16 2011. The author wishes to thank Yara Guasque, Jason Scott, Dragan Espenschied, and Christiane Paul for their help in shaping this essay.

² 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, accessed February 9, 2012.

³ "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.

⁴ Peggy Phelan writes that "performance cannot be saved, recorded, documented, or otherwise participate in the circulation of representations of representation." Quoted in Diana Taylor, The Archive and the Repertoire: Performing Cultural Memory in the Americas (Durham: Duke University Press, 2003), 5.

⁵ Bernard Stiegler, "Le temps de l'amatorat," *Alliage*, no. 69 (Octobre 2011), 17 July 2012. I'm indebted to Roger Malina for pointing this article to me.http://revel.unice.fr/alliage/index.html?id=3272, accessed October 3, 2014.

⁶ Eternal September: The rise of amateur culture, curated by Valentina Tanni, Škuc Gallery, Ljubljana, 2-26 September 2014. Curatorial statement at http://www.aksioma.org/eternal.september, accessed October 3, 2014.

⁷ Tom Sherman, "The Premature Birth of Video Art," *iDC* email list, January 8, 2007.

https://mailman.thing.net/pipermail/idc/2007-January/000949.html, accessed October 3, 2014.

⁹ See for example Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2007).

¹⁰ Through his involvement with the Carnegie Mellon Computer Club, Michael Dille was instrumental in recovering Andy Warhol's digital art for the obsolete Amiga platform; he jokes that a reporter who wanted to talk to the "kids" who reconstructed the Warhols never addressed him "Dr. Dille" despite his graduate-level experience with digital forensics. Private correspondence with the author, May 13, 2014.

¹¹ Benkler, 69.

¹² See the About section of David Levy's home page, http://www.jarnac.org/aboutdavid.htm, accessed October 3, 2014.

¹³ For a lugubrious litany of the obstacles facing today's preservators, see the "Death by Technology," "Death by Institution," and "Death by Law" chapters of Richard Rinehand and Jon Ippolito, *Re-collection: Art, New Media, and Social Memory* (Cambridge: MIT Press, 2014).

¹⁴ http://variablemedia.net, accessed August 10, 2014.

¹⁵ "Seeing Double: Emulation in Theory and Practice," Solomon R. Guggenheim Museum, New York, March 18–May 16, 2004. http://variablemedia.net/e/seeingdouble, accessed August 10, 2014.

¹⁶ http://photosynth.net/, accessed August 10, 2014. For an excellent overview, see Blaise Aguera y Arcas, "How PhotoSynth can connect the world's images," TED2007, March 2007.

http://www.ted.com/talks/blaise_aguera_y_arcas_demos_photosynth, accessed August 10, 2014.

¹⁷ http://www.123dapp.com/, accessed August 10, 2014.

¹⁸ Nathan Hurst, "3D-Print Your Own Ancient Art at Museum Scanathon," Wired (San Francisco), October 2, 2012, http://www.wired.com/2012/10/scanathon/, accessed November 1, 2013.

¹⁹ The crowdsourced information about provenance was visible at the following URL on May 18, 2012, but it has since been moved: http://www.brooklynmuseum.org/opencollection/objects/147096/Figure_of_a_Clergyman/right-tab/talk/.

- ²⁰ 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* 24:213 (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 2 November 2013.
- ²¹ For more on the controversy over Ted Turner colorizing movies, see Glenn Collins, "Tribute for a Dauntless Bette Davis. Yes," *The New York* Times, April 20, 1989. http://www.nytimes.com/1989/04/20/movies/tribute-for-a-dauntless-bettedavis-yes.html, accessed August 13, 2014.
- ²² See for example the discussion of the production of Malanggan cloth in Papua New Guinea in Joline Blais, "Indigenous Domain: Pilgrims, Permaculture, and Perl," *ThoughtMesh*, http://thoughtmesh.net/publish/6.php, accessed October 3, 2014.
- 23 Gunther Waibel, presentation at Digital Curation Summit, Washington, DC, January 8, 2013, organized by Johns Hopkins University, University of Arizona, and Simmons College. See also Anthropolog: The Newsletter of The Department of Anthropology National Museum of Natural History, Spring 2012. http://anthropology.si.edu/outreach/anthropolog/Springanthropologa.pdf, accessed August 10, 2014.
- ²⁴ 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).
- ²⁵ http://variablemediaquestionnaire.net, accessed August 10, 2014.
- ²⁶ http://botaniq.org/, accessed August 10, 2014.
- ²⁷ http://botaniq.org/2010/09/17/theory-of-botaniq/, accessed August 10, 2014.
- ²⁸ Victoria Sears Goldman, "Omen and oracle: Dutch images of beached whales."

http://www.victoriasearsgoldman.com/16th-17th-century-dutch-images-beached-whales, accessed August 10, 2014. ²⁹ Lizzie Muller, 'Towards an oral history of new media art," Daniel Langlois Foundation for Art, Science, and Technology,

- 2008. http://www.fondation-langlois.org/html/e/page.php?NumPage=2101, accessed August 10, 2014.
- ³⁰ "bwFLA—Emulation as a Service," http://bw-fla.uni-freiburg.de, accessed October 3, 2014
- ³¹ "JSMESS—The JavaScript MESS," http://jsmess.textfiles.com, accessed October 3, 2014.
- ³² "Olive Executable Archive," https://olivearchive.org, accessed October 3, 2014.
- ³³ "bwFLA—Emulation as a Service."
- ³⁴ Private correspondence with the author, May 13, 1014.
- ³⁵ http://recodeproject.com, accessed October 4, 2014.
- ³⁶ http://www.reprogrammed-art.cc, accessed October 4, 2014.

³⁷ See John Bell's discussion in John Bell and Jon Ippolito, "Diffused Museums: Networked, Augmented, and Self-

Organized Collections," Michelle Henning, ed., *The International Handbooks of Museum Studies* (Malden, MA: Wiley-Blackwell, forthcoming).

³⁸ For a general description of this dynamic, see "The Open Museum" chapter in *Re-collection: Art, New Media, and Social Memory* (Cambridge: MIT Press, 2014).