

Archiving a Website for Ten Thousand Years

After shutting down, an online community plans to preserve its data on a micro-etched metal plate.



The Rosetta Disk, an archive of human languages micro-etched in nickel

Spencer Lowell / The Long Now Foundation / Rosetta Project

GLENN FLEISHMAN

MAY 12, 2016 | TECHNOLOGY

TEXT SIZE



In May 1940, Thornwell Jacobs, the president of Oglethorpe University in Atlanta, dedicated a 2,000-square-foot [Crypt of Civilization](#) intended to be sealed until May 28, 8113 C.E. He picked that date as the marker of a duration into the future equal to that which had passed since the oldest surviving recorded history, some 6,200 years prior. The crypt contained about 640,000 pages of text reproduced on microfilm. It also housed technological artifacts and bric-a-brac, along with a

windmill-powered generator to play back audio and film recordings.

[Hi.co](#), a website that allows its users to post “moments” with a photo and annotation, plans a similar trip to the distant future. The operators, Craig Mod ([who has also previously written for *The Atlantic*](#)) and Chris Palmieri, [announced today](#) that the site will freeze service in September 2016. However, all posts present in the site’s database at that time will be microprinted onto a two-by-two-inch nickel plate. The entire site—2,000,000 words and 14,000 photos—should fit on a single disk. Several copies will be made and distributed across the globe; the Library of Congress has already been secured as a repository. The plates have a lifespan as long as 10,000 years, and they may be viewed with a 1,000-power optical microscope.

Hi also will be archived in more ordinary ways. Mod says he and his partner plan to sell the domain, in part to cover the estimated \$30,000 cost of making the nickel plates. They will maintain a copy of the site, and a rights arrangement has been made with the Internet Archive for permanent archiving. These measures already go well beyond the efforts much larger and more popular online services have undertaken after shuttering.

But [digital work fades](#). “If you say, ‘We’re going to keep this URL for at least twenty years,’ the amount of consistent energy that has to be put into the system to keep it sustained is very high,” Mod says. So many dependencies exist to keep domain names active, servers running, and back-end technology up to date. Thus the idea of using nickel plates, which have a couple of decades of history—a blink of the eye by some measures, long by others—for epochal archiving.

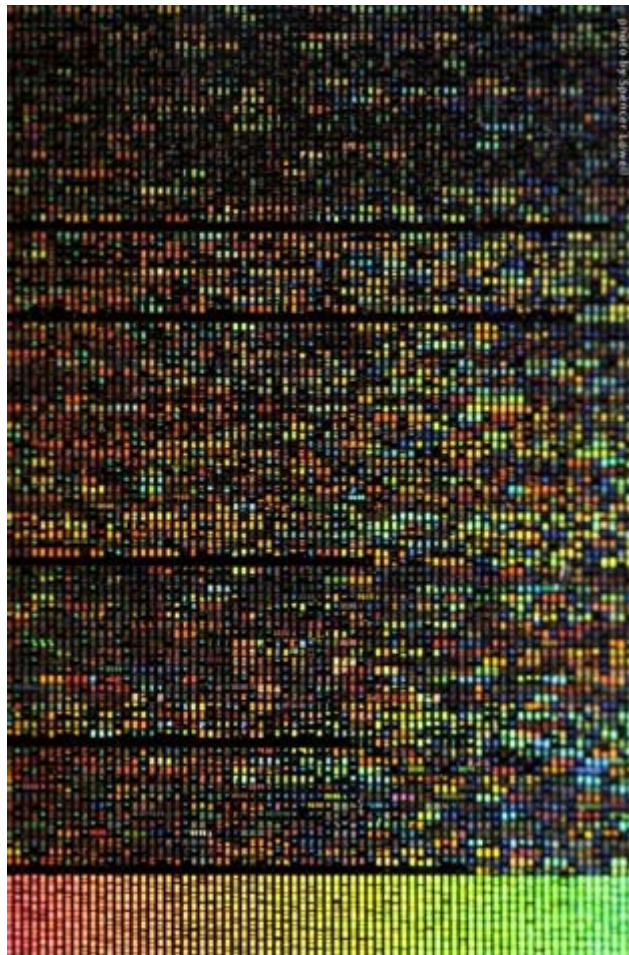
Mod says he’s been quietly consulting Hi users who have made the largest contributions to discuss the near-term and long-term future of the site. The response has been positive, as people tell Mod about the friendships they’ve formed through the site. Those who would prefer not to accompany Hi into the distant future can delete their account, a feature available since the beginning.

It is not the first attempt to find a reliable and ultra-compact way to pass

information into an unknown future. It's been about 80 years since microfilm became a practical tool for preserving records and since [time capsules](#) started to become a fad. Rather, Hi's efforts reveal how affordable and trivial it has become to shoot information into the far future—far easier, in fact, than keeping it available in the present.

* * *

A time capsule is bottled optimism. It makes material the belief that human beings will survive long enough to retrieve and decode artifacts of the distant past. In 1938, during the planning stages of the Crypt of Civilization, Jacobs dedicated the vault's massive steel door. His [remarks](#) exhibited an expansive vision: “Today we can place articles in the crypt and nothing can keep them from being readable a million years from now.”



A close-up of the Rosetta Disk (Spencer Lowell / The Long Now Foundation / Rosetta Project)

By 1940, Jacobs's tone had changed, stifled by the rise of fascism and America's entry into a global war. At the ceremony to seal the vault, he made a very different statement: "The world is now engaged in burying our civilization forever, and here in this crypt we leave it to you." His speech was recorded and placed in the vault before it was sealed.

The Oglethorpe crypt was built during the heyday of time capsules, probably driven by the fear, shared by Jacobs, that humanity was on the verge of extinction, and by the desire to preserve something—a seed that would bloom after winter had passed. And yet, many time capsules intended to last millennia are already considered lost, because the care with which they were hidden in building foundations and other locations wasn't paired with a plan to perpetuate that information even a few decades into the future. (Oglethorpe University's remains intact and well-documented, so far.)

Ten thousand standard letter-sized sheets of text or more could fit onto a 2.2-inch diameter nickel plate.

For example, the Pulitzer (later World) Building, erected in New York in 1889, had a copper box placed inside masonry at the laying of the cornerstone. Despite an avid interest in recovering it during its demolition in 1955 and 1956, the *New Yorker* [reported](#) that it took 16 months before it was found. It's now in the [ostensibly permanent collection](#) of the Columbia University Libraries.

In 1999, the *New York Times* set out to create a new kind of time capsule, trying to learn from past errors. The *Times*' editors [met with futurists and tech gurus](#), who scoffed at the newspaper's notion that the time capsule would contain digitally-encoded information. Instead, it would be better to preserve the thing itself, such that its information that could be interpreted directly by a human in the distant future.

Fortunately, a perfect technology already existed. A process licensed from Los Alamos National Laboratory (LANL) had been adapted by a New Mexico company

to render text at orders of magnitude smaller than that possible with microphotography. Ten thousand standard letter-sized sheets of text or more could fit onto a 2.2-inch diameter nickel plate. The “*Times capsule*,” a two-ton, stainless-steel above-ground sculpture, contains such plates, as part of 50 cubic feet of miscellaneous artifacts.

* * *

Hi’s Mod is well aware that it might seem excessive to build a 10,000-year archive for an arbitrary collection of user-contributed images and posts. But the impetus to do so was already engrained in the site’s mission. The name “Hi” derives from a previous publication Mod, Palmieri, and others ran called Hitotoki, which Mod translates loosely from Japanese as “one moment.” Both projects aimed to capture and preserve ephemerality, and Mod tells me that they felt they had made “an implicit moral contract” to keep it going in perpetuity, or else “to give the content that was created the most respectful archive that you can find for it.”

The very banalities that may wind up in the final archive—especially through late additions by people who hear of the impending freeze—are part of what he cherishes, along with the egalitarianism of that inclusion. It’s a bit like some space missions that incorporate messages or signatures from ordinary people. “Anyone in the world who has a smartphone can be part of the archive,” Mod says.

Even so, making an archive that spans ten millennia wasn’t Mod and Palmieri’s first idea when they realized the site would have to be shuttered. Mod, a book designer and publisher among his many trades, originally planned to produce print-on-demand volumes. He estimated it would take about 50 volumes of 400 pages each. The cost would be manageable, but the weight, storage, and transportation onerous.

Mod also figured that the lifespan of printed books isn’t that long, and “the amount of space required to house it is a burden,” even if they found curators. The books might only last a couple hundred years before degrading or, perhaps worse, being tossed out.

After a conversation with Kevin Kelly, a founder of *Wired* magazine and a board member of the Long Now Foundation, Mod shifted his focus. He connected with John Bishop at Norsam, a company that uses focused ion beam (FIB) technology to sharpen diamond probes, inscribe materials, and microprint onto nickel. Long Now's Rosetta Project worked with Norsam to create the first iteration of the [Rosetta Disk](#), a three-inch diameter plate with 13,000 pages of text describing 1,500 languages.

Hi's efforts reveal how affordable and trivial it has become to shoot information into the far future—far easier, in fact, than keeping it available in the present.

LANL came up with the technique Norsam licenses as a way to preserve data “in case there was some kind of above-ground nuclear blast that eliminated digital files.” In Norsam's version of the technique, the FIB shoots gallium ions at a silicon substrate coated in a material (a “resist”) that can be removed in a chemical bath; a similar process is used in mass producing computer chips. The gallium ions create exceedingly fine detail—the beam size is 7 nanometers—which are removed when the resist is put in a developing bath.

The next stage uses electroforming, to create a “father” disk made of nickel from the master. The master is “sacrificed” in this process, and father is left with raised nickel deposits roughly 100 nanometers high. The father, in turn, creates “mothers,” which are reverse image recessed duplicates. Those can be the final product, but because for large runs that would prematurely degrade the father, each mother can be used to produce multiple “sons” as the end result. Bishop says his fee works out to roughly a dollar a page, plus \$1,000 for a father plate, and \$500 for a mother.

This technique isn't ideal for reproducing photography, however. Bishop says he has about 4,000 pixels square to render the equivalent of an 8.5-by-11-inch source image, which is roughly 300 dots per inch, regardless of miniaturization. Grayscale

and color tonal values have to be converted to relatively coarse dithering or halftones. That's similar to the quality of photographic reproduction in newspapers a few decades ago or in early laser-printer output. (A much slower, and thus more expensive, process can render the equivalent of tones.)

Electroformed nickel is known to be highly resilient. In 1999, Bishop [commissioned LANL](#) to give an estimate of how long his technique would remain legible under adverse conditions, such as in a fire or immersed in salt water. The lab couldn't put a precise point on it, but even in extreme cases, the plates should survive hundreds of years. In the best? Bishop suggests a range of 2,000 to 10,000 years.

Concerns more ordinary than longevity do arise, however. Laura Welcher, the head of the [Rosetta Project](#) at the Long Now Foundation, says nickel is very easily scratched, and when left out in the open, the plates get grungy. Nickel can also cause a contact skin reaction in some people, among them Dr. Welcher. To combat these risks, the foundation created a holder for the dozen nickel plates it printed: a presentation globe with one hemisphere of glass, with a small magnification effect, and the other of stainless steel. Dr. Welcher is working with the Lawrence Berkeley National Lab to find a more straightforward way to protect the nickel. One strategy under consideration is to coat it with a layer of titanium so thin that it's transparent. It would be "a tough outer layer to prevent scratches; it would still get dirty, but you could clean it," she explains.

* * *

If the past is any lesson, any information we want those in the future to find needs to be distributed broadly. It should be documented, public, and obvious. This contradicts the intent of early time capsules, but we can see how well their strategy of obfuscation has panned out.

The *New York Times*, following the advice of its experts, commissioned a sculpture by Santiago Calatrava that contains its artifacts, including the nickel plates, and arranged for the American Museum of Natural History in Manhattan to display it

prominently at a building entry, where it remains so far. A hyperlink from the *Times* site to the museum died, however.

Researchers continue to push to find ways to better disseminate information and make it denser. Many efforts have [inserted data into DNA](#), an absurdly dense and redundant medium. And in February of this year, researchers at the University of Southampton said they had encoded “[five dimensional](#)” information into a form of glass that could survive billions of years.

Dr. Welcher has more modest goals. She says of the first Rosetta Disk, “We were never able to achieve that LOCKSS [‘lots of copies keeps stuff safe’] version” due to cost and size. She’s working on a next-generation disk with a firm co-founded by a former Norsam employee. The new version will include just 1,000 pages, but it will fit on a smaller, two centimeter disk and cost much less to make.

She intends to make a wearable keepsake, affordable as a not-excessive gift that doubles as additional dissemination of the archive—and a reminder of the thin slice of time through which we all pass. Perhaps, sealed in amber, it might be found millions of years hence, when all that exists now is otherwise not even a distant memory.

As for Mod, he hopes he can spread the Hi archive relatively widely, although costs and interest by repositories are a constraint. He also recognizes that there’s a potential futility to the long-term archive. “We’re making a thing that will probably never be looked at. We could print a whole bunch of nothing and nobody would know,” he concedes. But in the face of otherwise assured relatively short-term disappearance, Mod would rather keep a small torch lit than accept the darkness.

ABOUT THE AUTHOR

GLENN FLEISHMAN is a writer based in Seattle. His work has appeared in the *Economist*, *Fast Company*, and *Macworld*.
