Extract and Preserve: Underground Repositories for a Posthuman Future?

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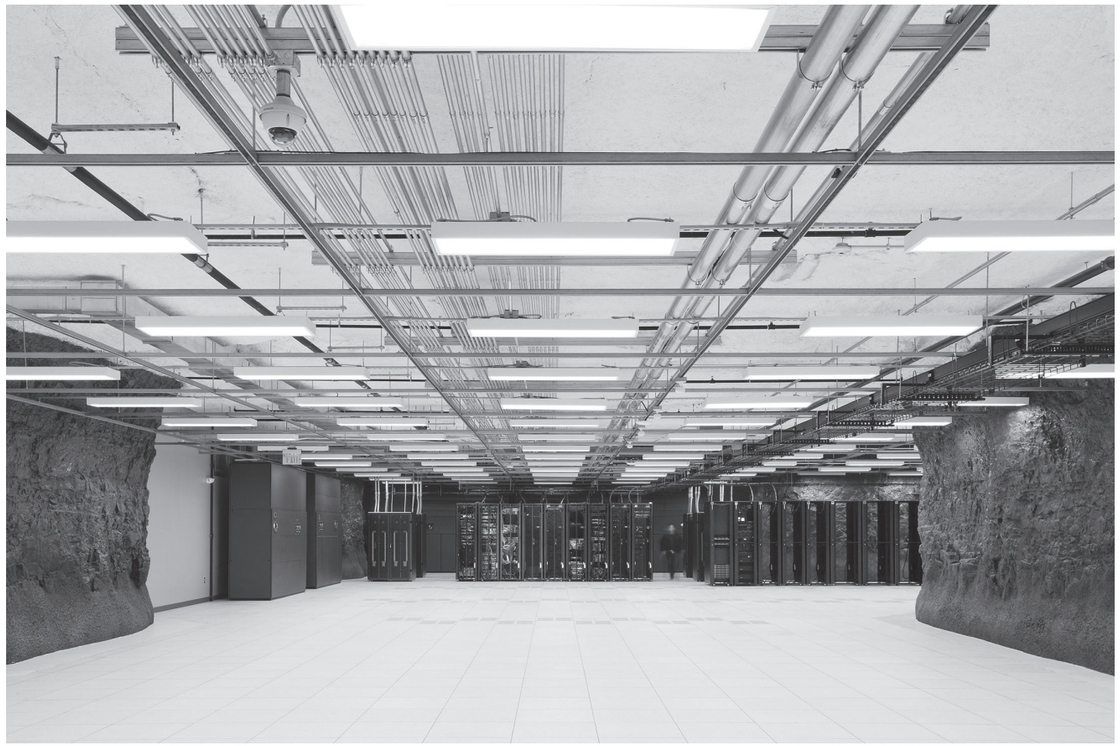

LightEdge data center, SubTropolis, Kansas City, Missouri.

Just outside of Randolph, Kansas, in a limestone mine carved into the bluffs north of the Missouri River, lies a 55-million-square-foot subterranean city. Here, in SubTropolis, Paris Brothers Specialty Foods cultivate their "cave-aged" artisan cheeses, automotive manufacturers produce parts for the nearby Ford plant, regional outdoor enthusiasts store their RVs and boats during the off-season, pharmaceutical companies make medications for farm animals and family pets, and the US Postal Service takes advantage of the right-in-the-middle-of-the-country location to run its stamp fulfillment center.[1] Low leases; high security; abundant raw, customizable space; a consistent underground climate and low energy costs draw tenants to similar facilities in limestone, iron ore, and salt mines all around the world, where we find stores of everything from perishable food and industrial supplies, to reserves of natural gas and spent nuclear fuel, to library books and (purported) weapons of mass destruction.

Underground nuclear and military materials have been the subject of international commissions, tribunals, and wars.[2] Yet subterranean facilities also commonly inventory a similarly volatile, though less noxious, resource: information. SubTropolis's central location, solidity, and security have drawn technology companies, who host data centers in the mine's massive pillared rooms. Many underground garrisons and command centers of the Cold War era have likewise become "data bunkers." Given that industrial metaphors of "mining" and "smithing" have long pervaded the discourses of intellectual labor, it should be no surprise that we're now data mining *inside* our mines.[3] And alongside the subterranean servers and fiber-optic cables, through which stream digital bits of intelligence, we often find shelves and refrigerated

1 As I completed this article, in late 2016, the Center for Land Use Interpretation opened the exhibition "Hollowed Earth: The World of Underground Business Parks" at its Los Angeles gallery. See http://www.clui.org/section/hollowed-earth-world-underground-business-parks. For more on underground architecture (from paintball fields to physics labs to telecom equipment vaults), see also the Center for Land Use Interpretation, "Going Deep: An Overview of the Underground," *Lay of the Land* (Winter 2017), http://www.clui.org/newsletter/winter-2017/going-deep.

2 Nuclear repositories present particular challenges, not only for securing their radioactive contents, but also for ensuring the preservation of knowledge about their existence and operation across generations. In 2011, the OECD's Nuclear Energy Agency initiated a Records, Knowledge, and Memory program that has been investigating various means—from environmental markers to rituals to highly durable data storage technologies—for communicating nuclear risk across the *longue durée*. See Nuclear Energy Agency, "Preservation and Records, Knowledge, and Memory (RK&M) across Generations," https://www.oecd-nea.org/rwm/rkm/; Nuclear Energy Agency, "The Preservation of Records, Knowledge, and Memory (RK&M) across Generations: Improving Our Understanding," RK&M Workshop Proceedings, September 12–13, 2012, Issy-les-Moulineaux, France, https://www.oecd-nea.org/rwm/reports/2013/rwm-r2013-3.pdf. See also Jeffrey T. Richelson, "Underground Facilities: Intelligence and Targeting Issues," *National Security Archive Electronic Briefing Book* 439 (September 23, 2013), http://nsarchive.gwu.edu/NSAEBB/NSAEBB439/.

3 See Lewis Mumford, *Technics and Civilization* (1934; repr., New York: Harcourt Brace, 1963), 70.

Film archive, SubTropolis.

vaults holding information and cultural heritage in myriad analog forms.

In SubTropolis and its other mines in Kansas and Kentucky, records management company Underground Vaults & Storage houses healthcare records, data tapes, maps, microfilm, architectural drawings, original artworks, historical artifacts, and, in refrigerated vaults, photographic negatives and film reels.[4] The National Archives and Records Administration maintains management centers in SubTropolis, as well as in Lenexa, Kansas; Lee's Summit, Missouri; and Valmeyer, Illinois, where bankruptcy and military records, tax files, and documents from other government offices and agencies are kept.[5] In Utah's Wasatch Range, not far from Salt Lake City, staff at the Granite Mountain Records Vault store and digitize microfilm containing the Church of Jesus Christ of Latter-day Saints's genealogical records. Meanwhile, much of Germany's cultural heritage is also documented on microfilm stored in the Barbarastollen archive in the old Schauinsland mine near Freiburg. And just below the Arctic Circle, where the cool climate makes for an ideal data center habitat, the National Library of Norway maintains a mountain vault full of paper documents, films, photos, and sound recordings; a bunker for volatile nitrate film; and a long-term digital repository.[6]

In this age of anthropocenic geoengineering and posthuman intelligence, our mountains and their minerals support both the production and long-term preservation of information resources. The coltan (columbite–tantalite) and copper in our machines are extracted from the earth, and the clouds of data they generate typically hang low over the landscape—or even under it, in subterranean data centers. Yet our media have always been geological, chemical, and environmental.[7] Composed of mud, various plant matter, gelatin, silver, and/or petroleum, they have been sustained by and remain sensitive to the ecologies that gave rise to them. As media scholar Nicole Starosielski notes,

4 Underground Vaults & Storage highlights its expertise in audiovisual archiving; its website notes that the company is a "proud member of the Association of Moving Image Archivists," and that it "maintain[s] close relationships with Kodak Certified Microfilm Preservation Labs" (See "Underground Vaults & Services, Movie Film Storage," http://www.undergroundvaults.com/offerings/items-stored/movie-film-storage/ and "Microfilm Storage," http://www.undergroundvaults.com/offerings/items-stored/microfilm-storage/).

5 The National Archives of the United Kingdom also stores part of its collection in DeepStore's salt mine facility in Winsford, Cheshire.

6 Bruce Royan, "In the Hall of the Mountain King," *IFLA Newsletter* 9: Audiovisual and Multimedia Section (December 2008): 11–13. See also the Svalbard Global Seed Vault, a repository of diverse plant life buried in a mountain on an island between Norway and the North Pole (https://www.croptrust.org/our-work/svalbard-global-seed-vault/).

7 See Jussi Parikka, *A Geology of Media* (Minneapolis: University of Minnesota Press, 2015) and John Durham Peters, *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (Chicago: University of Chicago Press, 2015).

> Different materials—whether paper made up of wood pulp, film with a nitrocellulose base, or microchips with silicon wafers—have their own thermosensitivities and expand, contract, and react with adjacent materials depending on the climate; quick or repeated movement between thermal states destabilizes the media content.[8]

These sensitivities and (in)stabilities are particularly pertinent for media preservation. Acidic paper, nitrate film, and magnetic tape (not to mention digital formats) are particularly fragile, and the mines' consistent temperature and humidity levels, as well as their security and abundant room for expansion, make them ideal locations for storing and extending the lives of media. In transforming these (former) sites of extraction into sites of preservation, we aim to marshal the forces of climate-control and geology not only to save our media from biochemical degradation, but also to shield ourselves from a host of enemies—from nuclear annihilation to litigation to climatic devastation.

Conflict, Conservation, and Speculation

Millions more media objects, including the Corbis photo collection and film reels from major movie studios, live inside a Boyers, Pennsylvania, limestone mine (where some negatives are literally frozen to prolong their preservation).[9] The mine is one of thousands of under- and above-ground storage facilities owned by storage-industry behemoth Iron Mountain. Another of its properties, a decommissioned mine in Germantown, New York, once yielded iron ore that made horseshoes and cannonballs for the Civil War.[10] Iron Mountain's founder, Herman Knaust, saw lots of potential in the Hudson Valley's abandoned mines (New York and the Mid-Atlantic region yielded much of the US's iron through the mid-19th century, before rich deposits were discovered around the Great Lakes). In the 1930s, he used them to grow mushrooms and establish a vast fungi empire. Through the war, according to Iron Mountain's corporate history, Knaust sponsored the immigration of European Jews who had lost their personal records. Inspired by their experiences—loss of documentation, home, and identity—and by the coming Cold War, he bought a huge bank-vault door and transformed the Germantown mine into a vault, founding the Iron Mountain Atomic Storage Company. The company promised to secure both corporate records and corporate executives—in fallout shelters—in the case of a nuclear attack.

Beginning in World War I, and increasing throughout the 20th century, the fear of aerial attack sent people and their beloved things underground. Facilities like Knaust's emerged in many warring nations to safeguard government officials, currency, critical technology, and precious cultural artifacts.[11] And as the Cold War's chill settled in, American government officials and military leaders began working with librarians and archivists to develop strategies for preserving the country's cultural and scientific resources: devising emergency preparedness plans for safeguarding government and business records; testing the effects of nuclear explosions on different storage media; building vaults in government buildings; and establishing "shadow" repositories in off-site subterranean facilities. Presumably, any citizens who survived a nuclear attack could mine the wisdom of those buried documents—handbooks, manuals, flowcharts, even the Constitution itself—to "run the country's political and economic systems," "ensure law and order," and "sustain civilization."[12]

Mines have long been linked to war and conflict. For centuries, Lewis Mumford writes,

> war, mechanization, mining, and finance played into each other's hands. Mining was the key industry that furnished the sinews of war and increased the metallic contents of the original capital hoard, the war chest: on the other hand, it furthered the industrialization of arms, and enriched the financier by both processes. The uncertainty of both warfare and mining increased the possibilities for speculative gains: this provided a rich broth for the bacteria of finance to thrive in.[13]

The stable climate of the mine would later protect financial materials, like currency, from mold and fungi, if not bacteria. The reclaimed mine's conservative preservation mandate contrasted with its original purpose for speculative extraction.

In 1969, about 80 miles from Washington, DC, the Federal Reserve opened a bunker to store billions in cash, serve as the hub of the FedWire communications network, and host a "continuity-of-government" facility for employees—all of which were meant to sustain the economy through a Soviet attack.[14] That facility now serves as the Library of Congress's Packard Campus of the National Audio-Visual Conservation Center, holding the "world's largest and most comprehensive"

8 Nicole Starosielski, "Thermocultures of Geological Media," *Cultural Politics* 12, no. 3 (November 2016): 302.

9 For more on the facility's on-site data center, see Daniel Moore, "Iron Mountain's Butler County Mine Expands to Hold Data Secure," *Pittsburgh Post-Gazette*, January 9, 2017, http://www.post-gazette.com/business/tech-news/2017/01/09/Iron-Mountain-data-limestone-mine-Butler-County-cloud-storage/stories/201612210004.

10 Joshua Rothman, "The Many Lives of Iron Mountain," *The New Yorker*, October 9, 2013, http://www.newyorker.com/business/currency/the-many-lives-of-iron-mountain.

11 J. Michael Pemberton, "Into the Depths: A Video Tour of Underground Vaults and Storage," *Records Management Quarterly* 24, no. 1 (January 1990): "During the Cold War, with the threat of nuclear attack even more ominous than it is now, the commercial underground vault and record center concept got considerably more treatment in the information management literature than it has lately. In fact, many of those operating today were set up in the 1950s, and many are still thriving. More recently, however, an increased interest in and an emphasis on vital records, disaster preparedness, and disaster recovery has re-sensitized the field of information and records management to solutions that, while not as jazzy as computer technology, work surprisingly well and very consistently."

12 Brett Spencer, "Rise of the Shadow Libraries: America's Quest to Save Its Information and Culture from Nuclear Destruction during the Cold War," *Information & Culture* 49, no. 2 (2014): 167–68. See also "Libraries as a Safe 'Haven' in Times of Conflict," *International Relations Round Table Blog*, November 6, 2014, http://alairrt.blogspot.com/2014/11/libraries-as-safe-heaven-in-times-of.html; and Alex Wallerstein, "The Bureaucracy Will Survive the Apocalypse," *Restricted Data: The Nuclear Secrecy Blog*, November 30, 2011, http://blog.nuclearsecrecy.com/2011/11/30/weekly-document-4-the-bureaucracy-will-survive-the-apocalypse/.

13 Mumford, *Technics and Civilization*, 76.

collection of films, sound recordings, television programs, and radio broadcasts.[15] As geographer Stephen Graham notes, "Cold War bunkers—engineered to be protected against the blast effects of megaton-level thermonuclear blasts—offer perfect places for housing the most valuable products of global, informational capitalism: data," or information in its material forms.[16]

Knaust's mushroom mine now joins 1400+ other global Iron Mountain facilities that support the storage of analog records and artworks, data management and data centers, document scanning and shredding, and "information destruction" services that, all together, help organizations "lower storage costs, comply with regulations, recover from disaster, and better use their information."[17] The implication is that "better use" could reveal "potential value" in the stacks and vaults; as the company's promotional video proposes, a possible medical breakthrough or a growth opportunity for a small business might lie dormant in the data. Might as well store *everything* for speculative data mining: you never know what treasure you might extract someday.

Preservationist Paranoia and Environmental Risk Management

While the compulsion for subterranean preservation has persevered over the past half-century, its motivations have shifted. The Cold War repository was an ark, an "exo-skeleton, a life preservation chamber," a "survival machine" powered by nuclear paranoia.[18] As *glasnost* spread, so did business computing—and with it, a proliferation of data formats. The new data deluge—which, paradoxically, effected an increase in analog paperwork—needed to be sorted and stored. In the early aughts, the Enron/Arthur Andersen scandal, followed by the Securities and Exchange Commission's penalization of Goldman Sachs, Morgan Stanley, and other financial institutions for failure to properly produce electronic documents, brought a sense of urgency to records compliance and retention. A new paranoia emerged: fear of litigation. The Sarbanes-Oxley Act of 2002 and other laws further pressed businesses to standardize their records-management practices, and Freedom of Information laws compelled public administrators toward greater transparency. Risk management drove more and more records into warehouses and underground facilities for long-term storage, from which they could be retrieved immediately, clients were assured, via encrypted transmission of an electronic scan or bonded courier delivery.

The ongoing (and interminable) process of digitizing historical analog records has created new records-management challenges for every institution—from major corporations to cultural institutions to individual families. The more we digitize, the more the backlog seems to grow. A portion of that backlog is in compromised condition, too fragile for a standard scan. And even as analog records acquire digital surrogates, the original documents often retain value and so stay on the shelf. Historian of photography Estelle Blaschke echoes many other archivists and historians in arguing that "the artifact does not become obsolete with … digitization"; "digitization is not preservation, but rather a safety backup."[19] That backup must then be continually backed up, and migrated as storage formats evolve. Thus, the digitized record must be remade over and over again. Data privacy and security present additional challenges. Recognizing the precarity of the digital record, many organizations have adopted redundant storage policies.[20] As they say, Lots of Copies (in distributed locations) Keep Stuff Safe!

Today, our information repositories face new external threats, too. Global warming and other anthropocenic natural disasters threaten to flood the basement storage rooms in our coastal cities' corporate headquarters. Fortunately, as records-management purveyors remind us, their subterranean facilities are "miles from danger zones associated with oceans, rivers, seismic fault lines, flood plains . . . [and] volcanic hot spots"; immune to airplane crashes, tornadoes, hurricanes, wildfires, and lightning; and, thanks to the presence of self-contained power and water sources and abundant on-site generators, insusceptible to brownouts and blackouts.[21] We're safe here from geologic and climatic threats. The greatest danger, we are told, is the archived media themselves, composed of highly flammable materials whose chemical degradation makes them even more incendiary. It's best, then, to retard that degradation in a carefully controlled subterranean climate. For extra precaution, facilities also separate storage units with thick firewalls, employ a number of automatic fire-suppression systems, and host on-site fire brigades.

But some disasters are inevitable. Iron Mountain facilities have suffered a number of fires over the years, including a fatal 2014 blaze in Argentina, allegedly set by tenants hoping to suppress evidence of tax fraud and money laundering. Records, despite their seeming banality, are a target for hostile activity. A resurgent Russia, with its skilled hacker corps, and a capricious, calamitous regime in the White House have revived many of our old Cold War suspicions about national and cyber security, and distributed acts of terror and civil unrest have threatened many global archives and cultural artifacts.[22] The Islamic State has famously destroyed numerous monuments, museums, and libraries in the Middle East. Fortunately, we're reminded, underground storage facilities are far from any likely military targets and urban sites of civil disruption. The mines tend to have a single entrance and exit, which facilitates monitoring by around-the-clock guards and surveillance video. They feature secure vault doors, redundant infrared and biometric security systems, and multiple alarms. And at Underground Vaults's salt mine in Hutchinson, Kansas, the only access is via a 650-foot drop, traversed by elevator; no getaway car can get away from there.

Iron Mountain even offers a potential defense against insurgent destruction elsewhere in the world. They've partnered with CyArk, a nonprofit dedicated to scanning and modeling global cultural heritage sites, to develop a comprehensive data management and archiving plan. The organization's data is saved on two magnetic tapes, one of which is delivered by Iron Mountain's secure MediaCare™ transport service, then stored in one of the company's underground tape vaults, where the materials are of course secured via carefully monitored temperature, humidity, and particulate filtration levels.[23] What does it mean to have a 3D model of an ancient ruin—say, the Mosul library or the Temple of Bel in Palmyra, both destroyed by ISIS—housed in a salt mine under Kansas? Some digital archaeologists propose that such archives of the ancient world might offer us the opportunity to recreate it, to undo its destruction.[24] Those heartland mines that once yielded physical building materials—stone and iron—can now yield architectural plans and digital scans, data-maps of the above-ground world, as it once was and perhaps could be again. The mine becomes a font of hope and regeneration.

Yet it is important to note that mines are still sites of violence and conflict, of tension between subterranean and above-ground political-geographies. Especially in the developing world, workers labor in harsh conditions, and locals are exposed to grave environmental hazards. Through a regime of "extractive imperialism," the exploited "colonial underground" feeds the insatiable appetites of the West.[25] Desires for land, labor, natural resources, and religious conversion drove enterprising nations into the Global South more than a half-millennium ago, and many of those same desires now draw global geoengineering corporations into the same regions. Still today, "the undergrounds of countries and continents are . . . being remade as volumes of postcolonial sovereignty, based on legal agreements that parcel them out to global mining firms under the armed protection of state security and paramilitary forces," writes Stephen Graham.[26] In the active mines that continue to fuel the global economy, there is little concern for national sovereignty, natural conservation, or the preservation of human life and heritage.

And in an interesting twist, many of our contemporary mining engineers—*data*-miners, the Silicon Valley elite—are retreating to the underworld. A growing "prepper" or survivalist community within the tech industry has invested in the construction of luxurious bunkers and vaults to escape impending environmental apocalypse or civil disorder. The latter unrest may be attributable, at least in part, to "a backlash against Silicon Valley," its job-killing robots, and its concentration of wealth.[27]

Geological, Chemical, and Temporal Transformations

Particularly before regulation and reform, mines inflicted their "unflinching assault" upon labor and landscape in the West, too.[28] In the US, we still wrest coal, natural gas, stone, iron ore, limestone, sand, gravel, diamonds, gold, copper, silver, nickel, uranium, and other materials from our hills. But in some cases, those operations are sufficiently tamed and aestheticizied to allow for display—for on-site mining museums with gift shops and visitor tours. In Hutchinson, Kansas, extracted salt, incoming and outbound records, and visitors to the Strataca mining museum enter and exit through the same opening in the earth.

14 The Federal Reserve bunker also included a cold-storage area for those bodies escaping continuity of life. The Center for Land Use Interpretation, "The Nation's Media Archive: Taking Our Present into the Future," *Lay of the Land Newsletter*, Winter 2013, http://clui.org/newsletter/winter-2013/nations-media-archive; Michael Gaynor, "Inside the Library of Congress's Packard Campus for Audio-Visual Conservation," *The Washingtonian*, May 9, 2011, https://www.washingtonian.com/2011/05/09/inside-the-library-of-congresss-packard-campus-for-audio-visual-conservation/; Matt Novak, "The Fed's Cold War Bunker Had $4 Billion Cash for after the Apocalypse," *Paleofuture*, April 24, 2015, http://paleofuture.gizmodo.com/the-feds-cold-war-bunker-had-4-billion-cash-for-after-1699204253.

15 Library of Congress, "Library of Congress Packard Campus for Audio-Visual Conservation," http://www.loc.gov/avconservation/packard/.

16 Stephen Graham, *Vertical: The City from Satellites to Bunkers* (Brooklyn: Verso, 2016), 355. See also Luke Bennett, "The Bunker: Metaphor, Materiality, and Management," *Culture and Organization* 17, no. 2 (March 2011): 155–73.

17 Iron Mountain, http://www.ironmountain.com/. See also the Iron Mountain promotional video: "We Are Iron Mountain," http://www.ironmountain.com/Knowledge-Center/Reference-Library/View-by-Document-Type/Demonstrations-Videos/Tours/Company-Overview.aspx. Underground Vaults & Storage offers similar services and proudly notes on its website that it has received "AAA certification from the National Association for Information Destruction (NAID)." (Underground Vaults & Storage, "Document Resources Division: Professional Destruction Services," http://www.undergroundvaults.com/document-resources/.)

18 Bennett, "The Bunker," 169; Mike Gane, "Paul Virilio's Bunker Theorizing," *Theory, Culture & Society* 16, no. 5/6 (1999): 85–102.

19 Estelle Blaschke, "The Excess of the Archive," in *Documenting the World: Film, Photography, and the Scientific Record*, ed. Greg Mitman and Kelley Wilder (Chicago: University of Chicago Press, 2016), 242. See also Dan Nadel, "Burying the Past," *Metropolis Magazine*, November 2002, http://www.wilhelm-research.com/corbis/MetropolisMag_Nov_02_Corbis.pdf.

20 Cold War analog record managers also adopted "duplicate and disperse" strategies, "making copies of a document, often through microfilming, and shipping the copies to several distant locations with the hope that at least one would survive a nuclear attack" (Spencer, "Rise of the Shadow Libraries," 148).

21 Underground Vaults & Storage, "Underground Storage: Disaster, Deterioration, and Deception Protection," http://www.undergroundvaults.com/offerings/secure-storage/underground-storage/. See also D. C. Hughes and V. J. Ryan, "Possibilities for Archives and Other Safe Storage Underground," International Society for Rock Mechanics International Symposium, Rockstore 80, Stockholm, June 23–17, 1980; and Tom Benjamin, "Adaptation of Underground Space," *National Archives* (March 1999), https://www.archives.gov/preservation/storage/underground-facilities.html.

22 Consider DataRefuge's efforts to preserve federal data—regarding climate and environmental research, in particular—that are believed to be particularly vulnerable during the Trump administration. See https://www.datarefuge.org/.

23 Iron Mountain, "Preserving the World's Heritage," 2013, http://www.ironmountain.com/Knowledge-Center/Reference-Library/View-by-Document-Type/Case-Studies/C/CyArk.aspx. For more on Iron Mountain's use of tape-based data storage, see Michele Hope, "Is Using Tape a 'Cool' Choice? The Numbers Tell the Story," Iron Mountain Knowledge Center, http://www.ironmountain.com/Knowledge-Center/Reference-Library/View-by-Document-Type/General-Articles/I/Is-Using-Tape-a-Cool-Choice-The-Numbers-Tell-the-Story.aspx.

24 Digital archaeology and the proposed recreation of destroyed cultural heritage sites are not without controversy. See Simon Jenkins, "After Palmyra, the Message to ISIS: What You Destroy, We Will Rebuild," *The Guardian*, March 29, 2016, https://www.theguardian.com/commentisfree/2016/mar/29/palmyra-message-isis-islamic-state-jihadis-orgy-destruction-heritage-restored; "Upon Reclaiming Palmyra, the Controversial Side of Digital Reconstruction," *NPR Weekend Edition Saturday*, April 2, 2016, http://www.npr.org/2016/04/02/472784720/upon-reclaiming-palmyra-the-controversial-side-of-digital-reconstruction.

25 James Petras and Henry Veltmeyer, *Extractive Imperialism in the Americas: Capitalism's New Frontier* (Leiden: Brill, 2014).

26 Graham, *Vertical*, 368.

27 Evan Osnos, "Doomsday Prep for the Super-Rich," *The New Yorker*, January 30, 2017, http://www.newyorker.com/magazine/2017/01/30/doomsday-prep-for-the-super-rich.

28 Mumford, *Technics and Civilization*, 69.

Where we once carted out rough blocks of limestone and chunks of salt, gouging ever-deeper into the earth, we today enact a new geological and architectural transformation: inserting steel doors and stacks, HVAC units and power cables, to turn caverns into vaults with geological properties conducive to the chemical preservation of material media. In these deep spaces of deep time, of rocks and minerals millions of years in the making, we strive to extend the lives of man-made artifacts that, above ground, in a more volatile climate, would disintegrate and decompose in a fraction of the time.

As Mumford explains, mines have long functioned as manufactured climates and time machines:

> Day has been abolished and the rhythm of nature broken: continuous day-and-night production first came into existence here. The miner must work by artificial light even though the sun be shining outside; still further down in the seams, he must work by artificial ventilation, too: a triumph of the "manufactured environment."[29]

In the repurposed mine, the mine-as-repository, bureaucracy meets climate and chemistry to reshape temporality and extend history.[30] These sites of extraction and conflict, of controlled geoengineering, are reborn as sites of controlled cultural preservation. In both cases, we exploit the landscape in order to regulate, and even reverse, organic material processes and the passage of time—to ensure our access to materials both produced and preserved across the *longue durée*.

Brian Michael Murphy poignantly notes that this "vast media preservation infrastructure," which "grew out of hauntings of destruction [and] fears of radioactive contamination," now reflects "our current fears, hopes, and persistent, impossible desires for permanent media invulnerable to the forces of (cyber)terrorism, natural disasters, and the indomitable force of decay that inheres in all media."[31] The slowness, stasis, and security of that subterranean repository are meant to provide a stable substrate for all the reckless speculation and rapid transactions transpiring in the world above. While the surface world accelerates, down below, we continue to dream of mastering geology and chemistry in order to engineer the retardation of time's passage. Our subterranean wager is that we'll find in the mines a secret to archival invincibility and perpetuity—as well as, perhaps, our own preservation.

Mined materials drive similar explorations in above-ground labs. Scientists and engineers are developing new storage media out of ceramic, nickel, tungsten, quartz, glass, even DNA, that promise to persist for thousands or billions of years.[32] Genomics and geology, in concert, might even provide a solution for the preservation and accessibility of our volatile digital records and obsolete digital media. In 2010 a group of European scientists, technologists, librarians, and archivists—the Planets group (Preservation and Long-term Access through NETworked Services)—created a time capsule containing five commonly used digital objects (a JPEG photo, an HTML website, a PDF brochure), along with file format specifications and encodings and a map of the "genetic code necessary to … access these file formats in the future."[33] That "digital genome," stored on an array of materials (flash drives, punch cards, microfilm, printed paper) to maximize accessibility to future generations, was then deposited in a metal box in the Swiss Fort Knox, a former bunker in the Alps that now houses high-security data centers. The experiment, according to Planets member Jacob Lant, of the British Library, was intended to "highlight the fragility of modern data, but also protect the tools for unlocking our digital heritage from a whole range of human, environment, and technological risks."[34]

It seems only fitting that mushrooms filled Knaust's mines before the files, films, and fiber optics arrived. Those natural decomposers foreshadowed our eternal struggle against time's passage and inevitable decay. While Iron Mountain's and SubTropolis's massive stone walls and sophisticated security systems might preclude the intrusion of moisture and gate-crashers, thus retarding the degradation of our data and documents, time still finds a way to sneak in. Over the *longue durée*, history itself takes its toll on our documents, the technologies we use to access them, and the individual minds and cultural ecologies in which those records hold significance. Yet we persevere in our preservation efforts, hoping, speculating, that these deep spaces of deep time will extend the lives of our human artifacts—and, by extension, human history and the human lives capable of remembering it—into a future of great uncertainty. Will anyone be around to mine the data?

29 Ibid., 69–70.

30 For more on the chemistry of archival storage, see the work of the Image Permanence Institute (https://www.imagepermanenceinstitute.org/index.php), and Paul N. Banks, "Overview of Alternative Space Options for Libraries and Archives," *National Archives* (March 1999): https://www.archives.gov/preservation/storage/overview-alt-space.html.

31 Brian Michael Murphy, "Bomb-proofing the Digital Image," *Media-N* 10, no. 1 (Spring 2014), http://median.newmediacaucus.org/art-infrastructures-hardware/bomb-proofing-the-digital-image-an-archaeology-of-media-preservation-infrastructure/.

32 "Eternal 5D Data Storage Could Record the History of Humankind," University of Southampton Press Release, February 18, 2016, http://www.southampton.ac.uk/news/2016/02/5d-data-storage-update.page#; Andy Extance, "How DNA Could Store All the World's Data," *Nature*, August 31, 2016, http://www.nature.com/news/how-dna-could-store-all-the-world-s-data-1.20496; Human Document Project 2014, http://hudoc2014.manucodiata.org/; Kevin Kelly, "Very Long-Term Backup," *The Rosetta Project*, August 20, 2008, http://rosettaproject.org/blog/02008/aug/20/very-long-term-backup/; Richard Kemeny, "All of Human Knowledge Buried in a Salt Mine," *The Atlantic*, January 9, 2017, https://www.theatlantic.com/technology/archive/2017/01/human-knowledge-salt-mine/512552/.

33 Lin Edwards, "'Digital Genome' Time Capsule Stored under the Swiss Alps," *Phys.org*, May 21, 2010, http://phys.org/news/2010-05-digital-genome-capsule-swiss-alps.html; Adam Farquhar, "Planets," *Digital Preservation*, http://www.digitalpreservation.gov/series/edge/planets.html; Planets, http://www.planets-project.eu/; Alasdair Wilkins, "Unlocking the Box That Holds the Secret to Digital Preservation," *Gizmodo*, June 11, 2010, http://io9.gizmodo.com/5558640/unlocking-the-box-that-holds-the-secret-to-digital-preservation.

34 Wilkins, "Unlocking the Box."

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