



WHAT'S LEFT BEHIND

A FLOODED COPPER MINE OUTSIDE BUTTE, MONTANA IS THE LARGEST CONTAMINATED BODY OF WATER IN THE COUNTRY. IT ALSO CONTAINS A SLIME THAT COULD SAVE LIVES.

DISCUSSED: *The Land of Wayward Relatives, The Promise of Precious Metals, Virgil in a Dusty Subaru, Uptown and the Flats, Geological Nuances, An Important Watershed, A Spectrum From Snake Oil to Brilliant, Fortuitous Evacuation, Iron-Sorbing Slime, Mining Identity, Butte's Christ the Redeemer, Enterprising Beavers*

BY KEA KRAUSE

If you're from Seattle, like me, you learn early in life that Montana is spacious, touristy, and full of wayward relatives who knocked off the grid a long time ago. You know about Glacier and Yellowstone and the lax speed limits on the swaths of flat, endless highway beneath limitless skies. And of the few big towns in the state, you know sparse details: Helena is the capital, Missoula is a liberal stronghold, and in Butte a flooded copper mine—the nation's biggest body of toxic water, called the Berkeley Pit—functions as a town monument, a plaguing reminder of the price of industry, and, for some, a lab of curiosity. Montana is a weird, wide-open space—it's the fourth-largest state in the country, but forty-eighth in population density; a place where you can still write personal checks for groceries, where bars feature attractions like live mermaids, and where Americans and mine waste alike are seemingly left alone to do whatever they want.

For years, as you approached Butte along I-90, all-you-can-eat-buffet-style billboards recommended the bizarre detour of the Berkeley Pit, marketing mine waste

as historic pollution worth visiting. A massive hole filled with battery-acid-strength water, the signs suggested, isn't a far stretch from picnicking at a battleground or an old fort, retired sites from a different sort of war. Eventually, administrators realized that advertising the pit as a tourist attraction was damning to the town's reputation and took down the enticing signage, but visitors can still pay two dollars and, from a viewing stand, enjoy a recorded history of the town and the breathtaking vista of one of the greatest American copper-mining calamities of the twentieth century.

Butte's history has all the heroic and romantic trappings of Wallace Stegner's nostalgic frontier saga *Angle of Repose*. After fortune-seekers panning for gold in Butte in the 1850s couldn't find any, the town was nearly left to return to nature. With only a handful of tacit laws keeping the peace, and without a mother lode, most men moved on. But miners working for one persevering entrepreneur named Marcus Daly, who had the copper version of the Midas touch, discovered a massive vein of the brown metal in 1882 and transformed Butte into the biggest copper-producing city in North America and, at one point, the entire world.

Upon my first visit I knew about the grandiose Butte lore and the pit, and I knew the word *perpetuity*, which the EPA appropriated while deeming the pit a Superfund site under the EPA's remediation program. The word was potent and suggested lifetimes: of scars, of people, of a pit—challenges that come without instructions. Everyone deals with their own disasters in

perpetuity, and at the time I had my own: gray teeth and a crisscrossed lip from an accident years ago, a hastily instigated breakup, friendships lost in gulfs of my neglect. This was how the people of Butte would deal with the pit as well: perpetually, for a very long time.

The morning I met Joe Griffin, the state of Montana's Department of Environmental Quality representative, I got into his car without knowing where he was taking me. My Virgil in a dusty Subaru, Griffin led me on a twisting road away from Uptown Butte, through intermittent neighborhoods with boarded-up craftsman bungalows, rusted-out cars, and the skeletal remains of bars and businesses, their irrelevant signs still dangling from chains with joints that creaked in the light summer breeze.

We came to a final stop in front of the fenced-in Diamond Mine, its gate guarded with a heavy chain. The air smelled of hot springs and hard-boiled eggs, and the elemental presence of sulfur clung to my hair and clothes like campfire smoke. Unbeknownst to me, the reason we were at this particular mine wasn't to observe the steel, mantis-shaped head-frame that once lowered men and horses nearly a mile underground, nor to marvel at the ground itself, sparkling with feldspar and pyrite like a mirrorball. Instead, we had come to take in the view of the Berkeley Pit, which, upon first take, surprised me with its similarity to a natural lake that might hold minnows, boats, and swimmers.

Panoramically, Butte doesn't make a whole lot of sense. What most people

would consider a downtown area—a space with tall buildings, museums, bars, restaurants, and government complexes—in Butte is called “Uptown” because it's higher than everywhere else. Everywhere else is called “the Flats”: a suburban valley populated with big-box stores and car dealerships. Uptown, the metropolitan center is an art deco masterpiece, a six-square-block area with a cluster of nationally protected buildings that are handsome and important the way Wall Street's once were. But overshadowing its stately and peaceful vista was the treeless pit, looking diamond-cut with its precise edges forming a mile-long, half-mile-wide arrowhead filled with water so brown it looked thick.

The damage of the pit, in its absurd scale relative to the town, signals the historic pillaging of the land. The discovery of copper beneath Butte coincided with the development of the filament light bulb, a product whose mass production necessitated an abundance of copper wiring. Since Montana would not become a state for another decade, copper companies were left to pursue their own interests without regulation. Butte became an ant farm, with mining corporations ultimately digging out ten thousand miles' worth of tunnels under the town, a distance that could comfortably span from New York to Singapore.

Heap roasting was a common technology that used heat to convert sulfides in crushed rock into oxides that could then be smelted and refined into valuable ore. In the process, piles of rock, often the size of city blocks, were set on fire and allowed to burn for days. Smelting was just as noxious,

producing excesses of smoke and another form of waste called slag, a muddy slush that would then get dumped from factories into nearby waterways. Silver Bow Creek, which runs through Butte, became a flowing mine-waste disposal site. Smoke from smelting engulfed the town; residents complained about not being able to see across streets. Cattle and other livestock died of arsenic poisoning. Trees ceased to grow.

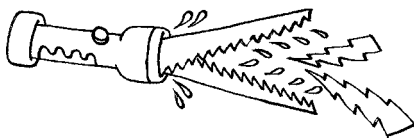
In 1955, Anaconda Copper, the largest mining company in Butte, adopted the technique of open-pit mining, whereby land is terraced away to create a spiraling hole in the ground. The company proceeded to dig the Berkeley Pit, a hole big enough to accommodate the Eiffel Tower, near the center of Uptown Butte, displacing hundreds of residents and ruining the morale of the blue-collar mining community.

Some geological nuances contributed to the environmental problems developing in Butte. The ground beneath the town is an alluvial aquifer, and consists of a watery porousness similar to the way fish-tank rocks sit loosely together. One of several abundant minerals in this soil is pyrite—fool’s gold—which, when exposed to air and water, produces sulfuric acid. For years, companies spent significant time and money pumping groundwater out of mine shafts to accommodate tunneling miners, inadvertently also keeping Butte’s pyrite dry. But when the oil company ARCO bought Anaconda in the late 1970s, copper was at its lowest price in years. To save money, ARCO decommissioned the nearly one-hundred-year-old pumps. As the water rose, it reached the pyrite

in the porous soil, producing sulfuric acid and mixing with the already existing pollutants. In 1983, once the tunnels flooded, the next thing to fill was the pit.

Catastrophe-wise, the pit falls in the middle of the spectrum. The Bingham Canyon copper mine, outside of Salt Lake City, is nearly three times its size. Entire coal towns, like Centralia, Pennsylvania, have been evacuated because inextinguishable fires burn for years in mines beneath their streets. Though Griffin and I gazed out on a scene that was conclusively bad for the environment, I would learn that the pit struggles with a Goldilocks dilemma. While it isn’t more disturbing than other sites, it remains the biggest body of contaminated water in the United States, and is essentially a walkable mile from Uptown—so close you could run errands to it on a lunch break. A sense of urgency also distinguishes the pit from those other sites: the contaminated water here is rising. If it reaches what the EPA has designated the “critical water level,” which it is expected to do by 2023 without intervention, it will reverse its course and flow back into the water table. To prevent this, the plan put in place via Superfund is to pump and treat the pit water in perpetuity.

The Berkeley Pit is not likely to evacuate Butte. But to keep it safe and contained will drain money—millions of dollars—and attention, for



whichever exists longer, the pit or us. All of southwest Montana is one big environmental liability in this sense: the region is infested with abandoned mines, an estimated twenty thousand of them, each coming with its own hazardous idiosyncrasies and resting above the same watershed, which rushes out to the Pacific.

“If we all intend to keep going as a civilization, as a society, we still need copper. You’re not going to stop progress. Nobody wants to give anything up, even environmentalists. It’s a dilemma, really,” Griffin mused. Even as we spoke, the Pebble Mine, in Bristol Bay, Alaska, one of the last unharmed watersheds in our country and the spawning ground of multiple endangered salmon breeds, was being proposed as a new copper venture.

“Obviously this isn’t going anywhere. I mean, even if you thought, Let’s take it somewhere, where the hell would you take it? So this will be here forever,” Griffin said. The summer heat pushed down on us as the silent pit, an accident whose full resonance is still unknown, stretched far off to the edges of Butte.

I wanted to make sure I had heard Griffin right, that he had actually used the word *forever* in our conversation, so I consulted a hydrogeologist. Nick Tucci, who worked on the Berkeley Pit for nearly a decade, clarified some some details. Tucci moved to Butte in 2003 to get a master’s degree in geoscience from Montana Tech, an outpost of the University of Montana and one of the nation’s preeminent mining colleges. For Tucci, Butte, with its flooded pit mine, was the perfect place

to study. Tucci is articulate and sincere, and bends your ear about complicated subjects in a way that makes you feel like you are discussing something as accessible as the weather.

“There’s no proven technology out there that we have right now to stop the water from infiltrating the pit,” he told me. “I think whatever technology you use that exists right now, you are going to be pumping and treating forever. Right now, we just don’t have the ability to clean up the Berkeley Pit.”

But that hasn’t been for lack of trying. In his time working at the Montana Bureau of Mines and Geology, Tucci had given out samples of pit water to varying types of scientists (some self-declared) eager to try to solve the problem. Tucci witnessed ideas that varied from snake-oil to brilliant. “There was a guy who brought in crystals and thought he could arrange them in such a way that it wouldn’t take the contaminants out of the water but would rearrange the molecules to the extent where they were no longer toxic. He was convinced it would work and he was going to show us by drinking it.”

Other ideas involved evaporating the pit water with mirrors or sprinkler heads spraying the water over fields where it would evaporate, a method that has worked with other pit lakes (though there would still be the conundrum of water quality to address). One idea that Tucci liked, but wasn’t sure was feasible because of its cost, was to fill the pit with mine tailings, a type of mine waste that’s like dirt. Groundwater would still have to be pumped in perpetuity, but at least the surface area of the pit could be used for something.

Even without the end goal of remediation, the pit has served as a laboratory for diverse experimentation. Andrea and Don Stierle, organic chemists and old friends of both Griffin’s and Tucci’s, grew interested in the pit water when they moved to Butte from San Diego. While Don taught at Montana Tech, Andrea, who had originally planned to be a marine natural products chemist, decided to explore Butte’s largest body of water, toxic or not. It’s not uncommon for scientists to pursue bacteria growth in mine waste—anything thriving in a toxic spot could hold the key to its own cleanup—but no one had really looked into acidic mine water as something that could support life. To Andrea, life in the pit didn’t seem too far-fetched. It posed a risky but thrilling challenge. She doesn’t dumb things down, so here’s how she explained it: “Nobody had looked in toxic waste for a bacterium or a fungus that could produce secondary metabolites that had biological activity that could be helpful. It seemed like a great idea!” It did.

The Stierles weren’t initially able to isolate any sort of living organism in the water—until a flock of snow geese spent a perilous night floating on the pit’s surface, resting their wings after flying directly into a storm. A black yeast that hadn’t been there before started to grow in the water. Andrea sent the culture to a lab for identification and learned something

unexpected: the yeast was associated with goose rectums. For years, scientists had been unsuccessfully throwing organic matter, like hay or horse manure, into the pit to see if it would yield new life. The night of the storm, when the party of geese realized that what they were treading wasn’t exactly water, they fled the toxic pond. When birds take flight they evacuate their bowels to lighten their load and ease the process of takeoff. In this instance, an entire flock evacuated simultaneously and filled the pit with biological matter. Goose poop had made the pit come alive.

Prior to the discovery of the yeast, Andrea Stierle had already had many successes in her career. While in San Diego, she held a postdoctoral position at the Scripps Institution of Oceanography, and in the ’90s, she discovered a fungus that produces taxol, a cancer-fighting drug, in the bark of the Pacific yew tree. Her focus was trained on the minuscule, and her process has always been to reduce her subjects to microscopic proportions and see what biological activity she could find.

In the pit, the Stierles had set out to find biological life with medicinal properties, similar to taxol’s cancer-fighting capabilities. In fact, the yeast was showing promise as having an effect on two types of ovarian cancer cell lines. But the yeast had another exciting attribute: it pulled metals out of Berkeley Pit water.

Acid-generating rock in the ground beneath Butte creates metal finds—or clusters—that clog filters and amass in wells. In the case of the pit, the finds are high in iron, which is responsible for the water’s bloodred color. And as

Gather the voices, forces I have forgotten (29)
gaunt, ugly deformed (138)
God love you (20)

Andrea learned through her studies, the slime liked to eat, or “sorb,” iron. “This is one of the things this little yeast does exquisitely. It takes these finds, and if you add a drop of the yeast when we grow it in liquid solution and add it to a big flask of pit water with the finds, this yeast will take all the finds, drop them out of solution, and just form this little blob,” she explained. “It’s amazing. It quickly adsorbs up to 87 percent of a lot of the metals that are present, and that happens within five to ten seconds. It’s almost magical.”

In her lab, Andrea held a pipette with the yeast cocked over a beaker filled with Berkeley Pit water and dripped its viscous contents into the beaker. “Let’s go, baby!” she encouraged the yeast. She swirled the beaker like a lowball glass of whiskey, the yeast twining in dark, wispy tentacles. In the midst of the swishing, the water’s cloudiness diminished and a black, marble-sized ball formed in the beaker’s center. The yeast had sorbed the metals that once polluted the water, which now did look clean enough to drink. Her slime was a glimpse of refreshing innovation, a repurposing of disaster.

Since grant money for people like the Stierles is scarce and there’s a dearth of sustaining jobs in Butte, I wanted to know who was young and brave enough to commit the burgeoning parts of their career to a town that is, for all intents and purposes, extremely economically depressed. Griffin pointed me in the direction of Julia Crain, the special projects planner at the Butte–Silver Bow Consolidated City-County Government, and

who is also involved in the Superfund program. Crain is a third-generation Butte resident—her grandfather helped build one of the town’s first railroads—and holds a graduate degree in urban and regional planning from Portland State University.

Crain is ambitious and devoted to Butte, and Griffin, Tucci, and Stierle all agree that if Butte has one good thing going for it, it’s Julia. She inexhaustibly writes grants for things that residents don’t even realize they deserve. In its risk, hard-rock mining once represented the pinnacle of manhood, with miners working hard in the wretched conditions underground and living hard in the bars and brothels above. Butte is still a tough town, and this attitude can stand in the way of progressive change. But Crain is undeterred, and has been awarded millions of dollars to build recreational trails through Butte’s public greenspaces and plant trees along Uptown streets, amenities the town didn’t know it missed until it had them. Butte’s been “taken hostage by its perception of itself,” Crain says, in regard to its proud reputation as an overbold frontier town—which can cause her work, along with elements of the cleanup, to be met with occasional hostility.

But that’s not necessarily a bad thing. “We know that dialogue here is really healthy and that people are really engaged, because every issue has contention surrounding it, and it’s because people are holding fast to something they love. I don’t think they’re saying no to ushering in a new era; I think they want to be confident there’s someone there to really carry it forward into the forever.” Change needs gentle coaxing

in Butte, but Crain knows that blooming late is better than never blooming at all. “We are playing catch-up. We had to spend thirty years cleaning up a bunch of contamination and figuring out how to protect the people that live here so they could stay. So it’s not as though we aren’t progressing; it’s just that we had to take a different approach to [progress] because of the situation we found ourselves in.”

Despite opportunity existing all around in subtle forms, no one was moving to Butte or staying in Butte for it. Instead, one might stay for the town’s sense of everlasting potential and the belief systems built around it—just like in the days when Montana was still a frontier. “I think everybody here has their own romances, and maybe some people don’t have the words to express it, but I know that Andrea Stierle was completely enraptured by the Berkeley Pit, and her research is the result of that,” Crain explained. “You have to be capable of seeing something more, and that’s how people can get through here. I’m not saying it’s that hard; I’m just saying it’s a diamond in the rough.”

Three thousand five hundred feet above Butte, along one of the Continental Divide’s arched ridges, stands a surprising, ninety-foot statue called Our Lady of the Rockies. Our Lady took six years to construct, from the initial plans in 1979 to the final portion, her head, which was airlifted by helicopter to the top of the mountain in the winter of 1985. She looms protectively over Butte, arms outstretched in a come-gimme-a-hug pose. She is impossible to miss from the streets of

Butte. During one of the city's economic downturns, miners designed and welded her out of donated steel to serve as a symbol of workers everywhere. She is as strange and Herculean as everything else in Butte: the patron saint of toughness. As the third-tallest statue in the United States, and painted a scorching white, Our Lady is Butte's very own Christ the Redeemer. And you can visit her, twice a day, by way of a shuttle bus departing from the Butte Plaza Mall.

I took the morning tour to Our Lady to avoid the hot July sun. The narrow, unpaved road, the retiree bus driver, and the bus that should've been retired were a nerve-wracking combination during the forty-five minutes we spent laboring up the mountain. At the top, I scurried around the base of Our Lady, taking pictures that never managed to get her full figure in the frame. Around me, kids kicked at bushes and people put quarters into mounted binoculars, but the majority of the tourists kneeled and touched Our Lady, seemingly in prayer. The few people I spoke to on the bus weren't from Butte, or even from Montana, but were on vacation, and, as people who were either still working or had worked blue-collar jobs, had a reason to be on that bus: they were paying homage to a town whose culture revolved around self-reliance and whose entire workforce had operated around hard, hazardous, thankless work for generations.

Without realizing it, I had begun to fancy myself a pilgrim, too. Being engulfed in the wilds of national parks still fills me with the awe I first experienced out on Washington's Olympic Peninsula, where I spent summers

growing up. There, the land is safe, and nature has the right of way. And it was in a national park, in my late twenties, that I realized that some of my favorite sensory perceptions, like the bitter smell of ferns after rain and the sounds of creatures scurrying through dried leaves, exist largely in places that are now protected by the government.

The lines between what is nature and what is natural have become blurred in my lifetime. Other mammals also consume the land: in Butte, enterprising beavers have depleted floodplains all around the valley with their dams. In getting what you want as a species, it sometimes seems impossible not to leave some sort of mark, but it is the remnants that have become my main concern. Since the damage has already been done, I want to know what we are doing with the damage—how we are transforming our destruction into creation.

During one of our conversations, Tucci, the hydrogeologist, said something to me that I had been thinking all along but had been afraid to say out loud, which was that the pit was beautiful. At first I had wanted to say that it was hideous, sinister even, but the pit's engineered tiers, industrialized terra-cotta complexion, and crimson water have a hard-won refinement, like western art scenes of dusty cavalcades and buffalo runs. "I think the research value of the Berkeley Pit is not quantifiable and the lessons that can be learned from the Berkeley Pit are not quantifiable," Tucci said. "People are going to come here, look at the Berkeley Pit, and know what we are capable of, and people will be cautious, hopefully."

Though on the morning of my visit to Our Lady I felt as though I didn't deserve a seat on the bus, by midafternoon I had decided the miners who built her would want me to believe she belonged to me, too, and that I was welcome to join my fellow tourists in praying at the folds of her steel robes if I liked. Even when it doesn't seem like it, there is a lot of connectivity in towns like Butte that masquerade as the edge of the universe but are really its center. Had I known at the time that we were all there because embracing our scars as they amass is difficult, and loving hard-to-love things is alienating, maybe I would've rested my forehead against her cool, steel siding, too. ✨

**HYPHENATED
COMPOUNDS IN
D. H. LAWRENCE'S
POEM "SNAKE"**

- ✨ water-trough
- ✨ strange-scented
- ✨ carob-tree
- ✨ earth-wall
- ✨ yellow-brown
- ✨ soft-bellied
- ✨ two-forked
- ✨ earth-brown
- ✨ earth-golden
- ✨ wall-face
- ✨ snake-easing
- ✨ earth-lipped
- ✨ wall-front

—list compiled by Eliot Harper