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If we remove metals for the service of man, all methods of protecting and sustaining health and more carefully preserving the course of life are done away with. If there were no metals, men would pass a horrible existence in the midst of wild beasts; they would return to the acorns and fruits and berries of the forest. They would feed upon the herbs and roots which they plucked up with their nails. They would dig out caves in which to lie down at night and by day would rove in the woods and plains at random like beasts, and as much as this condition is utterly unworthy of humanity, with its splendid and glorious natural endowment, will anyone be so foolish or obstinate as not to allow that metals are necessary for food and clothing, and that they tend to preserve life?

Georgius Agricola, *De Re Metallica*, translated from the first Latin edition (1556) by Herbert Clark Hoover and Lou Henry Hoover (1950 [1912])

Mining, at least next to Agriculture, is of primitive and essential interest to men, for it, alone, with the exception of the arts of obtaining food, leads enterprise directly to the supplies of nature.

Prof. F. H. Vinton, "Mining Engineering" (1874)

INTRODUCTION

Arsenic in the Wilderness, or Knowing Nature through Mining

In the spring of 1993 I stood in line at the University of Montana cafeteria absentmindedly tapping my spoon on the stainless steel countertop. I was working as an environmental reporter for the Missoula *Independent,* where I had just filed a story about a massive fish kill in the nearby Clark Fork River. The fish had been poisoned by arsenic that had been scoured into solution from the sediments behind the Mill Town Dam, a few miles upstream, when an ice floe had made its way down the Blackfoot River and ground into the reservoir sediments. The arsenic was residue from a century of copper mining and smelting that had taken place 120 miles upriver in Butte and Anaconda. I was puzzling over the scope and scale of the environmental impact, admittedly indignant at the arrogance of the copper interests and dumbfounded by the seeming willingness of Montanans to allow such impacts in their home landscape.

At the time, the Butte and Anaconda Superfund Complex—tens of thousands of acres of heavy-metal–laden earth, piles of mining waste, huge swathes of forest acid-burned to all but the most tenacious scrub, a half-mile-deep hole in the ground, and 120 miles of toxic river sediments—was among the nation's largest Superfund problems, a hazardous and toxic waste site of gargantuan proportions. I had learned that the first detection of arsenic in Mill Town's water had stumped the Missoula Health Department in 1981; the officials had no idea where it had come from. Some of them suggested a natural source, such as a vein of arsenic ore under the reservoir; others thought that perhaps a buried toxic dump, as had been found in the Love Canal community in upstate New York five years earlier, existed under Mill Town without anyone knowing. Only later were the upstream smelters identified as the source.[1]

The arsenic had come from the copper ores in Butte. Miners and geologists had long known that arsenic commonly existed as a natural by-product of copper smelting. In Butte, almost one-third of the copper ores were of a mineral called enargite, a compound containing half as much arsenic as copper. Smelting enargite had passed the arsenic out into waste dumps, up into the air, and down the Clark Fork River. As early as 1918 the main smelter in Anaconda was processing 65,000 tons of 6 percent copper ore a year, or about 1.3 million pounds of arsenic annually (a production level that continued to grow as ore quality continued to diminish throughout the twentieth century). In the most basic material sense, then, the quantities of arsenic were a factor of the quantities of copper produced. Given these known dangers, I wondered why so much copper ore would be processed in the first place. Many historians explained that production was necessitated by the invention of the telegraph, telephone, and electrical-generation systems, whose miles of copper wiring and various conduction needs required unprecedented amounts of the so-called red metal. The American and European desire for long-distance communication and domestic electrification created a demand for metallic copper to which Montana (and other western) copper developers had responded; the arsenic was an accidental by-product.[2]

But as I stood there tapping my spoon, I remained confused about how such a significant turn of events—the historically unprecedented excavation and processing of copper ores and the landscapes they produced—had been forgotten by late-twentieth-century Montana residents and had been somehow erased from the national stories told about Montana. The Montana I thought I had moved to in the early 1990s was a region celebrated for its wilderness areas—it contains some of the largest tracts of roadless land in the contiguous United States—and its national parks (Yellowstone and Glacier). Everyone I knew in Missoula celebrated the undeveloped wilderness characteristics Montana's mountain landscape provided, its white-water rafting and backcountry skiing, its mile upon mile of untrammeled nature. This other, *industrial* history had been somehow masked in the region, except dur-

ing moments like the fish kill, when it demanded a kind of sensationalized attention. "New Jersey with a view," was how my more cynical environmentalist friends described it before they jumped into their vehicles and headed for the nearest trailhead. I wondered why arsenic pollution and Superfund landscapes were not part of the general history of electrification and the rise of telephone communication or even, for that matter, the main part of the story of the rise of the mining industry in the United States during the late nineteenth century, as these stories seemed so obviously connected.[3]

While puzzling over these questions that day in the cafeteria, I had a flash of insight about them that would eventually lead to the present study. Mining had disappeared in plain sight. I stopped tapping my spoon and looked around at my surroundings: at the stainless steel countertop and serving utensils, at the eyelets in my shoes, at my belt, my glasses, the ovens and toasters and surfaces in the cafeteria, the window frames, wires, and cables; I thought about my car and my television and my personal computer. I realized for the first time, in a manner I had never considered before, that every part of my life depended to some degree on the refined products of mining. Metals were everywhere, and they were fundamentally necessary for the lives we live. It wasn't that I hadn't noticed metals before; it was rather that I hadn't considered them a part of nature.

My own ontological categories, the assumptions I made about how the world was composed, had led me to disassociate nature from the metals in my built environment. Up to that point, I had divided the material world into two large groups: natural things and artificial things. Natural things had their origins in nature and were produced by natural, organic processes. Artificial things, in contrast, originated in factories and laboratories and were produced by science, technology, and machines; they were artifacts of the human imagination and labor. This binary construction not only pitted the one against the other (the artificial *versus* the natural) but also had the cognitive effect of implying opposing forms of *origin*. Metals, as members of the category "artificial," would have no natural origins at all, or at least none with any substantial meaning.

My conceptual oversight became crystal-clear to me that day. I had operated with a limited understanding of the natural origins of metal, crediting its existence to science and technology and failing to imagine that the path of metals led back to nature. I had disassociated my own dependence on metals from the processes of ore formation and the practices of extraction, refinement, and fabrication into the artifice that surrounded and supported me. By seeing metals as artifice only, I had lost sight of their existence as a product of nature and of everything that natural existence implied. Montanans were not the only ones who had forgotten the devastating impacts of mining and smelting that made the ubiquity of metals possible; that

ubiquity had been circumscribed by common sense itself. The modern categories by which most Americans had come to make sense of their complicated material world had created a material shortsightedness, an incomplete knowledge about the natural context of a minerals-based society. We have, oddly, forgotten that we are fundamentally a mining nation.

But for me, the boundaries that had separated the artificial from the natural suddenly began to appear less certain, less absolute. It became clear to me that day that metals are as natural as wheat flour, lumber, or sides of beef. I realized that our entire "artificial" infrastructure and the billions upon billions of tons of metallic materials that made such a world possible required and continued to require the relationship with nature that we call mining.[4]

Common sense suggested that I would uncover the deeper connections that wove natural minerals into modern society in the field of mining history, where there were hundreds of studies of western mining, including many that focused on Montana mining specifically. But this proved a bit of a dead end. Most of the vast scholarship in the field said very little about mining as an engagement and exploitation of *nature*; nor was much sustained attention given to the evolving processes by which the naturally existing enriched mineral deposits became the cultural commodity known as metal. In addition, these sources were often silent about describing these deposits. Instead, most of the studies constructed careful institutional, social, labor, and political histories similar to those done on any of several sectors of US business and political development. The studies collectively construct mining as something miners and mining companies simply did in places where large or valuable ore deposits existed. Mining seemed to emerge as a natural extension of national economic growth—although clearly, throughout all the studies, one can see an unusual degree of uncertainty and contingency in the practices.[5]

I turned next to the field of environmental history, a growing body of scholarship whose practitioners had set out to uncover the role of nature in US history. Here I found no studies of mining and only troubling guidance about how to frame the problem of mining within the discourse of environmental history. In the early 1990s, environmental historians had focused a large share of their attention on organic nature, studying agriculture, forests, parks, and the human habitat of cities, as well as the ideas and practices surrounding these dynamic ecological communities. Powered by the romantic-fueled wilderness ideal of nature, many of these studies constructed their stories against the background of a once-uncultivated, untouched landscape upon which they either traced a decline under the burden of the US economy or celebrated the preservation of some of these lands as a result of US conservation efforts. While these studies helped me understand the larger ideological reasons I had lost sight of the natural origins of metals, the approach threatened to

reduce an environmental history of mining to a simple measurement of impacts. As a senior historian once asked when I told him I intended to write an environmental history of mining, "what else is there to say but that mining came in and tore things up?" Armed with the romantic wilderness ideal, an environmental history of mining could not be imagined as anything more than an environmental impact statement written backward. I didn't think such an approach would help us understand the nature of mining so much as make us horrified by mining's ecological outcomes.[6]

Serendipitously, however, at the same time I was beginning to frame these questions into a doctoral project, the field of environmental history was undergoing a process of rethinking and re-imagining that would ultimately enhance the kinds of questions I asked about mining as an environmental history. In particular, the historiographical concern with "nature" began to include questions of relationships, and narratives borrowed metaphors from physics and began to tell stories about the organization of space and the role of work in contributing to our ideas about nature (and not nature). At least one book-length study of mining followed immediately upon this turn, providing a wonderful critical analysis of the culture of the Klondike gold rush.[7]

Among these new studies, the most relevant to the questions I ultimately pursued was Richard White's *The Organic Machine*. In his short but provocative book, White reframed the question of nature in history as one in which relationships among energy, labor, and knowledge became the central focus. In my estimation, such a shift provided a workable alternative to studying environmental impacts for an environmental history of nineteenth-century metal mining. Rather than stories of abuse, White suggested looking for stories of relationship. Following Henri Lefebvre's very useful characterization of the living organism as an "apparatus which, by a variety of means, captures energies active in its vicinity," White had composed a succinct history of the Columbia River seeking out these *energy relationships*. His findings suggested that there have been historical configurations of knowledge, tools, landscapes, and ambitions, what he characterized as "energy regimes," whose interactions reveal the most intimate dimensions of the human-nature relationship. His narrative of the Columbia River uncovered not a widening gulf between people and nature, as the wilderness narrative has suggested, but instead a growing (if dysfunctional) intimacy, a hybrid tangle of human manipulation and natural processes, physical energies, and cultural narratives that can never be undone. White suggested that rather than characterize human use of nature as "rape," as so often happened in environmentalist discourse, "what had happened is closer to a failed marriage."[8]

Such a conception of environmental history gave my puzzle about Montana new life as a doctoral project and, eventually, as this book. I realized that my initial question about how people stood by and allowed their landscapes to be ruined was

potentially misconceived and perhaps even distorted the relevant history of mining in Montana and, as I would soon discover, across the metals industry of the US West in the nineteenth century. I began to focus instead on the potentially more interesting and revealing stories about the processes by which Montana and the United States became so committed to mining in the first place. Clearly, the long-term environmental and human health outcomes that are metal mining's legacy today served no one, but like all failed marriages there had to be more to the story than the long-term outcomes. To understand the environmental history of mining from this perspective, it seemed prudent to explore western mining as the formation and development of a specific kind of social relationship with the natural world at a specific historical moment in a specific spatial and social context. *Gambling on Ore* is an attempt to do just that.

But writing about the formation and development of mineral exploitation as a social relationship in the nineteenth-century US West, it turns out, does not lead to an obviously "environmental" story. First, mineral deposits do not lend themselves to the familiar tropes and categories of environmental history. Few romantic poems have been written for ore lodes. Worse, the same mountains that are celebrated in the romantic tradition for their sublime presence, scale, and permanence are, through mining, excavated and even removed from the landscape; if ever an industry qualified for the "rapist" metaphor, mining would appear to do so. Further, the geological sciences have never been the traditional interpretative lens for environmental narratives. Rocks are, at best, the underlying and distant foundation creating the limits and possibilities atop which the real action of nature—ecology and community interaction—takes place; rocks have few stories of their own to add.[9]

In addition to the narrative challenges, the natural structure of mineral deposits—key actants, it turns out, in mining's environmental drama—makes them an elusive subject for both miners and environmental historians. Unlike forests and farms, cities and wildlife, mineral deposits are functionally invisible. For nineteenth-century miners, they were buried under solid, opaque earth. A miner could not have known whether valuable minerals existed in a particular location without prior investment of time, labor, and, as the nineteenth century wore on, money. In a delicious material irony, the only solid confirmation that a mineral deposit was valuable was the existence of valuable metal that was by then no longer a part of that deposit. When miners sought to profit from rocks, they entered into a kind of blind wager. For this reason, trying to synchronize the words and behaviors of miners with an actual physical mineral deposit is very difficult. Indeed, again and again in all forms of mining, one finds nothing but uncertainty at the interface of miners and rocks.

This persistent uncertainty made the mining relationship unstable; in the US mining industry after 1860, it created a recurrent set of patterns emerging out of mining's elusive successes. In short, US western miners developed an industry in which miners tended to over-invest in periods of uncertainty and to over-produce in periods of success. The one often led to the other, with some subset of the aggregate efforts yielding success and thus locating a site where overproduction would soon follow. Because these patterns were designed to exploit mineral deposits—hidden, specific, discrete, and, critically, finite geological material—overproduction meant the rapid exhaustion of a paying claim, which represented its own set of uncertainties and also contributed to industry dynamics. In the US West during the second half of the nineteenth century, these qualities engendered a growth dynamic whereby miners and mining companies continually pressed to intensify and expand production, well ahead of market demand. The overproduction of the age led many to characterize and understand the products of mining as the simple linear outcome of an extant natural resource endowment and made the presence of lots of metals something quite natural. Thus, in another rich irony related to mining, the almost unnatural overproduction of metals from US mineral resources led to the naturalization of metals in society. Because of the intensive pace of exploitation, the richest deposits disappeared very quickly and ore lodes either diminished in grade or disappeared, yet somehow the mining industry continued to wrest more and more metal every year from an ever-lower grade of ores.

Many of the stories that follow do not seem to have much to do with nature or environmentalist concerns; they are mostly about miners trying to profit from rocks. They divert waterways and fell forests and leave behind messes of tremendous proportion, but none of these impacts is my primary focus. Mineral deposits contribute to environmental stories by leaving a trace of their influence in the institutions and practices miners organize to exploit them. For this reason, *Gambling on Ore* focuses more on miners and mining institutions than on impacts and more on rocks and metals and water than on trees and animals. I have written a story that does not present itself as obviously "environmental" in the common sense of that term; that is, I am not narrating ecological decline. But in creating a story about what has become an inescapable relationship with nature in the modern world, I am writing what I believe is a very important environmental history.

Through this approach, I have come to believe that metal mining is not just another story to be told about the place and role of nature in US history; it also represents a keystone material relationship in the years that followed the US Civil War. In ways I hope will become clear in reading this book, as they became clear to me while writing it, mining established a set of approaches to natural resources that have come to define our production practices since that time. In this way, mining has had

a profound influence on the human ecology and social relationships of modernizing North America throughout the twentieth century and the world after World War II. I believe that understanding how we forged these particular relationships is central to understanding the environmental history of the United States after 1850.

Gambling on Ore tells this story by studying the evolution of mining practices in the US West during the second half of the nineteenth century. Because my questions began in Montana, the main focus of this book is the Montana mining region, but it is offered as a representative case study of mining developments in the broader US mining west. Montana's mining history, like mining in the US West as a whole, can be divided into four major intersecting and overlapping mining episodes, each existing as a fundamentally different energy regime: the gold rush, the development of silver lode mining, the development of low-grade copper production, and the corporate consolidation of the regional base-metal production (in Montana's case, copper) industry.

In Montana, the accidents and uncertainty of the gold rush culture in the 1860s not only generated extreme acts of violence and chaotic, short-lived settlements; they also contributed to a shift to the extraction of silver ores and—after a period of adjustment, federal recognition, and the rise of a professional mining culture in the 1870s—began to express a pattern of iterative, uncertainty-related growth that came to mark the practice of hard-rock mining. The size and scale of silver lode mining by the 1880s not only brought deposits of copper ore into view; they also stimulated the belief that low-grade copper ores could be mined and processed for a profit in the western region. This belief did not generate immediate profits, but it did lead to some of the largest copper-processing facilities in the world, the enormous overproduction of metallic copper, and the early formation of modern business institutions in the US West.

But the modern copper industry could no more keep up with the perils of uncertainty embedded in the mining relationship than had any of the earlier stages of metal mining. Its efforts to control against these uncertainties only led to the production of landscape-scale impacts. The social conflict that followed as other users of the same landscape challenged the industry's right to diminish the fertility of their shared environment raised new levels of uncertainty for large-scale producers who had to justify their behavior in the courts. Only radical changes in the law and practices of adjudication that had, not incidentally, emerged in response to mining needs since the 1850s prevented the success of these social challenges to the kind of mining and smelting that had taken shape at the beginning of the twentieth century. By the

time it became eminently obvious that mining had evolved into a set of destructive ecological relationships, the market products of these relationships had become too important for modern society to live without. This remains our conundrum.

The steps and stages on the way to twentieth-century, industrial-scale, mass-production mineral processing reveal a steadily growing commitment to an increasingly problematic undertaking, confronting proximate challenges only. At no individual point was it obvious how deep and destructive the mining relationship would become in the United States, but the anxious scramble to stay ahead of uncertainties and stabilize instabilities might have given us pause that something was afoot. Like failed marriages that can leave two people in utter despair, it was only when too much time had passed, too much water had flowed under the proverbial bridge, and too many wrong moves had been made that the pattern culminated in an obvious mistake. Unlike the metaphorical couple, however, the parties to this relationship were unable to go their separate ways; instead, as may be human nature in such circumstances, denial, deflection, and deceit worked to marginalize the ultimate results—except in moments when they insisted on reminding us they were still with us, like the arsenic in the Clark Fork River.

NOTES

1. "ARCO Environmental Action Plan for the Upper Clark Fork River Basin, Spring 1995," published by the Atlantic Richfield Company; Kevin Miller, "Arsenic Found in Milltown Water Supplies," the *Missoulian*, December 15, 1981; Miller, "Arsenic Probe Is Stepped Up, Warning Issued," the *Missoulian*, December 16, 1981; Miller, "Quantity and Toxicity of Arsenic in Milltown Top Previous Levels," the *Missoulian*, December 22, 1981; David Roach, "Contamination Leaves Residents Perplexed," the *Missoulian*, December 16, 1981.

2. Watson Davis, *The Story of Copper* (New York: Century Company, 1924), 37; G. L. Loughlin, *Mineral Resources of the United States: Part I—Metals, 1918* (Washington, DC: Government Printing Office, 1921), 270; Michael Malone, *The Battle for Butte: Mining and Politics on the Northern Frontier, 1864–1906* (Helena: Montana Historical Society Press, 1995), 34–35.

3. To give just two influential examples, neither Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore: Johns Hopkins University Press, 1983), nor David E. Nye, *Electrifying America: Social Meanings of a New Technology* (Cambridge, MA: MIT Press, 1997), mentions copper ores or copper mining in their discussions of the rise of electrification in the western world.

4. Marx's labor theory of value makes a very similar point, although his concern was to recover the social activities (social labor) hidden behind the seemingly just-so market commodity, while mine is to recover the social relationships with *nature* embedded in these

hidden social activities. See Karl Marx, *Value, Price and Profit* (New York: International Company, 1969), esp. chapter 6, "Value and Labor." On the spatial expression of these three natural commodities, see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991), esp. part 2: "Nature to Market," 97–260.

5. There are many books about the California gold rush, but most of them either focus on the adventurous and sometimes paradoxical experiences of gold seekers leaving their homes and coming to new circumstances or treat the social, demographic, or cultural challenges confronting the communities that formed around gold mining in the absence of formal political structure and formal policy and regulation, but they rarely consider or even much describe the natural conditions of gold, the techniques enlisted for its exploitation, or the relationship between the two. See, for example, Mark A. Eifler, *Gold Rush Capitalists: Greed and Growth in Sacramento* (Albuquerque: University of New Mexico Press, 2002); May McNeer, *The California Gold Rush* (New York: Random House, 1994); JoAnn Levy, *They Saw the Elephant: Women and the California Gold Rush* (Norman: University of Oklahoma Press, 1992); Robert M. Senkewicz, *Vigilantes in Gold Rush California* (Stanford: Stanford University Press, 1985); Bernard J. Reid and Mary McDougall Gordon, *Overland to California with the Pioneer Line: The Gold Rush Diary of Bernard J. Reid* (Stanford: Stanford University Press, 1983); Ralph Mann, *After the Gold Rush: Society in Grass Valley and Nevada City, California, 1849–1870* (Stanford: Stanford University Press, 1982); J. S. Holliday and William Swain, *The World Rushed In: The California Gold Rush Experience* (New York: Simon and Schuster, 1981); Donald Dale Jackson, *Gold Dust: The California Gold Rush and the Forty-Niners* (Boston: Allen and Unwin, 1980); Robert E. Levinson, *The Jews in the California Gold Rush* (New York: Ktav, 1978); Rudolph M. Lapp, *Blacks in Gold Rush California* (New Haven, CT: Yale University Press, 1977); Andrew Bronin, *California Gold Rush, 1849* (New York: Viking, 1972); Rodman Wilson Paul, *California Gold* (Lincoln: University of Nebraska Press, 1965); Mary Floyd Williams, *History of the San Francisco Committee of Vigilance of 1851: A Study of Social Control on the California Frontier in the Days of the Gold Rush* (Berkeley: University of California Press, 1921). There are also a number of studies beyond California, stories about the discovery of ores in Nevada and the rise to fame of the silver barons on the Comstock Lode, such as future senators William Stewart and George Hearst, and stories about the millions made by Marcus Daly and future senator William Clark in the Butte copper fields. In all cases, the studies provide typical narratives of self-made men who learned how to best the uncertainties of mining and whose ambitions and character helped them join the ranks of the business and political elite during the aptly named Gilded Age, but these books also give few details about the natural state of the minerals exploited, and, other than profits and fortunes generated and sometimes measurements of the volume of metals produced, the social and environmental relationships comprising mining practice are all but neglected. See, for example, Richard Peterson, *The Bonanza Kings: The Social Origins and Business Behavior of Western Mining Entrepreneurs,*

1870–1900 (Lincoln: University of Nebraska Press, 1977); Russell R. Elliot, *Servant of Power: A Political Biography of William M. Stewart* (Reno: University of Nevada Press, 1983); Carl B. Glasscock, *The War of the Copper Kings: Builders of Butte and Wolves of Wall Street* (New York: Grosset and Dunlap, 1935); John Stewart, *Thomas F. Walsh: Progressive Businessman and Colorado Tycoon* (Boulder: University Press of Colorado, 2007). In the social histories of mining communities, mining serves as a backdrop within which settled working society organized itself against the harsh edges of industrial exploitation. This is also the case with other institutional and economic histories of mining companies that likewise present the act of mining, with the underlying environmental relationships as a given. See Mary Murphy, *Mining Cultures: Men, Women, and Leisure in Butte 1914–1941* (Urbana: University of Illinois Press, 1997); Philip J. Mellinger, *Race and Labor in Western Copper: The Fight for Equality, 1896–1918* (Tucson: University of Arizona Press, 1995); Susan Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W. W. Norton, 2000). Studies of mining labor show that mining was a specific and unique activity in nature, requiring specialized knowledge and understanding of the mining environment and the character of mineral deposits. As essentially labor histories, however, concerned with the formation and fate of the working class, these studies provide details of the underground workings only insofar as they help to reveal the consequences of deskilling as industrialization at the hands of finance capital gained control over the American economy. Thus they reveal little more about mining as a unique activity in nature or as a new US industry in the nineteenth century. As social histories of labor, these studies also show little interest in the broader ecological and geological forces influencing and being influenced by the rise of mining in the American West. See John Rowe, *The Hard Rock Men: Cornish Immigrants and the North American Mining Frontier* (New York: Barnes and Noble Books, 1974); David M. Emmons, *The Butte Irish: Class and Ethnicity in an American Mining Town, 1875–1925* (Urbana: University of Illinois Press, 1989); David Rosner and Gerald E. Markowitz, *Deadly Dust: Silicosis and the Politics of Occupational Disease in Twentieth Century America* (Princeton, NJ: Princeton University Press, 1991). Other exceptions include a very small handful of historical treatments of the broad pattern of mining development as it unfolded across the American West or across the United States generally. These studies reveal more of the kinds of large-scale changes that marked American mining development in the nineteenth century, tracing the growth of the industry from the first wave of the gold rush and placer mining in 1849, through the development of silver ore lodes in Nevada in the 1860s and elsewhere in the West in the 1870s, to the exploitation of complex copper ores in Montana, Utah, and Arizona in the 1880s and 1890s. These broader studies of the entire region help identify the geographic specificity of ore lodes and deposits and follow the steady import and development of mining skills and knowledge as mining district after mining district came under the productive energies of the American economy. They chart an interesting shift in the contours of American frontier development, as the slow but steady agrarian

frontier that had pulled the United States westward through the first half of the nineteenth century gave way to a more rapid industrialized mining frontier that began in the Sierra Nevada foothills in California and leapfrogged its way eastward into the interior of the Rocky Mountains. As the industry came to dominate the western mountain landscape and to move into ever-more-complex ore lodes and lower-value metals, a parallel growth in the scale of mining operations and the engineering skills needed to develop the systems of extraction and processing embedded in these new mining systems tagged along, sometimes leading the way but more often following on the heels of expensive mistakes and waste of capital in less carefully planned investments. We finally learn about the environmental impacts associated with mining development every step of the way—from sand, gravel, and mercury pollution in California rivers, which impacted the budding agricultural interests of the Central Valley; to the tailings and other by-products of hard-rock silver mining; to the sulfur smoke and toxic pollution of the low-grade copper smelting choking entire communities in the valleys where mining took place. But from the earliest of these studies to the most recent, mining is framed as a story in which a given deposit of ore in the ground is unproblematically "discovered" and subsequently exploited by whatever mining interest is at hand. The mineral or ore was in the ground, as measured by its final production figures, and all the miners and mining companies needed to do was remove it as cheaply as possible and process it as efficiently as possible. The prior existence of minerals in the earth, in whatever volume they occurred, is presented as the unmitigated natural condition that drove the vast development of a mining industry in the US West in the nineteenth century. Everything else is narrated as a logical reaction to this "natural endowment," and the American public understood the impacts as the necessary results of this demanded exploitation, if they were thought to be understood at all. Interestingly as well, none of these studies makes any effort to link the mining and ore-processing activity to the broader material economy (to assess when and how demand emerged, for example). See Thomas A. Rickard, *A History of American Mining* (New York: McGraw-Hill, 1932); Rodman Wilson Paul, *Mining Frontiers of the Far West, 1848–1880* (Albuquerque: University of New Mexico Press, 1974); Clark C. Spence, *Mining Engineers and the American West: The Lace-Boot Brigade, 1849–1933* (New Haven, CT: Yale University Press, 1970); Duane A. Smith, *Mining America: The Industry and the Environment, 1800–1980* (Niwot: University Press of Colorado, 1993 [1987]). In fairness to the fields of mining history and environmental history, historians have already begun an effort to understand mining from this broader, more contextualized perspective. Two recent books suggest some of the contours and major themes that begin to arise with this kind of conceptualization of an environmental history of mining. The first is Andrew Isenberg's *Mining California: An Ecological History* (New York: Hill and Wang, 2005), which describes how patterns of industrialized nature in the California goldfields repeated themselves in gold mining experiences across the intermountain West and at the same time animated the region's timber and grazing interests with a similar spirit of indus-

trialized natural resource exploitation. In other words, the techniques by which California gold rush miners solved the gold extraction problem in the Sierra Nevada foothills proved more broadly applicable to other natural resource exploitation efforts than previously acknowledged. Isenberg describes a "California example" in which large-scale technological control exploited resources as quickly as possible and usually with profligate waste, perpetuating a boom-and-bust economic development pattern that would define the American economy. "Mining" was both the original source of these impulses and an apt metaphor for the development spirit that followed. "Euroamericans reinscribed the political ecology of California upon the landscape of the West," Isenberg concluded (p. 178). In this way, the environmental history of western Montana's mining exists within a broader set of technical developments that began in and around California's gold creeks. Montana's gold rush took place nearly thirteen years after California's, but it recapitulated patterns of development very similar to those expressed in the Sierra Nevada foothills in the 1850s. Similarly, Timothy J. LeCain's more recent *Mass Destruction: The Men and Giant Mines That Wired America and Scarred the Planet* (New Brunswick, NJ: Rutgers University Press, 2009) not only offers a boldly conceived mining narrative that traces the cultural repercussions of brute force technology from its origins in open-pit mining out into the technological world of twentieth-century society, it also develops a story in which technological and ecological causes together produced a hybrid mining landscape. *Mass Destruction* follows the career of Daniel Jackling, who invented the techniques known as open-pit mining in response to increased scarcity of high-grade ores in US mineral fields. LeCain argues that overproduction of the richest ores in the West by the dawn of the twentieth century had created an industrial appetite for metals unprecedented in human history and soon to be starved by diminishing ore reserves. Jackling's technique filled the growing void between demand and supply, preventing scarcity and contributing to continued mining industry success and imagined new cultural ideas about power. LeCain's use of what is called an "envirotech" framework, an emergent perspective that seeks to merge the field of environmental history and the history of technology, contributed forcefully to his conception of mining technology as a particular cultural response to the conditions of nature as perceived by the industry.

6. Multiple studies explore the origins of environmental and ecological thought and policy, but some of the landmark studies in the field are Roderick Nash, *Wilderness and the American Mind* (New Haven, CT: Yale University Press, 1982); Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955–1985* (New York: Cambridge University Press, 1987); Donald Worster, *Nature's Economy: A History of Ecological Ideas* (New York: Cambridge University Press, 1994); Paul Sutter, *Driven Wild: How the Fight against the Automobile Launched the Modern Wilderness Movement* (Seattle: University of Washington Press, 2002). See also Donald Worster, "Transformations of the Earth: Toward an Agroecological Perspective in History," *Journal of American History* 76, no. 4 (March 1990): 1087–1106. An example of the first kind of analysis can be found in

Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979) and an example of the second in Brian Donahue, *The Great Meadow: Farmers and the Land in Colonial Concord* (New Haven, CT: Yale University Press, 2004).

7. Kathryn Morse, *The Nature of Gold: An Environmental History of the Klondike Gold Rush* (Seattle: University of Washington Press, 2003). William Cronon, "Kennecott Journey: The Paths out of Town," in William Cronon, George Miles, and Jay Gitlin, eds, *Under an Open Sky: Rethinking America's Western Past* (New York: W. W. Norton, 1992), 28–51, also examined mining through the lens of environmental history.

8. See also Henri Levebvre, *The Production of Space,* trans. Donald Nicholson-Smith (Cambridge, MA: Blackwell, 1991 [1974]), 176; Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995), 29, 59.

9. See, for example, "Prologue: Rocks and History," in Ted Steinberg, *Down to Earth: Nature's Role in American History* (New York: Oxford University Press, 2008), 2–7.