

calating environmental damage. MHA members who attended the 2002 conference held in the Silver Valley may recall the yard signs reading “Just Say No to the EPA.”

Those who wonder why cleanup is such a contentious issue must look to Aiken’s Bunker Hill book or Laurie Mercier’s *Anaconda*, about another smelter town, for in-depth analysis of how communities, dependent on a single industry or company over which they have little control, may forgo their own health to keep jobs and often display great distrust of outsiders, whether they be from the EPA or the *Washington Post*. That tension between proud heritage and environmental legacy plays out throughout this volume as it does throughout the history of many communities in the mining West.

The force of *Leaded’s* relentless probe of the environmental impact of Bunker Hill activities overpowers these criticisms. Mix’s book complements Aiken’s company history and Julie Whitesel Weston’s 2009 memoir *The Good Times Are All Gone Now* (reviewed in the 2010 *Mining History Journal*) about growing up in Kellogg. Together they vividly portray not only changing mining and processing practices and their environmental legacy but also the people who call the Silver Valley home.

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Hjalmar Fors. *The Limits of Matter: Chemistry, Mining and Enlightenment*. Chicago: University of Chicago Press, 2015; 241 pp., 10 illus., notes, bib., ind., cloth, \$40.00. ISBN: 9780226194998

In 1676 Stockholm, Urban Hiärne, later head of the Swedish Bureau of Mines’ *Laboratorium Chymicum*, sat on a tribunal that sentenced a witch to be burnt at the stake and decapitated. As the witch hunt continued, he and his peers became skeptical, questioned the accusers’ motives,

and required better evidence. The trial process, with new criteria, stopped and then reversed the outcome for later accused witches.

In *The Limits of Matter: Chemistry, Mining and Enlightenment*, Hjalmar Fors uses the witch trials and Hiärne’s role as symbols of shifts in thought on mysticism. They also lead into the discussion of transformations within the mining industry from myth and wizardry to the beginnings of a more enlightened approach. At the onset, Fors suggests to the reader that the witch trials are “a powerful reminder that people of the late seventeenth century defined reality quite differently from most who live in the early twenty-first century” (p. 20).

This is an important point, to lead the reader away from our secure view of progress, science, and technology, to a distant world at the “edge of the map,” where there be dragons. The author transports us to a very different time and place. Historian Fors teaches at the Department of History of Science and Ideas at Uppsala University, Sweden, and uses a surprising wealth of extant, original source materials for his study. He is also passionate about his topic, the Swedish Bureau of Mines, founded 1637, and its part in seventeenth- and eighteenth-century evolution of “knowledge” during what we conveniently call the Scientific Revolution. In the usual histories of science, Sweden is slighted, he believes. Fors provides a superb corrective to the literature through the examination of the mining bureau and its members’ experiences.

Fors starts with an overview of major concepts and a brief synopsis of the chapters, then begins chapter two with the witch trials. He describes the world of miners and their strongly held belief in the spiritual or mystic, a world populated by trolls, gnomes, mine keepers, and “demons of the underworld.” The first published description of such beings, Fors writes, was in Agricola’s lesser-known book *De Animantibus Subterraneis* (1549) on “demons of the mines,” which included mine creatures deadly to dangerous, harmless to,

even, helpful.

Fors then expands to the Swedish mining experience. For example, all mineral deposits were owned by mine keeper entities, mostly invisible, who decided when and where to allow people to discover ore and mine; mine keepers could also evolve into animals or beautiful women. Bulls or rams that lay open the glint of metallic ore, trolls that might put miners in danger; these mythic and magical entities were part of the world of mining when the Bureau of Mines was formed.

As in the witch trials, bureau head Hiärne and his peers began to question the power of mine keepers, stating that they had no influence over mining business, though for the moment they left the question of their existence open. The Swedish bureau was allocated space and a healthy budget with the best of assay laboratories and backed by the King's court. Fortunately not tasked to conduct alchemical transmutations or to find the mythic elixir of life, but instead seeking to find practical improvements for the business of mining, the bureau flourished from 1680 to 1760. For instance, it sought new metallurgical processes for the great Falun copper mine, alternative methods to extract copper from its ores, when Sweden dominated the world's copper market.

The bureau articulated a new type of thinking, toward the new "scientific" view of matter as solid and often made of multiple compounds. As the author says, the bureau's "*chymistry* had a major role in discrediting the material reality of trolls, witches, miraculous transformations, and magical causation because it was chemistry that established itself as the authority on what matter was; thus it also had the final say on what matter could not be and do" (41). The Swedish Bureau of Mines defined the limits of matter.

In chapter three, "Chymists in the Mining Business," the book romps around pre-Enlightenment Europe, with a focus on Swedish, German, and British mining philosophy and practice at the time. For example, Fors shows the state of the mining world through travel letters writ-

ten by bureau chemist (assayer) Erich Odhelius during his extended stays in mining regions like Freiburg and the Tyrol. He visited the continental centers and Britain, where he found the great Robert Boyle far past his prime: "He is old now," Odhelius wrote to the bureau, "and would do well to die with a [good] reputation, and to cease to write further, because his things are not 'ingenii auctoris.'" These travel reports show the bureau as an important link and rival in the European network of exchange of scientific ideas.

Among the bureau's leading members were Georg Brandt and Axel Fredrik Cronstedt, the first to describe cobalt and nickel, respectively. Their and other members' works are reviewed in chapters four and five, on evolving "knowledge" and advances toward Enlightenment. In the bureau's laboratory, Brandt organized a school of assaying to move beyond the tradition-bound work of the artisan. He also published a volume using a new systematic description of metals. Brandt is best known for his *Dissertatio de Semi-Metallis* (1735), and for his careful chemical analysis of ores. His student, Cronstedt, used assaying, or the new analytical methods, for the purpose of finding new ways to define minerals—not quite modern as we understand them, but moving in the right direction. His *Försök til Mineralogie* (1758) is the classic volume on his work, which, some claim, warranted the argumentative Cronstedt the title of founder of modern mineralogy.

This is not a history of heroes but of transitions toward the Modern. The bureau's leaders, Fors notes, left room for the mythic entities but gradually removed them from the processes of the exploration, mining, and smelting businesses through criticism and ridicule, and removal from examination. If the bureau was to be taken seriously in the community it had to, Fors writes, "set in place rules about proper discourse and actions that were to be followed by actors who wished to be taken seriously" (148). There were two worlds, that of new science ("knowledge"), and that of folk myth, alchemy, wizards, and magic. Alchemy

was not going away, nor were mine keepers. They became a separate sphere from the new order as defined and delineated by the bureau's scientists.

Fors concludes that during the greater part of the eighteenth century the Swedish Bureau of Mines was admired as the cutting edge in engineering, chemistry, and mineralogy "among Europeans, and Britons, in the know" (152). However, after 1760, the bureau waned with the rise of the university center at Uppsala and its faculty, which has over-shadowed the earlier work of the bureau.

The bureau is largely unknown today because, Fors writes, later historians of science and technology saw, primarily, that seventeenth- and eighteenth-century innovation proceeded from England, and anything not connected to English technical or industrial development was ignored. The bureau was overlooked as well because mining historians focused on Freiburg and the establishment of its school of mines in 1765.

Although the focus is less on specific Swedish mines and their history, mining historians in the Americas will enjoy this close examination of some roots of chemistry, metallurgy, and the industry. The many tales in the American West of animals helping prospectors discover mines immediately bring to mind Fors' discussion of mine keeper entities. The folk tales here in the West may indeed have come from overseas along with European immigrants, a sprite in their cultural baggage. Not as important to mining historians, but significant, is Fors' success, at least to this reviewer, in elevating Sweden's Bureau of Mines to a respectable place, once forgotten, in the history of the Enlightenment.

The University of Chicago Press, as usual, has produced a good-quality book, with ten half tones of period images and artifacts. A map would have been of benefit to the reader.

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Bradley D. Snow. *Living with Lead: An Environmental History of Idaho's Coeur D'Alenes, 1885-2011*. Pittsburgh: University of Pittsburgh Press, 2017; xi + 275 pp., 20 b&w illus., notes, gloss., bib., ind., paper, \$28.95. ISBN: 9780822964483

A twenty-first century traveler through the Coeur d'Alene mining district might be excused for not recognizing one of the greatest silver mining districts in the world or one of the most challenging environmental legacies of mining. The massive Bunker Hill smelter and zinc refinery, once a prominent feature just south of I-80, is gone. A golf course sits on old tailings and the former metallurgical site has been re-contoured and vegetated. A visitor departing the interstate at Kellogg will shortly encounter odd buildings decorated in "alpine" style with nearly illegible gothic signage. A visit to the Coeur d'Alene River downstream would reveal lush vegetation, clear water, and wildlife, but the soil under one's feet—contaminated from decades of tailings flushed down the river—might contain several percent lead and zinc.

How this all came about and how it was and is being dealt with is the subject of Bradley Snow's magnificent *Living with Lead*, which is a very apt title. When I and my colleagues at the U.S. Geological Survey studied the distribution and extent of tailings throughout the Coeur d'Alene River basin during the 1990s, we quickly realized that removing all of the lead was not possible. There was simply too much earth to move, too much habitat that would be destroyed. People were going to have to learn to live with the lead.

Fortunately, some things could be and were done. While the various mills in the district sent their lead-laden tailings into the river, the Bunker Hill smelter emitted tons and tons of lead, cadmium, sulfur, and other pollutants into the air. Lead got into the blood of locals, particularly children, mainly through ingestion of smelter dust settling in back yards and school playgrounds. Sulfur di-