meals and wore warm clothing and shoes in heated homes, it was clear that the town could not continue without a reliable source of employment. Although the mine reopened under local ownership in 1951, it produced only ten to fifteen thousand tons a year and provided jobs for a relative handful of workers. The men agreed to work without a union, but the UMWA intervened and prevented that from happening. Still, the small mining operation continued to produce coal and provide some work. But not enough, so an outmigration began in the 1950s. In 1952, J. Paul and Molly Andrick left to teach in another school district where he eventually became principal. By 1956, the settlement had only 34 homes and 151 citizens.

The Buffalo Coal Company bought the mine in 1968, but closed it in 1971. Only fifty people were living in Shallmar by that time. In 1970, a mountain of coal tailings gave way "burying outhouses and filling the basements of the houses." It was another serious blow and most of the remaining occupants saw it as a sign to move out. Shallmar became a veritable ghost town, although some hearty souls remained behind and, in fact, a few still live there.

In constructing the story, Rada relies on interviews, newspapers, websites, secondary sources, and various types of official documents. Although *Saving Shallmar* is written for a popular, not an academic, audience, the author provides nearly page-by-page referencing in the "Notes" section in the back of the book. Rada clearly conducted a good deal of research to prepare the volume. His use of individual names and places, along with several photographs, helps enhance the reality of the narrative.

Three points of analytical consideration regarding the volume: First, the author sometimes displays what could be interpreted as an ideological bias in his criticisms of "the government" and "the union," without delving too deeply into the details surrounding their respective weak responses to Shallmar's crisis. Second, at certain points the narrative borders on the nostalgic while devoting more attention to the descriptive and less to the analytical. Third, the author's list of the coalfields in the U.S. properly includes the Appalachian, Midwestern, and Rocky Mountain fields, all bituminous. However, he does not mention the other American coal, anthracite or hard coal, produced in a ten-county area in northeastern Pennsylvania. Not that this exclusion diminishes the well-told story, but it is worth remembering that anthracite was the first American coal to be mined and, as such, played a vital role in fueling the nation's industrial revolution after 1820. A few hearty souls still mine it—and live in places like Shallmar!

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Eric C. Nystrom. ***Seeing Underground: Maps, Models, and Mining Engineering in America.*** Reno: University of Nevada Press, 2014; 320 pp., 43 b&w illus., notes, bib., ind. cloth, $40. ISBN: 9780874179323.

A dozen lawyers on a side,
And eminent experts multiplied;
Maps of the biggest and the best,
And models 'til you couldn't rest.

So begins Rossiter Raymond's poetic satire of mining litigation. But maps and models served other important purposes besides the litigious one lampooned by that eminent expert Rossiter Raymond. In *Seeing Underground*, Eric Nystrom examines the development of what he calls "the visual culture of mining," meaning the uses of map making and model building to interpret underground spaces for purposes of development, safety, litigation, and education.

Seeing Underground considers the period from 1870 to 1920, the era of the triumph of industrial mining, largely through case examples. The book is divided into two sections that discuss the mak-

ing of maps and of models.

The first chapter of the maps section introduces the map-making process through the techniques and tools of the trade. The next discusses the earliest sustained map-making, which took place in the anthracite fields of eastern Pennsylvania thanks to the path-breaking Pennsylvania mining law of 1870, which required underground mapping by mining companies for safety reasons. Nystrom focuses the story of the progress of mapping in Pennsylvania on Eckley Coxe, mining engineer, coal mine owner, and a leader in the rationalization of anthracite mining. The final chapter in the maps section shifts the focus to copper mining in Butte, Montana, where mining engineer David Brunton developed the mine map from an information storage and retrieval system into an analytic tool used, in turn, to further develop the mine.

The early driving forces of mine mapping were the scale of the industrial mine, which required some sort of systematic accounting, and mine safety and litigation, which demanded it. Even in the early twentieth century, however, Nystrom finds that "a spectrum of accuracy and care" existed throughout the industry in underground mapmaking.

Nystrom also observes that "mine mapping and surveying became central to the professional identity of mining engineers. Creating and using maps made mining engineers who they were." This at a price, however; interpreting maps and models permitted an understanding of the underground beyond what had been already exposed, enabling geologists to supplant mining engineers as the most significant figures in mine development, especially in hard rock mines. Nystrom provides a fine example and lucid explanation of how management at the Mountain View mine at Butte used map analysis to discover a portion of a double vein disguised by faulting.

The second section of the book, also of three chapters, discusses the making and uses of mine models. Models fell into three general types: block models made of wooden blocks; glass models that used sheets of glass to represent the different levels; and negative or skeletal models, usually made of metal, that showed the workings and portrayed undeveloped areas as negative space. Each type of model had advantages and limitations in terms of ease or cost of production, of amendment, and of the information it could convey.

The fifth chapter of *Seeing Underground* discusses the use of mine models in litigation, citing the Tonopah, Nevada, apex suit of 1914 between the Jim Butler Tonopah Mining Company and the West End Consolidated Mining Company, a case won by the latter company, partly, Nystrom argues, due to its more convincing mine model. The sixth and final chapter of the book looks at ways in which mine models were used to educate university students or the general public. Here the example is that of the curator of the Smithsonian Institution's United States National Museum, Chester Gilbert, who worked with mining companies in the 1910s to use mine models to present mining in a way favorable to the industry.

In the chapters on models in litigation and education, Nystrom makes two crucial points that might sometimes apply to mine maps. He observes that the mine models used in litigation were accepted by juries and non-expert judges as illustrations of fact, whereas they were actually interpretations of fact, a fine but vital difference. Thus, as Nystrom demonstrates, the legal victory could go to the side that did the better model making rather than the one that presented the better argument. Or put another way, the model, masquerading as fact, presented the better argument.

Of the model's educational role, particularly concerning the general public, Nystrom notes that the mining depicted on a model was not mining in fact, but in ideal. Mine models appearing at expositions or in museum exhibits during the Progressive Era showed the industry as idealized by the Progressives—an orderly and efficient process; they did not depict polluted streams

or unstable hanging walls. Nystrom argues that these models, and museum mining exhibits more generally, were used in an ideological partnership between large corporations and major museums as "educational propaganda," in Gilbert's words, for mining companies. "Gilbert [and others] . . . saw common cause with the heads of companies and industries . . . and sought to mobilize the visual culture of mining to help shape public understanding," writes Nystrom, a charge that other authors have also brought against museums of technology.

At the beginning of *Seeing Underground*, Nystrom mentions the importance of maps and models as material culture artifacts, a fascinating observation that perhaps remains underdeveloped. Material culture is the study of the meanings of an artifact, which are both utilitarian—what it does—and symbolic—what it represents. "Underground surveying and mapping not only helped mining engineers better understand and control their mines," Nystrom writes, "but also contributed to their professional identity. The power to make and wield technological representations set mining engineers, as a professional group, apart from others who could purport to do similar work, such as so-called practical men."

Early on, those "practical men" regarded the "college boys" suspiciously, but the scale and cost of modern industrial mining eliminated the possibility of an informal approach, however experienced, to mineral exploration and development. Thus the tools—maps and models—not only served the utility of information storage and retrieval, they also functioned as symbols of authority, evidence of the technological and social victory of college-trained engineers and geologists over "practical" miners by the late nineteenth century.

This reviewer's criticisms of *Seeing Underground* are limited mostly to mentioning what this significant study had to omit. The subject of maps and models as promotional tools is scarcely considered. Left unmentioned, understandably, is that other way of seeing underground, photography, about which the author has written in this journal (q.v. 2010). The work also suffers slightly from its final editing, chiefly from word omissions and noun-pronoun disagreements. None of these points diminish the contribution Nystrom's book makes to the field of mining history, and, more broadly, to the study of science and technology and to the literature about the triumph of the engineer in the age of industrialization.

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Karen Dustman. ***Silver Mountain City: Ghost of the Sierra.*** Markleeville, CA: Clairitage Press, 2011; 208 pp., numerous b&w illus., 4 maps, notes, ind., paper, $25. ISBN: 9780983333104

The Alpine County mining story has a familiar ring to historians. Despite its frigid perch along the isolated crest of the Sierra Nevada, mining began there in the wake of the Comstock excitement, after prospectors found a number of large quartz outcrops that dipped almost vertically through andesitic wall rock. Although the mineralized zone was extensive and some samples assayed high in silver, most lodes below the water table contained a mixture of complex, low-grade ores that could not be reduced without smelting.

The lack of local smelters and the absence of good roads or railways to carry concentrates to processing facilities in Nevada or California did not deter British investors from pouring money into these speculative mining ventures. Most of it was wasted driving tunnels and building expensive and generally useless surface plants—an outcome this book attributes mostly to management scams, but the story is more complicated than that.

When silver was demonetized and capital dried up the mines were abandoned. Since the 1880s a few small operators have periodically tried their luck, but they lasted only a few years and produced little. Today Alpine County rests in splendid rural isolation, a haven for ranchers,