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THE INDUSTRIAL ARCHAEOLOGY OF THE MILL CREEK ARRASTRA SITE (5CC637), CLEAR CREEK COUNTY, COLORADO

By
Eric Twitty, William Martin, and Todd Kohler

ABSTRACT

In 2002, archaeologists and historians from SWCA Environmental Consultants recorded and documented a small arrastra site along Mill Creek in northern Clear Creek County, Colorado. While widely used in the early development of the mining industry in the state and across the region, this type of site has not been systematically investigated or reported in the historical or archaeological literature. This research, which was primarily undertaken to help with the long-term management and preservation of this important site, was designed to place the site within the larger context of mining development in the Clear Creek Valley, describe the milling technology and material culture associated with this site type, and provide a history of the site as it relates to who operated it and when. Based on several historical sources, the Mill Creek Arrastra Site appears to have been in operation during the early to mid-1860s.

INTRODUCTION

In the summer and fall of 2002, historians and archaeologists from SWCA Environmental Consultants conducted historical and archaeological research into the Mill Creek Arrastra Site (5CC637)—a comparatively unknown site type in the Colorado Rocky Mountains. The primary focus of this research was to assess the age and significance of the site so that land managers could appropriately manage the site and surrounding areas. Along these lines, the goals for this research were to: 1) provide a more-detailed, comprehensive history of the site; 2) place the Mill Creek Arrastra Site into the larger context of the development of the Morris Mining District; 3) fully record all of the features associated with the site and better define the site limits; 4) provide a detailed evaluation of the site in terms of its National

Eric Twitty, William Martin, and Todd Kohler ■ SWCA Environmental Consultants, 8461 Turnpike Drive, Suite 100, Westminster, CO 80031

Register of Historic Places (NRHP) and Colorado State Register of Historic Places (CSRHP) eligibility status; 5) develop management recommendations for the protection, interpretation, and public use of the site; and 6) identify data gaps that need to be addressed to provide a more detailed understanding of the site and direct future research efforts.

Within the Clear Creek County Lands Department and the community at large, there are a number of competing interests wishing to develop the site, including calls for developing it into a soccer field or selling it. The Clear Creek County Open Space Commission is actively interested in managing the property to preserve its historical integrity and to develop a *Master Plan* for the site, including developing an interpretative program, such as where to place interpretative signage, sign content, pamphlets, maps, trails, and markers. Clear Creek County officials could make better-informed decisions on future management and treatment of the property if they had a better understanding of the site in terms of its history and place in the development of the local mining history, its physical setting and condition, and its significance.

SITE SETTING

The site is located northwest of Dumont in unincorporated Clear Creek County, Colorado (Figure 1). The site is located on a series of stream terraces in a moderately wide valley between two high, northwest/southeast-trending ridge systems that form a portion of the northern edge of the Clear Creek Valley near the confluence of Clear and Mill creeks (Figure 2). The area is in a locale characterized by rugged, mountain topography. Elevations in the study area average approximately 8,190 ft (2,496 m) above mean sea level. The study area is drained by the Mill Creek, which is a tributary of Clear Creek.

The project area has been extensively developed through either mining operations or residential development. Surface soils in the project area consist primarily of sandy to stony and gravelly sandy loams formed in stony, gravelly, and loamy alluvial and colluvial material derived primarily from igneous and metamorphic rocks, which were the source of the bedrock ore deposits processed by the arrastra on the site. Along with the surface soils, there are several areas where the bedrock outcrops on the surface, particularly along the slopes above Mill Creek.

PREVIOUS WORK

Bureau of Land Management (BLM) archaeologist Monica Weimer first recorded the Mill Creek Arrastra Site in May 1993 during an inventory of the property before it was deeded over to Clear Creek County. She described it as consisting of an ore-processing area comprised of the remains of a water-driven arrastra (Feature 1); a small ditch leading from a rock work area to the arrastra; a second ditch which possibly supplied water to the arrastra; a rock pile of spent ore; a possible prospect pit; a drag rock; a cement foundation located on the creek terrace near the ore processing area (Feature 2); and a cement wall and rubble pile (Feature 3) which may be associated with ore processing and occupation areas to the north of the main site area. Based on a review of mineral survey data, Weimer concluded that the site was established by at least March 1904. She recommended that the site be considered eligible for listing on the NRHP under Criterion A because of its association with the development of mining in the Clear Creek

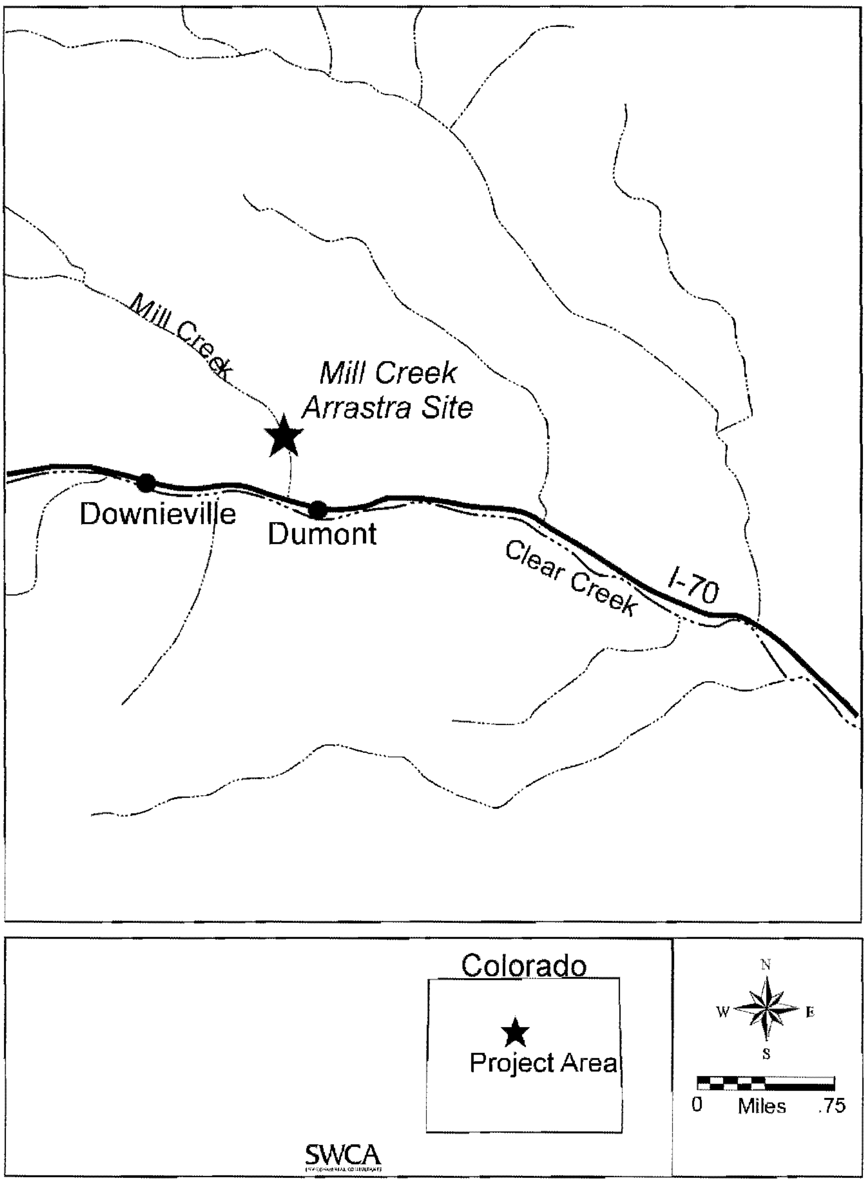

FIGURE 1. Location map showing the Mill Creek Arrastra Site and other places mentioned in the text.

FIGURE 2. Environmental setting of the Mill Creek Arrastra Site.

area and under Criterion C because the site contains a relatively intact, water-driven arrastra associated with the early mining history of Colorado. Based on her analysis, the site possesses integrity of location, setting, feeling, design, and association. She did not evaluate the site in terms of its CSRHP status.

Meg Van Ness, staff archaeologist with the Colorado Office of Archaeology and Historic Preservation (OAHP), visited the site in October 1997 at the request of the Clear Creek County Lands Department. As a result of her visit, she expanded the site boundaries considerably to include a quarry east of the main site complex. In her letter to the county and on a *Colorado Cultural Resource Survey Site or Property Reevaluation Form*, she concluded that: 1) the site is an important and rare site type that little is known about; 2) the site needs to be protected from future development; and 3) a detailed recording of the site, including archival research, and possibly subsurface testing, is needed to better manage the site. She also noted that John Beardsley of the Canon City BLM Field Office, assisted by a Boy Scout group, conducted a ground penetrating radar (GPR) inventory of the site in the early 1990s, and they identified a possible anomaly, suggesting the possibility of intact, subsurface archaeological deposits. (No readily available information about the GPR inventory is on file either at the Canon City BLM Field Office or at the Colorado OAHP.)

MILL CREEK ARRASTRA SITE

Site 5CC637 is within the Morris Mining District and possesses three distinct feature complexes (Figures 3-4). The remnants of an arrastra serve as the site's primary feature complex and lie on the east bank of Mill Creek.

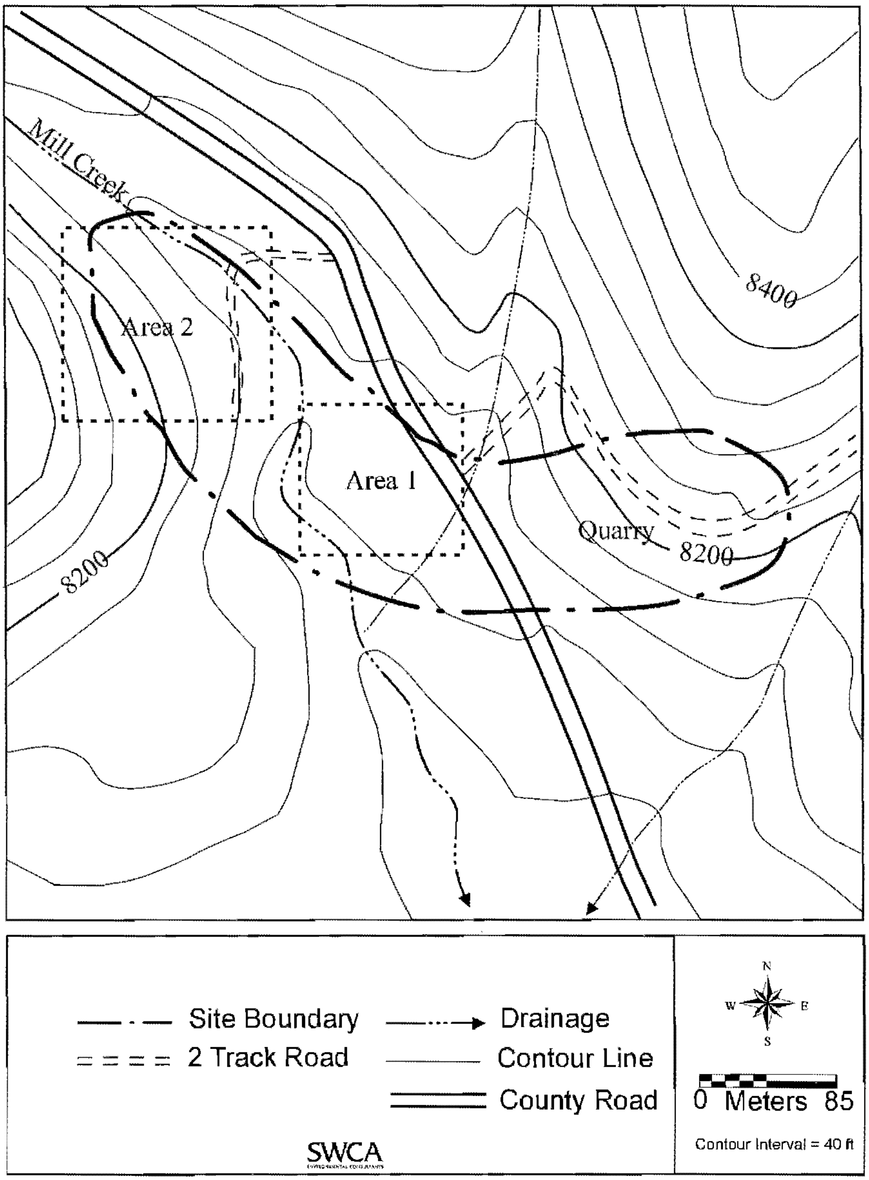

FIGURE 3. Overview of the Mill Creek Arrastra Site (5CC637).

A group of features associated with pastoral activities is located on a river terrace upslope from and southwest of the arrastra. Finally, features pertaining to a residential complex based on agriculture and the keeping of livestock are spread out on Mill Creek's west side northwest of the arrastra. To present an organized discussion and interpretation, the three complexes are discussed separately below, although special attention is paid to the arrastra remnant due to its rarity and importance.

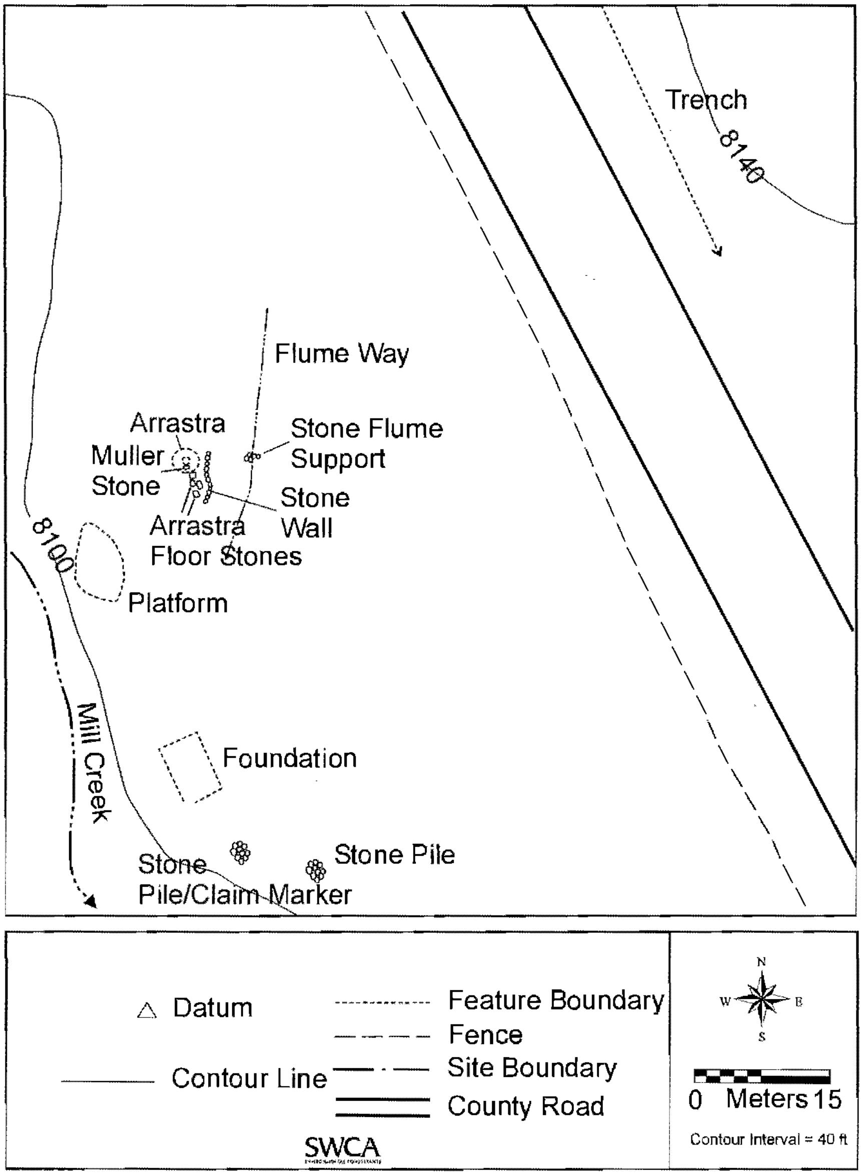

FIGURE 4. Area of detail showing the arrastra site complex.

The arrastra on 5CC637 serves as a physical vestige of the Idaho Springs region's early mining history. No archival information directly pertaining to the arrastra could be located, although mineral claim records at the BLM's State Office in Lakewood offer some data regarding the site's other cultural resources. Mr. Jim Kennedy, a long time resident of the area, stated that local oral history suggests that the complex is associated with early Mexican mining activity in the area and dates to the 1840s, although this is difficult to prove given the lack of associated diagnostic artifacts. An 1866 lithograph entitled *Map of Clear Creek County, Colorado* (on file at the Clear Creek County Archives) does show a mill at the exact location of the Mill Creek Arrastra Site, but it is not indexed to any specific company or individual. A review at the Clear Creek County Archives for the Morris and Downieville districts for 1865 and 1866 does not specifically note an arrastra on Mill Creek. Hollister (1974 [1867]) does note that John Young had a mill on Mill Creek (35 by 42 power overshot wheel), a Bullock crusher, and a stone arrastra. He had a 1,300-ft claim on the Silver Star Lode. Again, the district records for 1865 and 1866 do not mention an arrastra, although John Young is mentioned in regards to some interest closer to Mill City. (Mill City was founded in 1859 and was so named because of the larger number of arrastras and other types of mills in the area. In 1880, Mill City changed its name to Dumont because the U.S. Post Office was confusing this community with a similarly named mining camp in the state [Historical Society of Idaho Springs 1986]).

A photograph in the Western History Collection, Denver Public Library, dated 1890 shows an "Old arastra (sic) mill" on Mill Creek in the same topographic and environmental location as the Mill Creek Arrastra Site, but it does not mention ownership (Figure 5). In 1904, the S & S Mining Company platted a cluster of hard rock, placer, and millsite claims over the site's three complexes defined above. The arrastra, not documented on the plats, apparently lay on the eastern portion of the Happy Thought Placer Tract B claim. The 1904 claim plats depict the agricultural and residential complex, and specifically the L-shaped house, as standing on the Happy

FIGURE 5. An 1890 photograph of Arrastra Mill on Mill Creek (courtesy of the Denver Public Library, Western History Collection, Call Number X-60012).

Thought Millsite and overlapping Happy Thought Placer Tract B claims. The plats also portray other geographic features of the area, including the Mill Creek road, prospects, and a mine and building complex up stream and northwest.

According to local assumptions and oral history, the arrastra on 5CC637 was a water-powered unit, which coincides with several of the complex's features. The remnant currently manifests as the arrastra floor, a tailings-covered platform, and two water ditches.

Workers initially graded a cut-and-fill platform 20 by 20 ft in area for the arrastra, and erected a dry-laid, 15 ft long and 3 ft high rock wall to retain the platform's cut-bank. They built the arrastra on the platform's northeast portion adjacent to the retaining wall. The arrastra floor (Feature 3), 9 ft in diameter, consists of four granite blocks carefully fitted together around a 20 in hole where a capstan stood (Figure 6). The blocks were shaped to form a neat circle when fitted together. The circle's top surface features a concave depression several inches deep polished through use. The arrastra's builders chiseled five incisions, each 1 in deep and 8 in long, radiating out from the floor's center. The incisions caught and overturned stones wedged under the mullers. A muller stone, 16 in by 24 in in diameter and 8 in thick, lies on the floor. The stone's bottom is convex and polished through use, and the stone's top features two forged hooks hammered into drill-holes. To ensure the hooks would remain fast, the arrastra's builders poured molten lead into the holes as cement.

No artifacts or structural remnants other than the arrastra's stone constituents are evident, and erosional deposits and duff blanket the platform. Four additional arrastra floor pieces were stacked on the platform's

FIGURE 6. Overview of the arrastra floor and muller stone.

southern portion and appear to have belonged to a smaller unit. Two muller stones lie off the platform's southeast edge. The erosional deposits and heavy duff coverage may obscure additional items. The arrastra's builders graded a second platform (Feature 4), which possesses an irregular footprint, downslope from the arrastra adjacent to a cascade on Mill Creek. Workers apparently used the platform to separate tailings from gold and left a deposit of tailings in the form of sorted sand. A recent hearth currently lies on the platform's east edge, and heavy duff coverage and erosional deposits may obscure artifacts.

A flume delivered water to the arrastra's platform, and the woodwork was removed long ago, leaving a flumeway (Feature 2) 8 ft wide and graded with cut-and-fill construction. The flumeway begins approximately 150 ft north of the arrastra, where a transfer structure delivered water into the flume's head from a ditch (Feature 1) above. Like the flume, the transfer structure was disassembled, leaving the small ditch incised into the hillslope ascending east to Feature 1, located upslope. The flumeway traversed the creek's cut-bank above the arrastra, and the tail emptied into the creek channel to the southeast. The remnants of a rock bolster that supported the plank flume cross the flumeway's floor near the ditch's tail.

While only the above features and rockwork remain and artifacts are absent, a few possible conclusions regarding the arrastra's function and construction can be elicited from the remnants. First, the group of features and their spatial arrangement suggests that the arrastra was in fact water-powered. By locating the arrastra floor against the platform's rock retaining wall, the builders left insufficient room for the harness beam and encircling track necessary to accommodate a draft animal. Given this, the arrastra had to be powered by another motive source. Because Mill Creek provided enough water for processing ore, the flume upslope delivered water for other purposes. The flume's height over the arrastra suggests the builders intended to use gravity to draw the water through a waterwheel located at the flume's tail. If a waterwheel was used, its rotation had to be translated through iron shafting and beveled gears to the arrastra's capstan. Such a power source required beamwork to brace the waterwheel, probably an intermediate bearing, and the gearing at the capstan. To brace the gearing, gallows frames were commonly used. No evidence of such structural remnants exists on the ground surface, however.

Second, the arrastra is missing a few vital components. The capstan is absent, although the center hole in the arrastra floor offers representation. The arrastra's sidewalls are also absent. If the builders used masonry, then some evidence would probably remain. Given this, the builders probably used planks embedded on-end around the stone floor, which was a common practice.

Third, the cleanup of an arrastra required shoveling the exhausted tailings off the floor to reveal the underlying amalgam. Rather than merely ejecting the tailings on the ground around the arrastra, the site's operators employed a system to move the material down to the platform (Feature 4) on the edge of Mill Creek. They could have used buckets, although a small sluice seems likely given the quantity of tailings. The primary reason for sluicing the tailings would have been to capture any free gold that escaped amalgamation, behind riffles. Last, the lack of evidence of a hearth or furnace suggests that the operators retorted the amalgam off site.

While the arrastra complex lacks material evidence reflecting the date of operation, it seems likely that it saw service during the early 1860s. First, the mineral claim records make no mention of the arrastra, strongly suggesting it was abandoned by 1904. Second, the site's current state of erosion, revegetation, decay, lack of surface artifacts, and the heavy erosional deposits reflect abandonment long ago. Third, the Clear Creek Valley saw the widespread employment of arrastras during the early 1860s, before mining operations exhausted the easily milled quartz gold. By the mid-1860s, such ores became exhausted, leaving refractory sulfide ores that were not easily processed in arrastras, and instead required roasting and advanced treatment processes. By the late 1860s, ore processing in the Clear Creek area became the domain of large companies with mechanized facilities (Stone 1918). It should be noted, however, that the Clear Creek drainage, as other areas in Colorado, hosted a variety of small mining outfits through the Great Depression, many of which possessed little capital. Such operations continued to employ simple, labor-intensive means for mining and processing gold ores. However, second-hand and inexpensive mill machinery was widely available in the Clear Creek Valley, rendering arrastras relatively inefficient, slow, and obsolete.

As noted by Meg Van Ness, a quarry exists on the wooded slopes above and east of Mill Creek and the arrastra feature complex. In this area, there are at least 15 to 20 large boulders that have been quarried from the bedrock on the slopes. Each of the boulders has shallow (no more than 8 in deep) drill holes on its edges. No artifacts are present in this area, and it is difficult to establish a direct link between this area and the arrastra feature complex.

ARRASTRAS AND CLEAR CREEK MINING

An arrastra (derived from the Spanish *arrastrar*, meaning "to drag") was a primitive apparatus miners employed to both crush hard rock ore and recover metalliferous material. Based on a review of the files at the Colorado OAHP, the Stephen Hart Library, the Western History Library at the Denver Public Library, and the Clear Creek County Archives, a number of arrastra sites have been documented to one degree or another in the archaeological and historical records. Arrastras range from single, isolated facilities cut into bedrock to complexes associated with larger mining and milling facilities. Arrastras have been recorded along the Front Range (including the Clear Creek and Sunshine areas), the Sangre de Cristo Mountains, the San Juan Mountains, and in the South Park area (including the Cripple Creek Mining District). A variety of power trains appears to have been used, including water, animal, and possible steam engines (Figures 7 and 8). Most of the reported arrastras date to the period between 1859 and

FIGURE 7. Relocated arrastra reported from the Dumont area (courtesy of the Denver Public Library, Western History Collection, Call Number X-60013).

the late 1890s, at which time stamp mills appear to have been exclusively used due to the economic reasons outlined above, although there is some evidence to suggest arrastras were used on small-scale operations up through the 1930s. Moreover, a number of geographic features named "arrastra"

FIGURE 8. The Montgomery arrastra in Park County, Colorado (courtesy of the Denver Public Library, Western History Collection, Call Number X-60019).

throughout the state, using a variety of English and Spanish spellings, provide further support to the widespread use of this technology. Examples include Arrastra Gulch in San Juan County; Arrastra Creek, Gulch, and Lake near Silverton; and Arrastre (sic) Creek near Crestone in Alamosa County, among others. More specific to this study, Mill City (present-day Dumont) was so named because of the number of arrastras in the area.

The arrastra's origins extend back centuries to the Middle East. Spanish metallurgists probably learned the technology through cultural contact during the Moorish occupation of Spain, and subsequently employed it in their silver production. During their conquest of Central and South America, the Spanish heavily pursued the exploitation of mineral resources, including gold and silver ore, and found the arrastra ideal for such purposes (Young 1980).

Arrastras were inexpensive to build and operate, required little maintenance, and required only rudimentary knowledge of engineering and metallurgy. A typical arrastra incorporated primarily local building materials, only a few manufactured pieces of hardware, and were labor-intensive. Such characteristics lent themselves well to remote areas where importing materials proved a burden, to operations lacking capital, and to locations where labor was inexpensive.

Through the 1600s and 1700s, Spanish, and later Mexican, miners heavily employed arrastras and carried the technology north as they developed mining districts in northern Mexico and the American Southwest. Mexican miners and metallurgists introduced the primitive technology to their American counterparts, who found it readily applicable to remote portions of the West. By the 1860s, when hard rock mining began in the West, various milling technologies proved superior to the arrastra, but because the arrastra was profoundly simple, inexpensive, and within reach of individual miners, it saw limited use into the twentieth century (Young 1980).

From its introduction to North America by Mexicans and Spanish into the twentieth century, the arrastra changed little in form and function. A typical arrastra featured a circular floor of carefully fitted stones, low sidewalls, and a capstan at center. They ranged in size from approximately 6 to 20 ft in diameter, and all featured common characteristics. A beam was attached to the capstan's top and, as it rotated, the beam dragged between one and twelve muller stones across the floor, depending on the arrastra's size. Usually the stones, chained to the beam, were staggered so they covered the floor's entire surface area. The early arrastras used by the Spanish relied on slave labor as motive power, which draft animals replaced in later decades. With the improvement of technology, scarcity of labor, and the desire for greater production, in a few cases engineers harnessed water power and steam engines (Figure 9). In Central and South America, and possibly the American Southwest, a few organized milling ventures adapted mechanized power to run batteries of arrastras, which is unusual in that other forms of milling technology proved more efficient. The simplest form of arrastra cost around $150 (in 1860s dollars) to build, much of which went to the labor necessary to dress and assemble the rockwork. The floor stones had to possess flat faces and tight joints, and the mullers had to feature convex bottoms and iron hooks hammered tight into drill holes (Meyerriecks 2001).

According to scant archival information, to build an arrastra a worker leveled a platform, excavated a pit at center, and installed the capstan, which had to be stout enough to resist great horizontal force. The worker paved the platform with a layer of fine clay and carefully fitted the floor stones together using more clay as mortar. With the floor complete, the worker erected the sidewall, which consisted either of more stonework or planks on end. During the twentieth century, concrete became a popular substitute for rocks. Once the beam and mullers were in place, the arrastra was ready for operation (Meyerriecks 2001).

Running an arrastra required more skill and experience with local ores than engineering and formal training in metallurgy. First, a worker scattered a *charge* of ore across the arrastra's floor, completely covering the stones, then introduced a little water. Then, the motive power began rotating the beam, dragging the mullers over the fragmented ore, slowly grinding it into sand. The worker periodically added more water to convert the material into a slurry and sprinkled mercury into the material. The mullers continued to reduce the ore into a combination of sand and fine particles known as *slimes*, and the arrastra's sidewalls contained all on the floor stones. The purpose of adding mercury was to create an amalgam with the metals as they became exposed by the continued fracturing of the ore. Fine particles offered a greater surface area, facilitating amalgamation. Here, experience and familiarity with local ores came into play, and the arrastra operator added enough mercury to form an amalgam paste, but not in excess, which

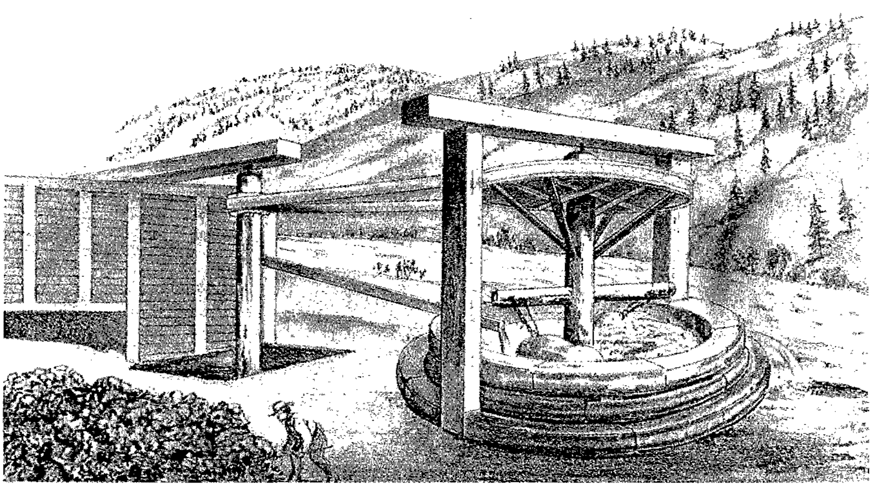

FIGURE 9. Circa 1865 A. E. Mathews lithograph of possible steam-powered arrastra on Clear Creek (courtesy of the Stephen Hart Library, Colorado Historical Society, Denver).

created a liquid difficult to recover. Generally, one ounce of mercury recovered an equal amount of gold or one pound of silver. In some cases, the operator added lye to bind with oils and grease, which interfered with amalgamation (Meyerriecks 2001).

Because a moderate-sized arrastra had a capacity equivalent to a two-stamp mill, crushing and amalgamating a load of ore required a full day. If the operator was adept and the ore simple, the arrastra could recover up to 90 percent of the gold and 80 percent of the silver present in the ore. Usually, though, the inefficiencies inherent in arrastras reduced the recovery to only 30 percent to 50 percent of the gold content (Meyerreicks 2001).

The next stage of processing ore was known as *cleanup*, where worthless *gangue* was removed and the amalgam recovered from the arrastra's interior. First, the operator had to drain the interior by either bailing, breaching the sidewall, or opening a port near the wall's base. With the water gone, the operator shoveled the exhausted sand and slime out, leaving a mud and sand layer on the flooring stones. The operator may have carefully washed additional material out of the arrastra's interior, exposing as much of the amalgam, smeared on the floor stones and deposited between the joints, as possible. At this stage, heavy labor came into play. The operator disassembled the floor stones, if small, and washed and scraped off the amalgam, or merely scraped the amalgam off the stones if they were large. Last, the operator filled a retort with the precious material and heated the vessel to volatize the mercury, leaving a sponge-like mass of metal. The retort's vapors were usually routed through cool pipes to condense the mercury for reuse. Afterward, the operator rebuilt the arrastra and repeated the process with another load of ore (Meyerriecks 2001).

Among the various regions of the West, Colorado miners employed arrastras at an early date, for the same reasons as Spanish miners in Mexico centuries before. As stated above, arrastras processed hard rock ore, which prospectors discovered in Colorado as a product of the Pikes Peak Gold Rush of 1858. Prospectors, however, struck gold in Colorado years before. In 1849, a party of Georgians, including Dr. L. J. and Green Russell, A. T. Lloyd, G. W. Kiker, and P. H. Clark traveled overland through Colorado on their way to the California gold fields, discovered one year prior. They arrived on the Colorado plains late in the season, and rather than risk being marooned in the Great Basin or the Sierra Nevada Mountains, decided to winter at what is today the Auraria Campus in Denver. Members of the Russell party already had experience with placer mining in Georgia's gold fields and, curious about their new environment, examined the piedmont area of the Front Range for its mineral potential. Panning samples of gravel along Cherry Creek, members of the party struck deposits of placer gold that were tantalizing but paled in comparison to the legendary riches of California. Early in 1850, the Russell party departed for California and arrived in Downieville, where they met with limited success.

In 1857, the party returned to Georgia and, discussing their strike on Cherry Creek, determined to examine the region once again. The Russell party established a camp at the site of their previous strikes and engaged in prospecting forays toward the base of the mountains. At the same time, another party primarily of Cherokee Indians led by John Beck learned of the Russell camp while searching the area around what became Colorado Springs and journeyed north. They too struck placer gold, and word spread to Kansas, inciting the Pikes Peak Gold Rush of 1858.

The excitement drew more people than there was gold, and the rush quickly went bust. The failure of the rush propelled a few daring prospectors into the mountains during a mild winter, whereas most of the activity up to that time was limited to the piedmont areas. Several individuals found gold on Clear Creek in 1859, creating speculation among seasoned prospectors that the gold's source probably lay deep in the mountains. Pursuing suspicions, B. F. Langley found gold on South Boulder Creek, a group of prospectors struck more gold on what they named Gold Hill in Boulder County, and George Jackson found placer gold on Clear Creek where Idaho Springs currently lies. Around the same time, the experienced John Gregory discovered one of the most important deposits of gold in Gregory Gulch, near present-day Central City. During the summer of 1859, small camps grew at the points of discoveries, but the rush was not on the same scale as the Pikes Peak excitement due to widely publicized stories of failure (Eberhart 1987; Hollister 1974 [1867]; Stone 1918).

During 1859 and 1860, three centers of placer mining commanded attention: Gold Hill, Jackson's Diggings (where Jackson made his discovery), and Gregory Gulch. The latter set a precedent in Colorado because, as the placer gold gave out after several years, miners found hard rock gold in friable, easily crushed granite country rock. As the profitable ground in Jackson's Diggings became claimed, prospectors made their way up Clear Creek and located additional deposits. The settlement of Fall River sprang up at the mouth of Fall River a short distance west of Jackson's Diggings, and Mill City grew further west. By 1861, prospectors established Georgetown and several settlements between. Like Gregory Gulch, miners quickly exhausted the placer deposits in these areas, and they turned toward the gold's hard rock source, which lay in quartz veins. The movement from placer to quartz initiated Colorado's nascent hard rock mining industry (Henderson 1926; Hollister 1974 [1867]; Wolle 1993).

Hard rock mining required capital, supplies, and an infrastructure. In response, the early placer settlements evolved into stable towns that offered a range of services. Among the services were mills, which recovered gold from the quartz ore. While many mining companies erected their own mills, some companies provided custom milling for independent operations lacking the capital for their own facilities. Stamp mills and arrastras were the two most popular forms of recovery facilities at this time; the former because they processed a high volume of ore with efficient returns, and the latter because they were inexpensive and easy to run. Archival sources make little mention of specific arrastras, although Gilpin County hosted the first at the mouth of Gregory Gulch in 1859, and the Syracuse Gold & Silver

Mining Company erected what may have been the most substantial in 1867 at the mouth of Turkey Run on the south side of Clear Creek. Syracuse's mill was water powered, 25 ft in diameter, and featured 12 muller stones. The first stamp mill in the Clear Creek drainage was a 20 stamp, water-powered facility erected at Mill City in 1861. Between 1859 and 1861, companies and partnerships undoubtedly built additional arrastras to process ores mined from the numerous properties active between these years (Henderson 1926; Hollister 1974 [1867]; Stone 1918).

Just as the Clear Creek region showed signs of high profitability, miners found that the easily milled quartz gold gave way to refractory sulfide ores at depth, which resisted simple amalgamation. Frustration mounted with abundant gold ore and no way to profitably treat it, mining collapsed, and an economic depression ensued by the mid-1860s. Metallurgists determined that the ores' high sulfur content interfered with milling, and a process mania swept the region as entrepreneurs experimented with various means to separate out the sulfur. While mechanical and chemical applications proved failures, trained metallurgists found that roasting and smelting offered the potential to solve the region's problems. Roasting in effect provided the energy necessary to burn off sulfur and stimulate an oxidation reaction with the ore, freeing the gold for simple amalgamation.

Caleb S. Burdsal built the first smelter in the region at Nevadaville, which proved effective, and the metallurgist Nathaniel Hill improved the process at his famed Black Hawk smelter in 1868. Imitating Burdsal and Hill, other entrepreneurs built smelters at most of the towns on Clear Creek, including Idaho Springs and Mill City. Coinciding with this, prospectors recognized silver ores in upper Clear Creek and Caribou in Boulder County, which required smelting. The development of a smelting industry fostered a revival of hard rock mining on an unprecedented scale and changed the mining industry. Due to the complexity of ores, the need for capital-intensive smelting and a need for a high volume of production, mining became the domain of organized companies. In general, most small outfits were unable to process their own ores and had to contract with custom mills (Stone 1918).

As mining approached industrial proportions, the Colorado Central Railroad graded a line to Black Hawk in 1872, primarily to serve Hill's smelter, followed by another line into the Idaho Springs area by 1877. The town of Dumont (formerly Mill City), named after John Dumont, owner of the Whale, Freeland, and Lincoln mines, became a railroad stop in part for its mills. Lawson, a nearby commercial center, also hosted a station. Mining in the Clear Creek Valley continued through the 1880s and stumbled in 1893 as a result of the Silver Crash. While most mines in the region produced gold, the Silver Crash wrecked Colorado's economy, which impacted capitalists, the mine supply business, and the smelting industry. However, because gold retained a stable value relative to silver's abysmal price, capitalists were quick to renew their interest in the Clear Creek Valley, and, as a result, ore production resumed within a few years. As Colorado's economy recovered during the late 1890s, the Clear Creek Valley experienced a boom on a scale surpassing previous decades. Equipment was more affordable, improved technologies lowered the costs of production and permitted the profitable processing of low-grade gold and silver ores, and capital was widely available. However, in their zeal to maximize production, mining companies exhausted most of the viable ore bodies by the 1910s, and the Clear Creek Valley's industry slipped into a permanent, irreversible decline. By the 1920s, most marginal and many formerly productive operations ceased, and the settlements dependent on the mining industry were depopulated.

The Great Depression snuffed out the little remaining activity in the region, throwing the Clear Creek region, and much of Colorado, into destitution. However, 1933 ushered in a glimmer of hope. At that time, President Franklin Delano Roosevelt and his advisors began developing programs to simultaneously stabilize the dollar while resuscitating the collapsed metals mining industry. At first, Roosevelt authorized the federal government to buy gold and silver bullion at artificially high prices, and when their values fell, signed the *Gold Reserve* and *Silver Purchase* acts in 1934. According to these two programs, gold fetched $35 and silver $0.71 per ounce, which achieved Roosevelt's intention. Mining across the West revived, including the Clear Creek area, but both the sum of activity and the scale of individual operations were much smaller than in decades past. As the 1930s progressed, the quality and volume of gold ore around Idaho Springs declined, threatening the mining industry.

Then, in 1942, the federal government defined a sweeping set of industrial restrictions intended to maximize resources and labor for World War II. A cessation of gold mining was among the restrictions, which mandated that gold mines across the West close. The consequence, while unintended, was the near destruction of the nation's gold mining industry, already in a precarious state as a result of the Great Depression and exhaustion of ore. Hoping their mines could be reopened with the war's conclusion, many property owners and companies found the post-war climate not conducive to mining. During the four years of idleness, many properties fell into disrepair and required too much capital for rehabilitation. Compounding this situation, the relative value of the dollar rose against the stagnant price of gold, rendering gold uneconomical. In addition, the nation's economy shifted away from heavy industry, including mining, toward business and commerce, and the labor demographic changed in parallel. The variables aligned against gold mining ensured that few properties would be worked again, spelling a relative end of 100 years of hard rock gold production in the Idaho Springs area (Young 1980).

SUMMARY AND CONCLUSIONS

The Mill Creek Arrastra Site is one of the few systematically recorded and investigated arrastra sites in the state. Arrastra technology, which was designed to crush hard rock ore and recover metalliferous material, was an early and inexpensive processing technology that allowed many small operators an opportunity to process ore without the added burden of shipping it to a large mill. Within the larger site complex, which contains a late 1800s and early 1900s pastoral complex and a quarry whose association with the arrastra complex is difficult to determine, the arrastra complex consists of the arrastra floor, a tailings-covered platform, and two ditches designed to deliver water to the arrastra. While little information was found during the literature and archival research and no diagnostic artifacts representative of the period were observed on the surface of the site, the site dates to the early history of mining in the Morris Mining District and in Colorado, based on the types of technologies present on the property.

In conclusion, the Mill Creek Arrastra Site (5CC637) is an excellent and important surviving example of an early mining technology employed during the initial development of the mining industry of the state. This study was ostensibly undertaken to provide the Clear Creek County Open Space Commission with information about: 1) the age, historical association, and function of the site; 2) the importance and significance of the site as it relates to mining and economic developments in the Clear Creek Valley and the state; 3) the long-term management of the property; and 4) interpretative potentials and issues that the site could provide visitors. Because few examples of this type of site have been systematically recorded and investigated, the property should be preserved for the enjoyment and education of future generations (Twitty et al. 2003). However, the fate of the site has not been determined.

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REFERENCES CITED

Eberhart, Perry
1987 *Guide to the Colorado Ghost Towns and Mining Camps.* Revised ed. Swallow Press, Athens, Ohio.

Henderson, Charles W.
1926 *Mining in Colorado: A History of Discovery, Development, and Production.* U.S. Geological Survey, Government Printing Office, Washington, D.C.

Historical Society of Idaho Springs
1986 *History of Clear Creek County: Tailings, Tracks, & Tommyknockers*. Historical Society of Idaho Springs, Idaho Springs, Colorado.
Hollister, Ovando J.
1974 *The Mines of Colorado*. S. Bowles, Springfield, Massachusetts. 1974 Reprint
[1867] ed. Promontory Press, New York.
Meyerriecks, Will
2001 *Drills and Mills: Precious Metal Mining and Milling Methods of the Frontier West*. Self Published, Tampa, Florida.
Stone, Wilbur Fisk
1918 *History of Colorado*. S. J. Clarke Publishing Co., Chicago.
Twitty, Eric, William Martin, and Todd Kohler
2003 *Cultural Resource Investigations at the Mill Creek Arrastra Site (Site 5CC637), Clear Creek County, Colorado*. SWCA Cultural Resource Report 02-218. Submitted to the Clear Creek County Open Space Commission. Copies available from SWCA Environmental Consultants, Westminster, Colorado.
Wolle, Muriel Sibell
1993 *Timberline Tailings: Tales of Colorado's Ghost Towns and Mining Camps*. Swallow Press, Athens, Ohio.
Young, Otis E.
1980 *Western Mining*. University of Oklahoma Press, Norman, Oklahoma.